UNIVERS OF AMERICA
Commission on Combating Synthetic Opioid Trafficking
Technical Appendixes

The United States Senate
The United States House of Representatives
The Office of National Drug Control Policy
The Drug Enforcement Administration
The Department of Homeland Security
The Department of Defense
The Department of the Treasury
The Department of State
The Office of the Director of National Intelligence
ABOUT THESE APPENDIXES

The Commission on Combating Synthetic Opioid Trafficking (“Commission”), established under Section 7221 of the National Defense Authorization Act for Fiscal Year 2020, is charged with examining all aspects of the illegal supply of synthetic opioids to the United States. The Commission developed a final report that describes its consensus on a strategic approach to combat the flow of synthetic opioids into the United States. Synthetic opioids have been a driver of overdose deaths since 2014. The challenge of reducing illegal production and importation of synthetic opioids incorporates aspects of national and homeland security, national and law enforcement intelligence, the legal system, supply chains, and other areas related to public health and the demand for drugs.

These appendixes contain research and analysis conducted by the Homeland Security Operational Analysis Center (HSOAC), a federally funded research and development center (FFRDC), in support of the Commission’s deliberations. This series of technical appendixes offers in-depth information and analyses that informed the findings and recommendations contained in the Commission’s final report—recommendations aimed at developing a comprehensive policy to reduce the problems associated with synthetic opioid trafficking and use.

Each appendix addresses a separate topic and can be read independently of the others. The topics are as follows:

- Appendix A provides an illustration of the various types of opioids that the Commission discusses in these appendixes and the report they support.
- Appendix B examines recent market trends using drug seizure and overdose death data furnished by the federal government. A small computational error in the calculation of the purchase prices in 2020 compared with 2017 on p. B-55 has been corrected in this version.
- Appendix C elaborates on and models the supply chain as it pertains to illegally produced synthetic opioids, offering considerations as to why synthetic alternatives to heroin are attractive to illegal suppliers.
- Appendix D describes the chemical nature of synthetic opioids, discussing recent synthesis trends and the use of precursor chemicals.
- Appendix E documents the online sourcing of synthetic opioids on the clear net and the darknet.
- Appendix F is an analysis of the international space for the illegal production of synthetic opioids. This appendix includes an overview of regulations in other countries known to produce, or suspected of producing, illegal synthetic opioids.
- Appendix G offers an overview of existing vulnerabilities in the United States associated with various dimensions of detection and screening at mail and cargo facilities and the southwest border.
- Appendix H addresses additional vulnerabilities relevant to disrupting supply, including limits to existing surveillance of drug markets, the online advertising space involving synthetic opioids, and limits to existing law enforcement capacities and information-sharing.

2 A small computational error in the calculation of the purchase prices in 2020 compared with 2017 on p. B-55 has been corrected in this version.
• Appendix I discusses whether additional money-laundering controls could help reduce the synthetic opioid problem in the United States.

These appendixes are grouped across thematic areas of research and serve as stand-alone documents, although some topics of overlap exist across areas. These appendixes provide no overarching strategic narrative—only additional insights, details, and findings that support the final report.
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Throughout these appendixes and the main report they support, the term *synthetic opioid* is most often used to refer to fentanyl, its analogues, and other novel synthetic opioids that, in general, are illegally manufactured. The Commission does not extend the meaning of that term to refer to methadone or tramadol, which are synthesized and are often prescribed medications. Figure A.1 illustrates this nomenclature and provides examples. (Unless otherwise noted, figures and tables in this report were generated by the Commission.)

![Figure A.1: Nomenclature for Opioids, with Examples](image)

NOTE: Semisynthetic opioids are synthesized from plant-based inputs. Fentanyl analogues are compounds that are pharmacologically or chemically similar (i.e., analogous) to fentanyl (see full statutory definition in the text). Novel opioids are not controlled by existing international conventions and have recently entered drug markets. The “other” category contains synthetic opioids that are controlled by existing international law or medications that are regulated at the national level.

**STATUTORY DEFINITIONS OF COMMONLY USED TERMS**

**Fentanyl-Related Substance**

_Fentanyl-related substance_ means

any substance not otherwise listed under another Administration Controlled Substance Code Number, and for which no exemption or approval is in effect under section 505 of the Federal Food, Drug, and Cosmetic Act [21 U.S.C. 355], that is structurally related to fentanyl by one or more of the following modifications:

(A) Replacement of the phenyl portion of the phenethyl group by any monocycle, whether or not further substituted in or on the monocycle;
(B) Substitution in or on the phenethyl group with alkyl, alkenyl, alkoxy, hydroxy, halo, haloalkyl, aminoo or nitro groups;

(C) Substitution in or on the piperidine ring with alkyl, alkenyl, alkoxy, ester, ether, hydroxy, halo, haloalkyl, amino or nitro groups;

(D) Replacement of the aniline ring with any aromatic monocycle whether or not further substituted in or on the aromatic monocycle; and/or

(E) Replacement of the N-propionyl group by another acyl group.¹

Controlled Substance Analogue

Controlled substance analogue means

(A) Except as provided in subparagraph (C), the term “controlled substance analogue” means a substance—

(i) the chemical structure of which is substantially similar to the chemical structure of a controlled substance in schedule I or II;

(ii) which has a stimulant, depressant, or hallucinogenic effect on the central nervous system that is substantially similar to or greater than the stimulant, depressant, or hallucinogenic effect on the central nervous system of a controlled substance in schedule I or II; or

(iii) with respect to a particular person, which such person represents or intends to have a stimulant, depressant, or hallucinogenic effect on the central nervous system that is substantially similar to or greater than the stimulant, depressant, or hallucinogenic effect on the central nervous system of a controlled substance in schedule I or II.

(B) The designation of gamma butyrolactone or any other chemical as a listed chemical pursuant to paragraph (34) or (35) does not preclude a finding pursuant to subparagraph (A) of this paragraph that the chemical is a controlled substance analogue.

(C) Such term does not include—

(i) a controlled substance;

(ii) any substance for which there is an approved new drug application;

(iii) with respect to a particular person any substance, if an exemption is in effect for investigational use, for that person, under section 355 of this title to the extent conduct with respect to such substance is pursuant to such exemption; or

(iv) any substance to the extent not intended for human consumption before such an exemption takes effect with respect to that substance.²

¹ Code of Federal Regulations, Title 21, Food and Drugs; Chapter II, Drug Enforcement Administration, Department of Justice; Part 1308, Schedules of Controlled Substances; Schedules; § 1308.11, Schedule I, ¶ (h)(30)(i).

² U.S. Code, Title 21, Food and Drugs; Chapter 13, Drug Abuse Prevention and Control; Subchapter I, Control and Enforcement; Part A, Introductory Provisions; § 802, Definitions.
MARKET TRENDS IN THE DEMAND AND SUPPLY FOR ILLEGALLY SOURCED OPIOIDS

OVERVIEW AND RESEARCH QUESTIONS

A firm understanding of evolving drug markets in the United States is important to making recommendations or developing strategies to reduce the problems stemming from exposure to potent synthetic opioids. The emergence of illegally manufactured synthetic opioids, such as fentanyl, has been swift, taking over some long-standing heroin markets in a matter of years, and largely unanticipated by most policymakers, practitioners, and analysts engaged with U.S. drug policy. Current data systems dedicated to measuring or assessing drug market trends are not well suited to the rise of novel drugs that are harder to detect and measure. Appendixes G and H document several of the surveillance gaps and ways to close them.

This appendix analyzes national administrative data series involving drug overdose deaths and drug seizures in the United States to understand the landscape of distribution and use of illegally manufactured synthetic opioids in recent years. Through a series of descriptive visualizations and an exploration of different measures involving deaths and drug seizures, these analyses clearly show that many illegal drug markets are trending toward synthetic drugs and away from heroin. This shift reflects, in turn, a change in the source country involved and modes of transportation, with a majority of fentanyl now arriving by land from Mexico. In some states, heroin seizures are increasingly rare and largely surpassed by seizures involving (mostly illegally manufactured) synthetic opioids.\(^1\) With more-potent synthetic opioids on the market, exposure to these drugs has increased, as has the number of overdose deaths in virtually every demographic group analyzed.

Based on analysis of available data and other insights from the literature, this appendix provides rough estimates of the annual total amount of illegally produced fentanyl consumed in the United States. This offers insight into the total volume of fentanyl needed to be produced or trafficked. More Americans are dying because the supply of drugs sold in illegal markets has changed and is becoming much more dangerous. These were previously drug markets that dealt in diverted prescription opioids and heroin but are now turning to cheaper alternatives.

This appendix explores several research questions related to the supply and demand for synthetic opioids, including the following:

- Who and where are people increasingly exposed to synthetic opioids, and how does this vary by demographic?

\(^1\) Mentions of synthetic opioids refer to illegally produced synthetic opioids.
MARKET TRENDS IN THE DEMAND AND SUPPLY FOR ILLEGALLY SOURCED OPIOIDS

- What is the total consumption of illegally manufactured fentanyl in the United States?
- What have been the trends in illegally manufactured synthetic opioids supplied to the United States in terms of concealment, port of entry, and mode of transportation?
- How has the retail supply of synthetic opioids changed in terms of prices, purities, and formulations?

Answers to some of these questions can better inform responses to ongoing changes in markets that transition rapidly.

DEMAND FOR ILLEGALLY SOURCED OPIOIDS IN THE UNITED STATES

The contours of use of synthetic opioids can be examined in a variety of ways. One way is through the National Survey on Drug Use and Health (NSDUH), administered by the Substance Abuse and Mental Health Services Administration. NSDUH, however, is a household survey (which excludes most institutionalized populations) and does not ask specifically about the use of illegally manufactured fentanyl. NSDUH is likely to grossly underestimate the true population of regular heroin users. RAND Corporation research has shown that the population of chronic heroin users was closer to 2.3 million in 2016, or five times the NSDUH estimate of the same population. Further, given the manner in which fentanyl is concealed in items sold as heroin or prescription medication, respondents might be unable or unlikely to report their fentanyl use accurately.

Another way of assessing trends in synthetic opioid use is to examine outcomes in user populations—treatment admissions, emergency department events, and records of overdose deaths involving synthetic opioids. Not all states report information on emergency department events, but all report on fatal overdoses to the Centers for Disease Control and Prevention’s (CDC’s) National Vital Statistics System. Drug overdose death data are helpful, but there are problems with these measures. First, not all states report deaths accurately. Some states (and some localities) might not conduct rigorous toxicology examinations to determine the presence of novel drug agents in a decedent’s system, which results in highly imprecise death records. For example, a recent overdose crisis in Pennsylvania has been observed, but official death records from that state suggest that a sizable portion of records of deaths involving drugs do not specify the particular drug in question (e.g., heroin, cocaine, synthetic opioids). This imprecision limits the ability to reach a firm understanding of the extent of the crisis.

Second, the codes used to record deaths, the International Classification of Diseases, tenth revision (ICD-10) codes, contain a single general measure for “synthetic opioids,” the T40.4 code. This record includes any death involving any synthetic opioids other than methadone. Synthetic opioid is a large category of chemicals, and listing deaths involving drugs as disparate as tramadol and carfentanil could confuse a clearer understanding. Further, this code does not allow a determination of the legality or source of the drug in question—either diverted medication or illegally produced. Nonetheless, CDC has done some text-based analysis of death certificates and determined

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2 Per the Substance Abuse and Mental Health Services Administration, people “excluded from the 2018 universe included those with no fixed household address (e.g., homeless and/or transient persons not in shelters), the active military population, and residents of institutional group quarters, such as jails and hospitals” (Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration, 2018 National Survey on Drug Use and Health Methodological Resource Book, Section 2: Sample Design Report, Rockville, Md., January 2019, p. 1).


4 The Treatment Episode Data Set (TEDS) series reported by the Substance Abuse and Mental Health Services Administration focuses only on treatment admissions involving “heroin” or “other opioids,” precluding any means of measuring trends in the use of fentanyl.
that illegally manufactured fentanyl is involved in the majority of these cases.\textsuperscript{5} Further, the lack of codes that involve novel synthetic opioids (e.g., uncontrolled fentanyl analogues and nonfentanyl synthetic opioids) also limits a better picture of emerging market trends. Therefore, an analysis of these data suggests only general trends in deaths involving synthetic opioids. With these limitations in mind, one can see death data showing ongoing trends in those who are dying from exposure to synthetic opioids, and the vast majority of those cases involve illegally manufactured fentanyl.

Examining Trends in Fatal Overdoses

Drug overdose deaths involving opioids have increased dramatically since the beginning of the 21st century.\textsuperscript{6} In the previous two decades, the United States has seen a sevenfold increase in the per capita rate of deaths involving opioid overdoses, from nearly three per 100,000 in 2000 to more than 20 per 100,000 in 2020 (see Figure B.1). During that time, overdose deaths involving synthetic opioids rose from 0.3 per 100,000 to 17 per 100,000. In other words, overdose deaths involving synthetic opioids went from something close to 10 percent of deaths to now being involved in 80 percent of deaths. Yet, overdose death totals or trends over time gloss over many details about what specifically is the cause of these deaths. Opioid-involved overdose deaths have shifted dramatically in recent years from prescription analgesics to heroin to synthetic opioids, such as fentanyl.\textsuperscript{7} Similarly, deaths across different demographic and social cleavages have also shifted, although several disparities remain.

There are important changes in opioid-involved overdose deaths over time by gender, race/ethnicity, age group, and urbanicity. Here, the Commission used publicly available demographic data from CDC as well as the U.S. Census Bureau to calculate per capita death rates through 2019 (the latest year for which individual death records were available at the time of this analysis). Researchers found trends in a series of sections that follow for specific overdose ICD-10 codes, including heroin (T40.1), semisynthetic opioids (most commonly, prescription opioids, T40.2), methadone (T40.3), and synthetic opioids (T40.4). They have also included deaths involving any opioid, which includes the four T-codes just listed as well as opium (T40.0) and unspecified narcotics (T40.6). ICD-10 codes, however, do not allow one to determine the source or legality of most drug poisoning deaths. With the exception of T40.1 for heroin, all other opioids could be from legitimate sources. CDC data offer no way to determine the share of deaths that involve synthetic opioids that were illegally sourced. However, CDC has determined that nearly all deaths involving synthetic opioids in recent years were of illegal origin.\textsuperscript{8}


\textsuperscript{6} Much of this section is drawn from ongoing RAND Corporation work on the opioid ecosystem.

\textsuperscript{7} Those overdosing on illegally manufactured synthetic opioids in recent years, however, might have been exposed to prescription opioids years before, leading to the development of a substance use disorder. Therefore, one would be mistaken to treat these drug overdose or substance use issues as discrete conditions or problems.

MARKET TRENDS IN THE DEMAND AND SUPPLY FOR ILLEGALLY SOURCED OPIOIDS

Figure B.1
Opioid-Involved Overdose Deaths in the United States, 2000–2020

In terms of general overdose death trends in the United States, there has been a marked shift in the share of deaths that involve different opioids (Figure B.1). Up through about 2015, prescription opioids (T40.2) were the main contributing drug agent reported in opioid overdose death statistics. Overdoses involving heroin started to increase around 2011, overtaking those involving prescription opioids by 2015. Heroin’s rise, however, was short lived, as the presence of more-potent synthetic opioids, such as illegally imported fentanyl, started to grow dramatically around 2014.

This most recent trend has continued, and since 2016, opioid overdose deaths involving synthetic opioids overtook those for either heroin or prescription opioids. Unlike heroin or prescription opioid overdoses, which have declined from their recent peaks in 2016 and 2017, respectively, synthetic opioid overdose deaths have continued to rise almost unimpeded. Per provisional CDC overdose death data, by December 2020, synthetic opioids were involved in 82 percent of all opioid-involved overdose deaths for the preceding 12 months.9 In short, what was once a prescription opioid problem has now become more complicated and complex, with substantially elevated potential and actual harm from illegally sourced opioids.

SOURCE: Analysis of multiple-cause-of-death data (Wide-Ranging Online Data for Epidemiologic Research [WONDER], Centers for Disease Control and Prevention [CDC], “National Center for Health Statistics Mortality Data on CDC WONDER,” last reviewed December 22, 2020).

NOTE: The following International Classification of Diseases, tenth rev. (ICD-10) poisoning codes indicate drug: T40.1 (heroin); T40.2 (semisynthetic opioids, typically prescription); T40.3 (methadone); and T40.4 (synthetic opioids except methadone). Any opioid includes T40.0 (opium) and T40.6 (unspecified narcotics).

9 Death counts for 2020 are provisional and subject to change.


B-4 Commission on Combating Synthetic Opioid Trafficking
Sex

There have been long-standing disparities in drug use, related outcomes, and responses between sexes.10 Opioids are no different, with males typically reporting greater rates of problematic opioid use and adverse outcomes, especially those related to illegally sourced opioids, such as heroin.11 Figure B.2 shows the per capita rates of overdose deaths between 2000 and 2019 for males and females. Rates for both sexes increased during this period, but males maintained higher overdose death rates than females across all categories of opioids. In 2000, the male overdose death rate involving opioids was about 2.8 times that of females. By 2019, that had slightly reduced to 2.3 times. There was a noticeable shrinking in the disparity of prescription opioid deaths across genders: The number of overdoses involving females grew faster than that for males over the decades. During this period, overdose deaths involving prescription opioids in females grew by a factor of 4.5, whereas death rates for males increased by a factor of 3. The number of heroin overdose deaths never overtook that of prescription opioids in the female population, but that cannot be said for males. By 2013, males were dying at greater rates from heroin than prescription opioids. The number of synthetic opioid overdoses overtook that for heroin in 2016 for both populations.

The biggest jump in overdose deaths over time came in the form of synthetic opioids. Both males and females reported similar overdose death rates in 2000, around 0.2 to 0.3 per 100,000, but by 2016, that number had grown to 6.05 and 16.3 per 100,000 for females and males, respectively. As of 2016, males were dying from synthetic opioids at rates of 2.7 times those for females. This is partially related to the nature of sourcing, with males more likely to source opioids from the illegal market, where illegally manufactured fentanyl is increasingly present; females are at greater risk for nonmedical use of prescription opioids.12

Race/Ethnicity

Using CDC mortality and population data, the Commission calculated race/ethnicity death rates across six categories. These results might not be accurate because the public health literature has noted racial disparities in coding deaths.13 Figure B.3 shows the trends observed from these analyses. Death rates for non-Hispanic white and non-Hispanic black people were the highest out of all groups. Other racial and ethnic groups have seen an increase in overdose death rates since 2015, but that trend is largely related to the encroachment of illegally supplied synthetic opioids in drug markets.


Opioid-involved overdose deaths were similar between non-Hispanic white and non-Hispanic black populations, at around 3.4 per 100,000 in 2000. Yet, over time, prescription opioid overdose deaths in the non-Hispanic white population have increased—a trend that has persisted through 2019. The non-Hispanic black population did not experience the prescription overdose death burden that affected the non-Hispanic white population, although rates of overdoses involving these drugs did increase. Instead, heroin overdose deaths were more prevalent for non-Hispanic blacks for most of the early and especially in the later part of the time period. Most of those heroin overdose deaths corresponded to older non-Hispanic black men who had likely begun using heroin decades earlier. They died from heroin overdose deaths at a higher rate than in any other race group in the early part of the time period. After 2010, deaths from synthetic opioid overdose deaths in non-Hispanic black males increased more rapidly than deaths from all other drug categories. Synthetic opioid overdose deaths have increased more rapidly in non-Hispanic black men than in any other population group over the entire time period.

Disparities in opioid-involved overdoses between non-Hispanic white and non-Hispanic black populations grew over time until the emergence of illegally manufactured synthetic opioids.

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Figure B.3
Opioid-Involved Overdose Deaths in the United States, 2000–2019, by Race/Ethnicity


NOTE: The following International Classification of Diseases, tenth rev. (ICD-10) poisoning codes indicate drug: T40.1 (heroin); T40.2 (semisynthetic opioids, typically prescription); T40.3 (methadone); and T40.4 (synthetic opioids except methadone). Any opioid includes T40.0 (opium) and T40.6 (unspecified narcotics).
The introduction of potent synthetic opioids, such as fentanyl, to drug markets is now affecting stimulant users and nonwhite populations in diverging ways that are suggestive of different overdose subepidemics. Recent studies have documented racial disparities in opioid-involved overdose deaths nationally, showing that non-Hispanic black Americans are now dying from synthetic opioid–involved overdoses at greater rates than those of non-Hispanic white Americans. In 2018, overdose deaths involving any opioid declined in the non-Hispanic white population but continued to accelerate in the black population. Today, a greater share of opioid-involved overdoses in black populations (both Hispanic and non-Hispanic) are due to synthetic opioids.

Age

Important variations in opioid-involved overdose deaths by age are also evident (see Figure B.4). Deaths are least common for those under 20 or above 61 years of age and highest for those ages 31 to 40. According to CDC, increases across these groups have been both substantial and significant. In terms of overdose trends by type of opioid, heroin-involved overdose deaths are more common and appear earlier in the time period for younger age groups, with the exception of those under 20. Prescription opioid overdose deaths were more common in populations over the age of 40, among whom heroin overdose deaths never overtook those involving common prescription opioids. Synthetic opioid overdoses rose across all age groups at the same time and have continued to rise, but the increase was sharpest in age groups ranging from 21 to 60 years.

Deaths involving traditional prescription opioids have declined in all age groups but mostly toward the end of the time period. The declines were least noticeable for age groups between 21 and 40 years, which vacillated over the years starting in 2010. In contrast, heroin overdose deaths declined in 2016 for these groups but remained relatively flat after 2016 for those ages 41 to 60.

What is important to remember is that the vast majority of overdose deaths involve people between the ages of 20 and 60. The number of people in these age groups whose lives abruptly end is of great concern given the many years of potential life lost, affecting intimates and whole communities. The Council of Economic Advisers for the White House estimated that the overdose crisis in 2017 cost the U.S. economy some $500 billion. The vast majority of that cost was attributed to lost productivity due to premature death in those ages 25 to 55, the most economically active and productive age range.

Figure B.4
Opioid-Involved Overdose Deaths in the United States, 2000–2019, by Age Cohort


NOTE: The following International Classification of Diseases, tenth rev. (ICD-10) poisoning codes indicate drug: T40.1 (heroin); T40.2 (semisynthetic opioids, typically prescription); T40.3 (methadone); and T40.4 (synthetic opioids except methadone). Any opioid includes T40.0 (opium) and T40.6 (unspecified narcotics).
Urbanicity

Using the core-based statistical area designation (a U.S. government designation that includes counties around major population centers) for the six statistical areas defined by the federal government, one can examine opioid-involved overdose death trends across degree of urbanicity. More–densely populated areas, including large central metropolitan areas, large fringe metros, and medium metro areas, have reported the highest shares of opioid-involved overdose deaths per capita (see Figure B.5). Yet, important variation across these designations is observed. More-rural areas (i.e., nonmetro areas, such as micropolitan and noncore) report higher rates of prescription opioid overdose deaths, approaching five per 100,000 for some years—a trend also emphasized by others.\textsuperscript{19} The number of deaths involving prescription opioids has trended downward in recent years, with steepest declines in more-rural areas from recent peaks.

Figure B.5
Opioid-Involved Overdose Deaths in the United States, 2000–2019, by Core-Based Statistical Area Designation

[source: Analysis of multiple-cause-of-death data (Wide-Ranging Online Data for Epidemiologic Research [WONDER], “National Center for Health Statistics Mortality Data on CDC WONDER,” last reviewed December 22, 2020) and core-based statistical area (CBSA) data (U.S. Census Bureau, “Metropolitan and Micropolitan Statistical Areas Map [March 2020],” undated). NOTE: The following International Classification of Diseases, tenth rev. (ICD-10) poisoning codes indicate drug: T40.1 (heroin); T40.2 (semisynthetic opioids, typically prescription); T40.3 (methadone); and T40.4 (synthetic opioids except methadone). Any opioid includes T40.0 (opium) and T40.6 (unspecified narcotics).]
Heroin overdose deaths increased for all six designated areas but overtook prescriptions only for more-densely populated areas. In short, heroin overdoses were more common in more-populated areas, whereas prescription opioid overdoses were more common in rural areas. Synthetic opioid overdose deaths were greater in dense regions as well, especially toward the end of the time period, when rates were closer to 12.5 per 100,000. That said, since 2016, the number of deaths involving synthetic opioids has outpaced those for heroin or semisynthetic (i.e., prescription) opioids across all six designations.

Synthetic opioid overdoses were more common than heroin in more-rural areas, especially up through 2010. This is likely to be related to prescription fentanyl and not illegally sourced fentanyl, which arrived around late 2013 to some geographic markets. In 2006, there is a noticeable bump in the number of synthetic opioid overdose deaths in the large central metro designation, which more than doubled from the previous year. This increase is likely to be associated with a prior outbreak of illegally sourced fentanyl, which affected major heroin and cocaine markets in parts of Chicago, Detroit, and Philadelphia.

Census Region

Important geographic variation in opioid-involved overdose fatalities is also evident within census region designations, as shown in Figure B.6. These are rough categorizations, given the wide expanse of a census region, but offer some helpful national comparisons. What is most clear is that the rise in synthetic opioid overdose deaths starting in 2014 is most prevalent in the Northeast and Midwest regions. The South and West report rises, with the West only at the very end of the time period and at much lower rates than the other two aforementioned regions. Trends in the Northeast are particularly noteworthy given that synthetic opioid death rates never slowed once they started rising in 2013 more than in other regions. In 2018, deaths involving synthetic opioids in the Midwest and South regions, slowed, which some credit to the departure of extremely potent synthetic opioids, such as carfentanil, from some drug markets in some states. State-level analysis of these data show a strong geographic concentration in overdose deaths involving synthetic opioids, with most occurring in states in New England, parts of Appalachia, and the Midatlantic.


21 State designations by region are as follows:

- South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia
- Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin

A similar geographic pattern is observed for heroin overdose deaths, which overtook prescription opioid overdose deaths in the Northeast and Midwest regions but not in the South or West. Deaths involving heroin in the Northeast and Midwest regions have declined since 2016, perhaps because fentanyl has largely displaced it in illicit markets. In contrast, the rates of deaths involving prescription drugs were higher in the South and West through much of the series, although the West never experienced death rates at or above five per 100,000, which all other regions did at some point. Except for the West, prescription opioid overdose death rates rose substantially, by a factor of three or four from 2000 to 2019. Death rates in the West rose fairly steadily, rising from two per 100,000 in 2000 to 3.2 per 100,000 in 2019.

These trends track for all opioid-involved overdoses as well, with the West reporting the smallest growth in the 20-year period as deaths more than doubled per capita from four to ten per 100,000. Every other region experienced a six- or sevenfold increase in opioid-involved death rates.
Polydrug Overdose

In the analysis described in the previous section, the Commission examined numbers of deaths by drug and demographic factor, showing important trends across groups. There have also been important changes in trends associated with the polydrug nature of deaths involving synthetic opioids—that is, deaths involving both synthetic opioids and other types of drugs, such as heroin and cocaine. The involvement of synthetic opioids in other drug-related overdose deaths suggests increasingly complex trends in drug supply and use.

In 2020, synthetic opioids (principally fentanyl) were involved in more than 80 percent of opioid-involved deaths and just over half of all drug overdose deaths. As of 2020, synthetic opioids were reported in about 70 percent of overdoses involving heroin or cocaine and in about half of those involving psychostimulants (see Figure B.7). The involvement of synthetic opioids, especially novel synthetics that are illegally manufactured, in drug overdoses is undercounted because some states do not accurately report underlying causes of death. The supply of illicitly manufactured opioids generates additional harms of its own (e.g., unregulated substances of unknown purity or consistency, user contact with criminal elements, intravenous drug use) as well as serve as ready substitutes for those who are suffering with opioid-use disorders (OUDs) realized by prescription opioids, delaying opportunities for recovery.

Nonetheless, the dramatic rise and involvement of synthetic opioids across other drug categories, including non-opioid categories, such as cocaine and psychostimulants (e.g., 3,4-methylenedioxy methamphetamine [MDMA], methamphetamine), present difficulties for managing risks in drug use, as well as overdose reversal and maintenance, in some populations. This is particularly true for those who generally do not take opioids and could be exposed to fentanyl in minute quantities through tainted cocaine. It is not clear whether a large share of the cocaine supply is contaminated by fentanyl, but risks of exposure to fentanyl in some populations are likely to have elevated since 2014.

An examination of overdose deaths that involve synthetic opioids across different drug death categories and age cohorts shows important variations in those who are dying. Figure B.8 shows that the number of deaths involving synthetic opioids is highest for those ages 31 to 40, with synthetic opioid–only deaths (i.e., deaths involving synthetic opioids and not heroin, cocaine, or other drugs) occurring at rates close to nine per 100,000 in 2019. The 21–30 age group reports lower death rates, including for synthetic opioids only, at about 7.5 per 100,000, but similar shares of overdose deaths across drugs that also include synthetic opioids. In this case, more than half of cocaine, heroin, psychostimulant, or prescription opioid overdose deaths also include mention of synthetic opioids for those ages 21 to 40. In some cases, this share was as high as nearly 80 percent for cocaine. Shares of drug mixtures were lower in older age groups.

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It is unclear to what extent decedents regularly used heroin and happened to become exposed to fentanyl or other synthetic opioids in the process or whether someone consuming a drug mistakenly ingested a counterfeit tablet containing a lethal dose of fentanyl. However, the age groups affected by synthetic opioids, at least through 2019, are mostly midlife and reside in certain parts of the eastern United States.
Figure B.8
Overdose Deaths in the United States from Synthetic Opioids Mixed with Other Drugs, 2013–2019, by Age Group


NOTES: Visualizations have omitted drug overdose deaths mentioning only an unknown or unspecified drug (T50.9).

* Excludes cocaine, heroin, prescription opioid, and psychostimulant deaths involving synthetic opioids.
Across census regions, shown in Figure B.9, deaths from synthetic opioids only are highest in the Northeast, with death rates at about seven per 100,000 in 2019. This region also reports the highest share of all categories of drug overdose deaths being those involving mixes with synthetic opioids. In this case, 75 percent of cocaine, 90 percent of heroin, and more than half of psychostimulant or prescription opioid overdoses also include synthetic opioids. The Midwest region was the next most affected, with synthetic opioid–only death rates at five per 100,000 in 2019. In this region, three-quarters of the fatal cocaine and heroin overdoses also included synthetic opioids, whereas close to half of the fatal overdoses involving psychostimulants or prescription opioids included synthetic opioids. The West region remains the least affected by synthetic opioids, although rates are rising and shares of other drug deaths that involve synthetic opioids are growing as well.

**Figure B.9**

*Overdose Deaths in the United States from Synthetic Opioids Mixed with Other Drugs, 2013–2019, by Census Region*


NOTES: Data do not include unknown- or unspecified-only deaths.

*Excludes cocaine, heroin, prescription opioid, and psychostimulant deaths involving synthetic opioids.
Implications of Overdose Trends

There have been important trends in opioid-involved overdoses over time across various groups as well as for any particular opioid in question. As of 2019, synthetic opioids were driving the overdose death crisis across virtually all demographic and geographic groups analyzed. The arrival of these more-potent alternatives has acutely affected rural white populations, but that has changed. Black Americans are now dying from exposure to synthetic opioids at higher rates than non-Hispanic white populations. Densely populated urban areas are also increasingly affected. That said, the problem is still largely constrained to states in the eastern half of the country—although it is growing in the western United States. Across drug categories, synthetic opioids were found in a majority of overdose deaths in the 2019 data, including those involving heroin or cocaine. In fact, the number of deaths from heroin or semisynthetic opioids (i.e., those generally involved in prescription opioids) have continued to decline since 2015, while deaths involving synthetic opioids without the presence of other drugs continue to rise each year.

Across age groups and census regions, a growing share of drug overdose deaths from other drugs also involve synthetic opioids. This trend was most noticeable in the Northeast and Midwest regions, as well as in people ages 20 to 50, at least through 2019. The most-recent data for 2020 are not available at the individual level, although preliminary counts show a continued rise in drug overdoses that mostly involve synthetic opioids. An examination of U.S. drug supply data reveals a similar geographic pattern, suggesting that drug markets are trending in favor of synthetic opioids. The changing dynamics of who is overdosing from what could affect existing efforts to understand drug demand. For example, rising use of stimulants and synthetic opioids could present unique challenges, so policy responses might need to be tailored in response.

Bounding the Potential Scale of Illegally Produced Fentanyl Consumption in the United States

Generating precise estimates of the amount of illegally produced synthetic opioids, such as fentanyl, that are consumed in the United States is not possible at this time. Whereas the most-recent “best” estimates of the amount of cocaine and heroin consumed in the United States (from 2016) are 145 and 47 pure metric tons (MT), respectively, the calculations discussed in this section suggest that the pure amount of illegally produced fentanyl consumed in the United States annually (c. 2021) is likely in the single-digit MT. It also raises questions about the utility of using morphine-equivalent doses (MEDs) to generate insights about consumption of illegally produced opioids.

The United States does not currently have the data, or even the means of collecting the necessary data, to adequately measure the amount of illegally produced synthetic opioids consumed in the United States (in Appendix G, the Commission offers ideas about how to rectify this). Many people unknowingly consume fentanyl (because, for example, the fentanyl is mixed in with other powders or counterfeit pills), which means that user surveys, the mainstay of many demand-side drug consumption estimates, cannot provide accurate data. In addition, the United States does not have reliable estimates of either the number of people with OUD or how many people knowingly use illegally produced opioids. Likewise, estimates of hectares under cultivation—a

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25 Fentanyl was used as the benchmark for these estimates because more information exists about fentanyl than about other options and it is the dominant synthetic opioid reported in drug overdose deaths and seizure events.

26 MED is a rough conversion in terms of an opioid’s analgesic properties. Clinicians use MEDs to determine dosing across opioids benchmarked to morphine.
foundation for some supply-side estimates of plant-based drugs, such as heroin and cocaine—are not relevant for synthetic drugs.

This discussion is intended to help readers think about the maximum potential scale of fentanyl consumption in the United States. Assuming no change in those using illegally sourced fentanyl, consider two thought experiments:

1. Suppose that all heroin consumption were replaced by an amount of fentanyl that is “medically equivalent” in terms of analgesic effect.
2. Suppose that all people with OUD consumed only fentanyl, not other opioids.\(^{27}\)

These exercises would produce bounds on fentanyl consumption if the parameter values were correct, since some of that demand for opioids will be met with other opioids, including heroin, prescription opioids (both painkillers and diverted medicine from opioid medication treatment), and synthetic opioids other than fentanyl (e.g., carfentanil). Furthermore, some (generally thought to be small) share of nonprescribed fentanyl comes from legally produced but diverted pharmaceutical fentanyl.

The caveat about parameter values being correct is important to stress. Calculations here are based on the best available insights, but the possibility that one or more of these parameters (e.g., MEDs for illegally produced heroin and fentanyl) are incorrect must be acknowledged.

**Thinking About Morphine-Equivalent Doses**

To convert various opioids into a common metric, analysts typically focus on the MED that produces a similar analgesic effect. Table B.1 presents the MED conversions for various opioids.

<table>
<thead>
<tr>
<th>Opioid</th>
<th>MED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>1</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>1.5</td>
</tr>
<tr>
<td>Heroin</td>
<td>2–5</td>
</tr>
<tr>
<td>Methadone(^a)</td>
<td>12</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>50–100</td>
</tr>
</tbody>
</table>


\(^a\) CDC notes that MED for methadone depends on the amount used per day. This figure is based on ≥61–80 mg/day (CDC, U.S. Department of Health and Human Services, “Calculating Total Daily Dose of Opioids for Safer Dosage,” March 14, 2016).

\(^{27}\) Because the risk of overdose death from fentanyl appears to be much higher per person-year of use compared to heroin and prescription opioids, the Commission could not use the ratios of, for example, heroin to fentanyl deaths to back out consumption for most of the country. The co-use of both drugs also creates challenges for deriving information from mortality data.
MARKET TRENDS IN THE DEMAND AND SUPPLY FOR ILLEGALLY SOURCED OPIOIDS

But as Caulkins notes, opioids might differ in ways other than their analgesic effects:

Even if one milligram of fentanyl provides as much pain relief as 20 milligrams of heroin, that doesn’t mean that opioid users find one milligram of fentanyl to be as appealing as 20 milligrams of heroin. Both are mu-opioid receptor agonists, but there are differences. Notably, fentanyl’s duration of effect is shorter; in terms of analgesia, it may be less than an hour, compared to four to five for heroin.\(^\text{28}\)

Although these conversion factors are helpful, they are not comprehensive in the sense that people who use opioids are not always focusing on analgesic potency when making decisions about which opioid to consume.\(^\text{29}\) Price, availability, legal risk, and other factors are also likely to affect these decisions.

There are other limits of equianalgesic, or MED, tables for these purposes. First, a primary motivation for creating the tables is the idea of medical opioid rotation, meaning that when a patient develops tolerance to one opioid analgesic, doctors might switch to a different opioid analgesic precisely because cross-tolerance could be partial. The starting point for dosage of the new opioid comes from equianalgesic tables, but the motivation for switching opioids is precisely the possibility that the patient will derive greater pain relief because of switching to an equianalgesic dose of the new opioid.

Second, the specific values in these tables have been revised very little since they were introduced around 1970. The underlying clinical studies were often done with subjects who had little prior opioid exposure, and the fentanyl studies generally considered transdermal (via skin contact), sublingual (under-the-tongue delivery), and buccal modes (substance absorbed through cheek, much like chewing tobacco) of administration, as well as subcutaneous infusion.\(^\text{30}\) Today, many people are injecting or inhaling illegally produced fentanyl;\(^\text{31}\) thus, it’s unclear how applicable these MED conversion factors are to the current situation.

**A Top-Down Approach Based on Heroin Consumption Estimates**

One exercise that can help us think about the magnitude of fentanyl consumption is to ask, “What if everyone who was using heroin switched to an equivalent amount of fentanyl?” The most recent figures for heroin are for 2016 and suggest that 47 pure MT of heroin (pure weight) were consumed that year. A lot of uncertainty surrounds the estimate, with the authors offering lower and higher estimates of 18 MT and 94 MT, respectively.\(^\text{32}\)

As noted in Table B.1, heroin is two to five times stronger than morphine, and fentanyl is 50 to 100 times stronger than morphine.\(^\text{33}\) Thus, for the sake of this baseline calculation, the Commission used the midpoints of 3.5 and 75,


\(^{32}\) These should not be considered extreme bounds or 95-percent confidence intervals.

respectively, to produce a conversion factor of 21.4, or 75 divided by 3.5. Dividing the heroin consumption estimate of 47 MT by 21.4 generates a weight of 2.2 MT of fentanyl (4,850 pounds). If one believed the heroin market in United States circa 2016 was closer to the higher figure of 94 MT, the fentanyl equivalent would be about 4.4 MT. Given that heroin dominated the illegal opioid market in 2016, one could also think about this figure as an upper bound on the amount of fentanyl that would have been used at that time if the entire heroin market was supplied by fentanyl.

However, this calculation might not be an upper bound for multiple reasons. First, these heroin figures are from 2016, and there was an upward trend in heroin consumption estimates in the preceding years. In particular, the 2016 consumption estimate was about 50 percent greater than consumption in 2011 (47 vs. 30 MT), so it could be that heroin consumption in 2021 is greater than 47 MT, stable, or lower. Midgette et al. showed that consumption for 2017 could have been higher or lower depending on which data sets were used to project consumption values from 2016 to 2017.34

Second, taking the midpoint of MED might not be appropriate for the conversion. It is also plausible that the “correct” factor is closer to 10 (using the low end for fentanyl—50—and the high end for heroin—5) or closer to 50 (using the high end for fentanyl—100—and the low end for heroin—2). Table B.2 displays the amount of pure fentanyl that would have been consumed in this hypothetical thought experiment for various conversion factors as well as various assumptions about how heroin use might have changed since 2016. Using the lowest conversion factor (10) and assuming that heroin consumption increased 75 percent from the best estimate of 47 MT for 2016, the MED equivalent would be 8.2 MT of pure fentanyl.

Finally, there is also the possibility that frequent fentanyl users could consume more MED on a daily basis than frequent heroin users. This possibility is further discussed in the next scenario.

### Table B.2

| Assumption About Changes in U.S. Heroin Consumption from 2016 to 2021 | Fentanyl-to-Heroin MED Conversion Factor |
|---|---|---|
| | Low (10 = 50:5) | Medium (21 = 75:3.5) | High (50 = 100:2) |
| Decreased 25% | 3.5 | 1.6 | 0.7 |
| Stable | 4.7 | 2.2 | 0.9 |
| Increased 25% | 5.9 | 2.7 | 1.2 |
| Increased 50% | 7.1 | 3.2 | 1.4 |
| Increased 75% | 8.2 | 3.9 | 1.6 |

NOTE: Relative to the best estimate for heroin consumption in 2016 of 47 pure MT. Since the MED ranges for heroin and fentanyl are 2–5 and 50–100, respectively, the Commission considered three conversion scenarios based on these ranges and the midpoints.

A Bottom-Up Approach

Another approach would multiply the average amount of fentanyl per person used by the number of people who use fentanyl. Unfortunately, the Commission does not have solid evidence about the amount of fentanyl consumed by those who use on a regular basis in the United States and account for most of the market. It also does not have precise estimates of how many people in the United States suffer from OUD, let alone how many are consuming fentanyl or other illegally produced synthetic opioids.

With respect to quantity consumed, some insights can be obtained by triangulating data from Canada and also examining what is known about the consumption of other opioids. Based on interviews with people who used opioids in Vancouver in 2017–2018, Bouchard et al. estimated that more than 60 percent of daily users spent more than Can$50 per day on drugs (at least $50 was the highest category included); however, they were unable to determine how much was spent on specific substances.35 If one assumed all daily users were spending Can$80/day on fentanyl (prices did not appear to differ from heroin), that would equate to 0.5 g of raw powder if they purchased in bulk (from data provided by the Vancouver Police Department). Pardo et al.36 interviewed a law enforcement official in 2019 who reported that a typical bag of “down” sold in Vancouver was 2-percent fentanyl, which might or might not also include some heroin.37 If this 2-percent figure is correct, it suggests daily consumption of 10 mg of pure fentanyl.38 At 300 use-days a year, that would equal 3 pure grams of fentanyl for the year, less than the weight of a typical sugar packet from McDonald’s (4 g).39

A reviewer of this document examined the same Bouchard et al. study and modeled “heavy” users as consuming 0.4 g a day instead of the 0.5 g per day generated above. The Commission does not know what the typical value is; either could be correct, or both could be incorrect. If the 0.4 g is indeed the more accurate amount, then it—along with the 2-percent purity value—would generate a daily consumption rate of 8 mg pure fentanyl. Of course, if one thought that the amount of fentanyl in a bag at the time was closer to 1 percent, this purity value would push these estimates to 4 or 5 pure mg fentanyl per day. Similarly, if one thought the amount was closer to 3 percent, that would increase these estimates to 12 mg or 15 mg.

This raises the question about whether 4 mg to 15 mg per day of pure fentanyl is a reasonable estimate for a frequent user. Table B.3 highlights what is known about the daily consumption for other opioids, with the last column converting these values to annual MED. However, if one uses the midpoints (which might not be accurate), MED for illegally produced fentanyl appears to be higher than it is for those using illegally produced heroin on a daily or near-daily basis or those entering substance use treatment for oxycodone. This estimate is


37 Whereas when heroin dominated illicit opioid markets, customers often asked for it by name or used a slang term specific to heroin (e.g., “horse” in New York City in days of yore), there are now places where the street argot has evolved to mean an illicit opioid without specifying the type. For example, in Vancouver the word “down” is apparently used in this fashion. The existence of such words captures the idea that heroin and fentanyl are close cousins and that users are buying bags of opioids without precise knowledge as to the contents of the bag.

38 Data analyzed from Canada later in this appendix show the purity of seizures involving fentanyl in British Columbia. The median values were around 5 percent pure fentanyl in 2018, but it is unclear what share of these seizures were at the retail versus higher levels of the market (which presumably involve more-potent product; it gets diluted along the supply chain).

39 McDonald’s, “Sugar Packet,” undated.
entirely plausible considering reports of greater frequency in fentanyl dosing because of the shorter duration of effect and the possibility that those who regularly use fentanyl have a greater tolerance for opioids.

### Table B.3

**Opioid Consumption, Converted to Daily MED and Annual Fentanyl Equivalent**

<table>
<thead>
<tr>
<th>Opioid</th>
<th>Population</th>
<th>Plausible Daily Amounts (Pure), in Milligrams&lt;sup&gt;a&lt;/sup&gt;</th>
<th>MED</th>
<th>Daily MED Equivalent at Midpoint of Ranges, in Milligrams</th>
<th>Annual MED Equivalent Pure Quantity of Fentanyl, in Grams&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illegally produced fentanyl (Canada)</td>
<td>Daily users in Vancouver</td>
<td>4–15</td>
<td>50–100</td>
<td>713</td>
<td>2.85</td>
</tr>
<tr>
<td>Illegally produced heroin (US)</td>
<td>Daily/near-daily users in the US c. 2016</td>
<td>72</td>
<td>2–5</td>
<td>252</td>
<td>1.01</td>
</tr>
<tr>
<td>Oxycodone (US)</td>
<td>Those entering treatment for OUD</td>
<td>40–400</td>
<td>1.5</td>
<td>330</td>
<td>1.32</td>
</tr>
<tr>
<td>Methadone for OUD treatment (US)</td>
<td>Daily amount for superior rates of patient retention in methadone treatment</td>
<td>80–100</td>
<td>12&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1,080</td>
<td>4.32</td>
</tr>
<tr>
<td>Pharmaceutical-grade heroin to treat OUD</td>
<td>Daily average doses in HAT clinical trials</td>
<td>400–600 across some recent trials</td>
<td>2–5</td>
<td>1,750</td>
<td>7.00</td>
</tr>
</tbody>
</table>

**NOTES:** Sources and additional discussion of these factors are discussed in the next section on “Daily Consumption of Other Opioids.”

<sup>a</sup> The Commission believes that these are plausible ranges but that the range could be wider.

<sup>b</sup> Assumes 300 use-days per year and based on midpoints of ranges.

<sup>c</sup> CDC has noted that MED for methadone depends on the amount used per day (CDC, “Calculating Total Daily Dose of Opioids for Safer Dosage,” March 14, 2016).

The last two rows of Table B.3 focus on the daily doses for two opioid medications used to treat OUD: methadone and pharmaceutical-grade heroin. Although not used as a treatment in the United States, heroin is prescribed to some people with heroin user disorder in Canada and a handful of European countries (usually after they have tried other treatments multiple times). These amounts (1,080 mg and 1,750 mg MED, respectively) are larger than the MED range for illegally produced fentanyl, suggesting that the 10 mg pure fentanyl figure is entirely plausible for daily/near-daily users.
The commonly reported estimate that 2 million people in the United States have OUD is a substantial underestimate; the number could plausibly be closer to 4 million and possibly exceed it. If one believed that in 2021 there were 1 million people who used fentanyl on a daily or near-daily basis—this is just a guess at this point, probably high\(^40\)—at 3 pure grams of fentanyl used per year, this works out to 3 MT annually.\(^41\) If the correct figure was 4 million people with OUD and one assumes that all of these people were using 3 pure grams of illegally produced fentanyl each year—a wildly implausible scenario for 2021—that would generate annual total consumption of only 12 MT.

**Summarizing Estimates of Fentanyl Consumed**

The bottom line is that the pure weight of fentanyl consumed in the United States is quite small in absolute terms and compared to some other common illegal drugs. That is primarily because fentanyl is so potent that the pure weight in a “dose” or that is consumed per day of use is much smaller than for most other common illegal drugs.\(^42\) The most recent “best” estimates of the amount of cocaine and heroin consumed in the United States (from 2016) are 145 and 47 pure MT, respectively.\(^43\) Based on the rough calculations provided here, mostly focused on assumptions favoring extremely high values, current annual consumption for fentanyl is likely in the single-digit MT.

The Commission concludes with a few additional thoughts about these figures:

1. The Commission strongly discourages anyone from dividing known quantities seized by extreme values (e.g., 1 MT or 8 MT) to generate a specific seizure rate for fentanyl in the United States. The correct figure is likely between these values and focusing on the extremes will generate biased estimates.
2. The conclusion about single-digit MT might not be applicable in a few years, especially if prices continue to decline (as suggested in other parts of the report) and more people become tolerant to fentanyl.
3. Fentanyl is not the only illegally produced synthetic opioid being used in the United States. Although there have been seizures of multiple fentanyl analogues and other nonfentanyl-related synthetic opioids, the National Forensic Laboratory Information System (NFLIS) seizure data suggest that fentanyl

\(^{40}\) The Commission’s limited data systems prevent us from knowing how many people are using fentanyl on a daily or near-daily basis: The NSDUH is not very helpful for understanding heavy opioid users (Peter Reuter, Jonathan P. Caulkins, and Greg Midgette, “Heroin Use Cannot Be Measured Adequately with a General Population Survey,” *Addiction*, Vol. 116, No. 10, October 2021) and TEDS, which largely covers publicly funded treatment episodes, has two categories for opioids—heroin and all other opioids. (For 2018, TEDS reports 502,845 primary admissions for heroin and 144,337 primary admissions for other opioids. Note these are for admissions, not individuals; thus, a person can show up multiple times in an annual count.) Fentanyl dominates opioid-involved deaths, but it is also more potent and more likely to lead to an overdose. If there were 4 million people with OUD today, and thinking in terms of round numbers, it is plausible that half primarily use prescription opioids, 1 million primarily use heroin, and another 1 million primarily use fentanyl. The Commission would also not be surprised if the fentanyl figure was closer to 500,000.

\(^{41}\) Of course, there are others consuming fentanyl who do not have an OUD and/or do not know they are consuming it (e.g., in addition to heroin, there are increasing reports of fentanyl being mixed into cocaine). For most drugs, daily/near-daily users account for a greatly disproportionate share of consumption; one estimate puts that share at ~80 percent for heroin. Fentanyl markets may differ given that many people are using it unknowingly, but it is hard to imagine that daily/near-daily users account for only 50 percent of total consumption. Still, for the sake of generating an upper bound estimate, assume that is the case, making total U.S. consumption 6 MT a year.

\(^{42}\) Lysergic acid diethylamide (LSD) would be an example of another exceptional drug for which very small doses are used and, as a result, has a low total pure weight.

\(^{43}\) Gregory Midgette, Steven Davenport, Jonathan P. Caulkins, and Beau Kilmer, *What America’s Users Spend on Illegal Drugs, 2006–2016*, Santa Monica, Calif.: RAND Corporation, RR-3140-ONDCP, 2019. The Commission was able to generate these estimates for cocaine, heroin, and methamphetamine largely because of data collected from people who use drugs (surveys and urinalyses) who participated in the Arrestee Drug Abuse Monitoring (ADAM) program. ADAM was cut in 2013, and it is unclear whether these national consumption estimates will ever be updated.
dominates this space. Although, in this analysis, the Commission focused on fentanyl, it is important to acknowledge other synthetic opioids of varying potency levels appear to be seized much less frequently. There could also be some diversion of pharmaceutical fentanyl products to nonmedical use, but this is believed to be small and so is not included in these calculations.

**Daily Consumption of Other Opioids**

Here, the daily consumption of other opioids informs the Commission’s modeling exercises above. These estimates, for illegally sourced heroin, prescription opioids, methadone, and prescription heroin, offer plausible daily ranges for the amounts of opioids consumed on a typical day. These were then used to convert to morphine-equivalent amounts.

**Heroin.** Paoli et al. rely on 2001 data from the White House Office of National Drug Control Policy (ONDCP), which suggest that U.S. heroin “addicts” consumed roughly 15 pure grams of heroin a year. Paoli et al. note that this works out to “about 50 milligrams a day when actively using, which is assumed to be about 300 days per year, allowing for sickness, a few days in a local jail or treatment program, and other short-lived breaks in use” (p. 96). Given that the purity-adjusted heroin prices have dropped considerably over the past 20 years, one might expect that this daily consumption figure could be higher today—that is, lower prices can not only bring more people into a market, but they also can increase the amount of consumption by those who are using.

Using data collected from the Arrestee Drug Abuse Monitoring (ADAM) program, RAND estimated that daily and near-daily heroin users spent $1,880 per month in 2016 dollars on heroin. Adjusting to 2018 dollars (×1.045) and accounting for in-kind acquisitions (×1.125), this translates to $2,210. Dividing this by the price per pure gram of heroin obtained at the retail level ($1,021; using System to Retrieve Information from Drug Evidence [STRIDE] data and accounting for quantity discounts) yields a result of 2.17 pure grams a month. Dividing this by 30 days generates a daily consumption rate of 72 mg.

**Prescription opioids.** Since there are people who use prescription opioids daily or near daily to treat chronic pain who do not meet clinical criteria for an OUD, one should distinguish between the two. There is surprisingly little published research on the consumption patterns for those with OUD who use prescription opioids in the United States. One 20-year-old paper reports:

This study undertakes an 18-month retrospective chart review at a private freestanding psychiatric facility to develop a profile of OxyContin addicts seeking treatment. There were 579 admissions to the Addictive Disease Unit of this facility from October 2000 to March 2002, with 298 of these admissions being for the treatment of opioid abuse or dependence. One hundred and eighty seven of these individuals were dependent on OxyContin, using an average dose of 184 milligrams of OxyContin per day.

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44 Fentanyl (98,954 reports), acetyl fentanyl (12,190 reports), tramadol (8,196 reports), and carfentanil (3,288 reports) (National Forensic Laboratory Information System, Diversion Control Division, Drug Enforcement Administration, U.S. Department of Justice, NFLIS-Drug 2019 Annual Report, September 2020). Carfentanil is of special concern given that it is estimated to be about 100 times more potent than fentanyl in terms of MEDs (Elaine Blythe Lust, Claudia Barthold, Mark A. Malesker, and Tammy O. Wichman, “Human Health Hazards of Veterinary Medications: Information for Emergency Departments,” Journal of Emergency Medicine, Vol. 40, No. 2, February 2011).


The 184 mg was based on a mean amount of OxyContin used on a daily basis (uncertainty around the estimate was not reported). Another paper by this research team—likely focused on a subset of the same population—reported a mean of 181 mg, with a range from 40 mg to 400 mg.\(^48\) There are reasons why this amount could be too high or too low. On the one hand, this figure might be high since consumption levels could be higher just before someone enters treatment. On the other hand, it could also be too low if these people were also using other opioids (e.g., heroin). This high estimate of 400 mg is consistent with some anecdotal information the Commission received about those seeking treatment for addiction to prescription opioids (most commonly oxycodone).\(^49\)

**Methadone for treating OUD.** A report by D’Aunno et al. (2019)\(^50\) notes,

Prior research also shows that Methadone Maintenance Treatment (MMT) effectiveness depends upon adequate dose levels (Faggiano et al., 2003). In particular, results from randomized controlled trials suggest that MMT programs that provide average doses in the range of 80–100 mg/day have superior rates of patient retention in treatment (Johnson et al., 2000; Kleber, 2008; Strain, 2006).\(^51\)

**Pharmaceutical-grade heroin for treating OUD.** A review of the clinical trials involving pharmaceutical-grade heroin in multiple countries suggests that a range from 400 mg to 600 mg/day is reasonable.\(^52\)

**INDICATORS OF THE AVAILABLE SUPPLY OF SYNTHETIC OPIOIDS**

Drug seizure data can inform some contours of markets. Data on weights, the chemicals, and time and location of the seizure offers some indication as to markets in transition. That said, drug seizure data are not random samples (though they are large convenience samples) and are likely to be biased as seizure events are a function of the flows of drugs, the interdiction efforts in any given day, and traffickers’ countermeasures.\(^53\) Further, most available supply-side data systems, such as those for drug seizures, are not well positioned to the synthetic opioid problem for two reasons. First, the ever-changing nature of chemical variations in drugs makes detection a challenge. Even with the latest detection equipment, authorities might still not be able to confirm accurately, particularly in the field, whether a bulk powder comprises a controlled substance or is used in the manufacture of synthetic opioids. Second, because fentanyl is highly compact, it can be trafficked in minute quantities through legitimate channels,


\(^{49}\) Personal communication with addiction medicine specialist Sally Satel. The Commission’s work included interviews with those who use drugs; one interviewee noted that, at the peak of his prescription opioid addiction, he was using 560 mg of oxycodone a day.


such as the postal system. This characteristic of fentanyl could affect the means with which seizures are generated, thus counts in a given period might reflect traffickers’ countermeasures rather than shifts in the flow of drugs. Further, seizure data from recent years are likely to be affected by the social distancing mandates associated with the COVID-19 pandemic that reduced law enforcement activity in retail street markets.

Overall, law enforcement seizure data are not generally available to the public. Though seizure data are favored by law enforcement for investigatory purposes, they can also offer important insights into transitioning markets if examined properly and promptly. Drug seizure events in North America show that markets, especially opioid markets, are trending toward synthetic opioids and that these seizures often contain a growing number of other uncontrolled or novel drugs that elevate overdose risk. By many accounts, these novel drugs are also produced by underregulated laboratories overseas.

The analysis relied on four sources of drug seizure data from North American authorities:

1. individual seizure events from the Customs and Border Protection’s (CBP’s) Seized Assets and Case Tracking System (SEACATS)
2. event-level data from the Drug Enforcement Administration’s (DEA’s) System to Retrieve Information from Drug Evidence (STRIDE)54
3. individual seizure events from the NFLIS run by the DEA
4. public seizure data from Health Canada’s Drug Analysis Service, which offered additional confirmatory measures of apparent trends.

By interview accounts, 2019 was an important year for the illegal supply of synthetic opioids. Many noted that the 2019 generic control regulations and other efforts by Chinese authorities might have shaped production in important ways. For one, seizure data analyzed here do suggest that the analogue generation and supply was substantially reduced in 2019 as reported across all data series analyzed. Similarly, CBP data show substantial variation in synthetic opioids arriving by different modes of transport, with those from air declining sharply in favor of a growing number arriving by land from Mexico. In the remainder of this appendix, the Commission presents summary statistics from these four data sources about various characteristics of the supply of synthetic opioids.

Customs and Border Protection SEACATS

CBP provided the Commission with SEACATS seizure observations containing fentanyl or other synthetic opioids, including fentanyl analogues and other novel series. Data contain observations from July 31, 2014, to December 31, 2020, and include measures on weight, port of entry, mode of transportation, and method of conveyance. Although weight is attached with the seizure event, given that these occur at ports of entry and are unlikely to reflect retail-level events, the analysis here presents trends overall.

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54 STRIDE was replaced by STARLIMS in 2014 as the DEA’s new laboratory drug evidence data system of record. The Commission refers here to STRIDE/STARLIMS collectively as STRIDE because the Commission was given observations from both systems in one data set.
Looking at the data by mode of transportation, the majority of the bulk weight of seizures arrive by land (Table B.4). Approximately 6.8 MT (unadjusted for purity) arrived by land, with an average seizure size of 3.4 kg. Over 2,000 land seizure events occurred during the time period of the data collected. Air-based seizures were second most common, with a much smaller total of weight (unadjusted for purity) at about 560 kg with an average weight at 330 g. The vast majority of observations in the series involved fentanyl, not fentanyl analogues.

Table B.4

CBP Synthetic Opioid Seizures, August 2014–December 2020, by Mode of Transportation

<table>
<thead>
<tr>
<th>Mode of Transport</th>
<th>Seizure Events</th>
<th>Total</th>
<th>Average</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>1,673</td>
<td>556.18</td>
<td>0.33</td>
<td>0.01</td>
<td>0.0001</td>
<td>50.06</td>
</tr>
<tr>
<td>Land</td>
<td>2,050</td>
<td>6,826.93</td>
<td>3.37</td>
<td>0.91</td>
<td>0.0000</td>
<td>137.00</td>
</tr>
<tr>
<td>Other</td>
<td>26</td>
<td>55.20</td>
<td>2.12</td>
<td>0.16</td>
<td>0.0006</td>
<td>21.14</td>
</tr>
</tbody>
</table>


Purity is a key parameter in these seizure events and one that is not collected or reported by CBP. That said, CBP and other federal law enforcement agencies report that there are large purity disparities in seizures arriving from the southwest border (mostly land) and those arriving by air (mostly from the People’s Republic of China [PRC] up until 2019). Land-based seizures coming from Mexico were reported to have purities well below 10 percent, often closer to 5 percent given the detection thresholds of many devices. In contrast, seizures from the PRC are often nearly pure—so pure, in fact, that DEA labs cannot determine a signature profile based on impurities. Therefore, one must consider that bulk weights reported here obscure the true nature of the source of illegally manufactured fentanyl for many of the years analyzed.

In short, bulkier product coming from Mexico is largely of nonfentanyl constituents, such as fillers found in counterfeit tablets, or other impurities, whereas the weight of product coming by air from the PRC is likely to reflect the full weight in fentanyl. Roughly speaking, if one were to adjust the total amounts reported by a factor of 7 percent for land-based seizures and a factor of 95 percent for air-based seizures, then there is considerably less disparity in the amount of purity-adjusted fentanyl arriving by each mode of transportation. In this case, the purity-adjusted amount of fentanyl arriving by land would be closer to 480 kg, whereas air-based seizures would be closer to 530 kg.

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55 CBP, *CBP Strategy to Combat Opioids*, Washington, D.C., March 5, 2019; confirmed by interviewees from CBP.

56 The Commission received indication in early 2022 that the average purity of fentanyl coming across the southwestern border was slightly higher, but the Commission did not have the raw data from which to revise the analysis.

Mode of Transportation

Monthly counts of CBP seizures, shown in Figure B.10, offer a sense of temporal trends in fentanyl and fentanyl analogue seizures by mode of transportation. Analogue seizures are almost all arriving by air, with the number of seizures peaking in early 2018. In contrast, fentanyl seizures arrived by both air and land. The counts of fentanyl seizures arriving by air trended upward until mid-2019, peaking at nearly 150 observations, but declined sharply since then with a small resurgence in the first quarter of 2020, perhaps reflective of COVID-related disruptions. Land-based seizures of fentanyl have continued to rise sharply, having now far surpassed the number of air-based seizures since mid-2020.

Figure B.10
Monthly Counts of CBP Seizures

![Graph showing monthly counts of CBP seizures by mode of transportation. Analogue seizures are almost all arriving by air, with the number of seizures peaking in early 2018. In contrast, fentanyl seizures arrived by both air and land. The counts of fentanyl seizures arriving by air trended upward until mid-2019, peaking at nearly 150 observations, but declined sharply since then with a small resurgence in the first quarter of 2020, perhaps reflective of COVID-related disruptions. Land-based seizures of fentanyl have continued to rise sharply, having now far surpassed the number of air-based seizures since mid-2020.]

Examining weight trends over time shows a similar temporal trend in seizures. In terms of raw weights (i.e., unadjusted for purity) of seizures by mode of transportation over time, shown in Figure B.11, quarterly seizures for land-based events involving fentanyl have risen dramatically since 2020 from nearly 250 kg in the first quarter of that year to nearly 1,500 kg by the last quarter of 2020. The raw weights of air seizures peaked in early 2018, though saw a slight resurgence in 2020. That year, federal law enforcement has noted incidents of air-based seizures arriving to express consignment carriers from Mexico, which suggests efforts by Mexican traffickers to circumvent border restrictions imposed during COVID-19.  

Prior to 2020, there were clearer divisions in originating countries and modes of transport. Seizure totals for analogues are much smaller and show no appreciable trend at this scale. Examination of analogues seizures aggregated by year is reported in greater detail in the following section.

**Figure B.11**

*Total Raw Weight of Seizures, by Quarter*

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**SOURCE:** Analysis of Seized Assets and Case Tracking System (SEACATS) data, 2014–2020 (U.S. Customs and Border Protection [CBP], "SEACATS-Data," metadata updated September 2, 2021), provided to the Commission.

**NOTE:** Q1 = quarter 1. These are raw weights, not adjusted for purity. Law enforcement has noted that land-based seizures are often highly impure.

---

Over time, the distribution of the raw weights of seizures had varied mostly for seizures coming by air. Figure B.12 shows the distribution of seizures of analogues or fentanyl over time by transport mode by year. As shown, there is a downward trend in the median seizure weights. Air seizures declined, but median weights increased in 2020, perhaps due to pandemic-related disruptions that could have restricted some land-based trafficking due to border restrictions.

Overall, land-based seizures report larger weights, which is likely to reflect the nature of their lower purity. The median seizure event by land has declined from multi-kilo seizure events to a median weight of about 1 kg. This decline could reflect a recent trend toward pedestrian seizures and decline in vehicle seizures since the start of the COVID-19 pandemic and ensuing border restrictions. CBP interviewees suggested that fentanyl’s potency could make it ideal for smuggling on persons, which present additional complications for law enforcement detection and screening given the numbers of crossing and the heightened legal requirements for body pat-downs or other invasive screenings.

Figure B.12
Distribution of Raw Seizure Weights over Time


NOTE: Boxes cover the interquartile range of the distribution of raw seizure weights; lines extending outward show the variability outside the upper and lower quartile bounds; dots are the outliers. These are raw weights, not adjusted for purity. Law enforcement has noted that land-based seizures are often highly impure.
Fentanyl Analogues

An analysis of seizures of analogues shows that almost all are coming by air (729) compared to those arriving by land (23). Figure B.13 shows the top ten most prevalent analogue seizures overall by time, which indicates a large jump from 2016 to 2017, with 2018 counts on par with the previous year. The number of seizures dropped dramatically in 2019 and remained low in 2020. Cyclopropyl fentanyl, methoxyacetyl fentanyl, and furanyl fentanyl were the three most-common analogue seizure events.

Figure B.13
Number of Fentanyl Analogue Seizures, by Year

SOURCE: Analysis of Seized Assets and Case Tracking System (SEACATS) data, 2014–2020 (U.S. Customs and Border Protection [CBP], *SEACATS-Data,* metadata updated September 2, 2021), provided to the Commission.
In terms of total weight by analogue seizure, most arrived by air (Figure B.14). Seizures by land peak in 2020 at less than 15 kg in total. For air seizures, 2017 was the peak year with seizure totals greater than 135 kg. That year, a large share of fentanyl analogues were seized. Seizure totals fell substantially in 2018 and continued in the following years. The majority of analogue seizures in 2019 and 2020 were for less common variants, suggesting major sources of more common analogues were less likely to be trafficked or supply of these drugs were drastically reduced. By weight, furanyl fentanyl was the most prevalent analogue seized throughout the time period. A total amount of about 3.6 kg of carfentanil were seized by air. One rather large seizure of carfentanil by land (in a Border Patrol observation) occurred in 2020, which requires more information or validity to determine the true weight or purity of these observation.

Figure B.14
Raw Weights of Fentanyl Analogue Seizures, by Year

NOTE: Weights are not adjusted for purity.
Ports of Entry

Looking at the numbers of seizures over time by port of entry for those containing analogues or fentanyl shows that seizure events for analogues are less frequent overall by quarter than those containing fentanyl. Analogue seizures were most frequent at international mail facilities (IMFs), peaking in early 2018 at nearly 150 events a quarter and declining sharply since (see Figure B.15). Seizure events reported by CBP were grouped with those coming by land at southern ports of entry into a category of “southwest border” to assess the overall nature of that vector. Fentanyl seizures were most frequent for those at the southwest border peaking in early 2020 at close to 400 events. The number of seizures reported by Border Patrol have risen steadily since 2019 (not shown separately but included with those at the southwest border). Fentanyl seizures reported at IMFs peaked at nearly 175 quarterly events in mid-2019 and fell sharply in late 2019, but increased slightly in the first quarter of 2020, perhaps reflecting a COVID-related effect. Since then, IMF seizure events have continued to decline.

Figure B.15
Quarterly Counts of Seizures, by Port of Entry


NOTE: ECC = express consignment courier. IMF = international mail facility. Border Patrol events have been combined with those in the Southwest-border category.
The distribution of seizure events has trended downward for the southwest border, with median bulk weights seized peaking at 10 kg in 2016 (Figure B.16). By 2020 the median weight of seizure events had declined to about 600 g. Since 2016 the median weights of seizures at express consignment carrier (ECC) facilities have remained fairly steady at around 1 kg. The weights of seizures at IMFs—for example, the IMF at JFK International Airport—have typically been the smallest, though the size of median seizure events has declined from the peak in 2017 at about 50 g to about 4 g in 2020.

**Figure B.16**

**Distribution of Raw Seizure Weights, by Port of Entry**

![Figure B.16](image)

**Concealment**

Where possible, CBP data also report the mode of concealment. These events have been recategorized to reflect seizure events reported by mail or parcel, on person, in a vehicle (e.g., car or truck), or other. Observations coded as “other” were not able to be grouped into any logical ordering and include observations labeled as “box,” “not concealed,” “other,” etc. These are lumped together and might not be readily interpretable.
In terms of counts of seizures by concealment method over time, one sees many arriving by mail or parcel, though they have declined since the start of 2020 (Figure B.17). Changes in concealment methods might suggest shifting tactics by traffickers to identify ways to circumvent detection efforts. Seizures involving vehicles and on persons have risen throughout the series with sharp increases in 2020. Overall, vehicle and on-person seizures grew substantially since the beginning of 2019, with the latter jumping sharply in the second quarter of 2020, perhaps reflecting a response by traffickers due to border restrictions imposed by COVID-19. In terms of the breakdown by analogue versus fentanyl, the former was almost exclusively concealed in the mail. Fentanyl comes by mail but also largely by vehicle and on persons (largely pedestrians crossing the border). Over the time period, mail or parcel were the most frequently used concealment methods, accounting for well over 1,500 seizure events, almost all by air. These methods were followed by the nearly 1,000 vehicle seizures all on land. Concealment on a person accounted for just over 500 land-based seizures.

Figure B.17
Quarterly Counts of Seizures, by Concealment Method

NOTE: Q1 = quarter 1.
By weight, fentanyl outweighs analogues, with the largest share of seizures involving vehicles, though there was a large increase in the share of weights reportedly concealed on persons in 2020 (Figure B.18). Again, weight totals are raw and not adjusted for purity. Although pedestrian seizure events are about as frequent as those involving vehicles, vehicle seizures far outpace the total weight of seized fentanyl as a function of raw weights. This difference is largely explained because the median seizure event by vehicle far outweigh those on persons. The distribution in weights by concealment method, reported in Figure B.19, shows that vehicle seizures reported the highest median weight of nearly 2.5 kg. Those seized on a person were closer to 200 g, with mail seizures reporting a median weight of slightly more than 10 g.

Figure B.18
Total Raw Weights, by Concealment Method
Figure B.19
Distribution of Raw Weights, August 2014–December 2020, by Concealment Method


NOTE: Boxes cover the interquartile range of the distribution of raw seizure weights; lines extending outward show the variability outside the upper and lower quartile bounds; dots are the outliers. These weights are raw, not adjusted for purity.
Precursors

CBP SEACATS also included seizure observations involving fentanyl precursors. These seizures occur much less frequently than those involving fentanyl but are analyzed here. Events span March 29, 2016, to December 30, 2020. Precursor seizures mostly involved commercial air transport modes, with over 700 kg seized through this mode of transport (Table B.5). This was followed by express consignment facilities, where over 250 kg were seized. A small share of seizures by mail involved precursors.

Table B.5
CBP Fentanyl Precursor Seizures, August 2014–December 2020, by Mode of Transportation

<table>
<thead>
<tr>
<th>Mode of Transport</th>
<th>Seizure Events</th>
<th>Total</th>
<th>Average</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial air</td>
<td>24</td>
<td>719.22</td>
<td>29.97</td>
<td>21.68</td>
<td>1.03</td>
<td>116.00</td>
</tr>
<tr>
<td>Express consignment</td>
<td>30</td>
<td>251.47</td>
<td>8.38</td>
<td>1.62</td>
<td>0.02</td>
<td>104.30</td>
</tr>
<tr>
<td>Mail</td>
<td>8</td>
<td>19.73</td>
<td>2.47</td>
<td>0.82</td>
<td>0.03</td>
<td>13.00</td>
</tr>
</tbody>
</table>

NOTE: Figures have been rounded to two digits.

Although the number of fentanyl precursor seizures is small each year, there is a trend toward greater complexity in seized precursors. In 2017 and 2018, 4-ANPP was the most commonly seized precursors (Figure B.20). Those chemicals are no longer reported in seizure data; instead, other uncontrolled variants have emerged, starting with 4-AP in 2019, which continued to be seized in 2020. The precursor 4-piperindone has also grown in frequency of seizures. Similar trends toward more seizures as well as variation in the precursor seized are observed when looking at the annual weight totals of seizures (Figure B.21). Seizure totals jumped substantially in 2019 after a few years with relatively low weight counts. By 2019, more than 100 kg of 4-AP were seized—the first year that precursor was reported in SEACATS. Nearly 200 kg of precursors was seized that year. Seizures of 4-AP continued to grow into 2020, as did seizures of 4-piperidinone and 4-anilo-1-Boc-piperidine, which was first reported in 2020. In total, nearly 800 kg of precursors was seized in 2020, many en route via air from the PRC to Mexico.
MARKET TRENDS IN THE DEMAND AND SUPPLY FOR ILLEGALLY SOURCED OPIOIDS

Figure B.20
Number of Seized Fentanyl Precursors, by Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Seizures of 4-anilino-1-Boc-piperidine</th>
<th>Seizures of 4-ANPP</th>
<th>Seizures of 4-AP</th>
<th>Seizures of 4-piperidinone</th>
<th>Seizures of Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2018</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2019</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2020</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

NOTE: 4-ANPP = 4-anilino-N-phenethylpiperidine. 4-AP = 4-anilinopiperidine.

Summary of Customs and Border Protection SEACATS Data

Overall, an examination of CBP SEACATS data show several clear trends in the illegal importation of synthetic opioids to the United States. The trends now favor product coming from Mexico by land, largely by car but also increasingly by pedestrians. IMF and ECC have declined in recent years, though those ports of entry report, in general, purer product inbound from Asia. Seizures arriving at IMF and ECC facilities have declined substantially since about 2019, especially for IMF seizures, which declined both in number and weight. The distribution of seizures at ECCs have remained about the same by weight, though the number have declined.

Seizures of analogues have dropped off substantially, especially since 2019. In contrast, seizures of precursors have continued to rise and become increasingly varied since 2019. Most of those precursor seizures were destined to Mexico. This trend suggests a shift in the sourcing of fentanyl or related inputs. Interviewees have reported that the PRC no longer plays a direct role in the shipping of fentanyl or fentanyl analogues to buyers in the United States but instead is an important source of precursors destined for Mexico. In contrast, Mexican trafficking organizations are increasingly involved in illegal fentanyl manufacture and trafficking, as evidenced by trends in the data.
To underscore this shift, the Commission notes that, prior to 2019, seizures of fentanyl arriving by air from the PRC accounted for about 70 to 80 percent of the pure fentanyl that CBP was seizing. Illegally manufactured fentanyl from Mexico, though bulkier, is highly impure, almost all arriving by land. In 2020, there were some events of Mexican-sourced illegal fentanyl arriving by air to ECC facilities, in some cases in pill form suggesting low purity. Given the shift in 2020, it is challenging to compare the share of pure fentanyl arriving by land or air. Prior to 2020, country of origin and mode of transportation were clearly delineated. Assuming all air-based seizures in 2020 originated from the PRC (which CBP notes is not the case), then that country’s share of fentanyl fell to 40 percent.\(^59\) Again, this estimate is inflated given that Mexican traffickers started utilizing the ECC system in 2020 to send, in some cases, kilograms of fentanyl pressed into counterfeit tablets.

\(^{59}\) In 2020, over 3,330 kg of fentanyl in bulk (unadjusted for purity) were seized at the southwest border. Assuming a purity of 5 percent, this comes to about 167 kg of pure fentanyl. In contrast, the bulk weight of fentanyl seized coming by air to ECC (making up by far the largest share of air-based seizures), international mail facilities, and other air cargo totaled about 120 kg. Assuming a 90-percent purity, which again is unlikely given events originating from Mexico, then about 109 kg of pure fentanyl arrived by air. The Commission received indication in early 2022 that the average purity of fentanyl coming across the southwestern border was slightly higher, but the Commission did not have the raw data from which to revise the analysis.
Drug Enforcement Administration STRIDE/STARLIMS Data

DEA provided the Commission with access to the STRIDE/STARLIMS seizure and undercover-purchase data containing purity, price, and weights of observations containing heroin, fentanyl, or other synthetic opioids, including fentanyl analogues and other novel series. Data contain observations from October 1, 2012, to August 4, 2021. According to DEA, there is a lag, sometimes of up to six months or more, between the time observations are recorded in seizure databases and when the event occurred. This lag reflects the time it takes for the laboratory to process observations and that some cases are sometimes still ongoing. As a result, data could be incomplete for later years as cases and investigations are pending. Data for 2021 are highly incomplete as many observations are missing for these reasons. Data have been cleaned and processed to calculate additional useful measures of interest, such as morphine-milligram equivalent (MME) amounts and merge state observations with their corresponding census region to identify possible geographic variation.

Because DEA observations often include weight measures, one can examine trends for those that are suspected to be retail (less than or equal to 1 gm) versus wholesale. That said, upon review of the seizure data and from discussion with DEA contacts, the STRIDE/STARLIMS seizure data reflects wholesale observations more so than retail-level observations. The median weights for heroin-only observations were close to 14 g while those of fentanyl only were about 10 g. Mean weight for either drug was well above half a kilogram, suggesting that most observations were not for retail events. The heroin drug monitoring program observations, whereby undercover agents would make routine buys of drugs in retail markets, were not included in these data, which could explain the lack of retail events. DEA’s transition from STRIDE to STARLIMS could have reduced some of the measures and records that were relied on to generate some of the purity-adjusted price series.

There are other limitations with using the DEA STRIDE/STARLIMS data. For one, DEA reportedly converted weights to net grams. A closer examination shows that this was not possible for some 300 observations, with reported weight in grams. Comparing the weights to price, these observations are highly suspect (with some single gram observations recording up to $10,000, which suggests that these are improperly recorded). In some cases, purity was above 100, suggesting data entry error. In addition, not all observations reported purity for fentanyl even if present. There were also substantial problems in the naming conventions used for drugs, with fentanyl reported as such or under some other organic chemistry naming convention. Efforts were made to recode these observations, but some observations had to be dropped without more information on how to correct the weights.

Despite the limitations, the Commission has attempted to describe trends in seizure and undercover purchase events over time.

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60 MME is the measure of morphine-equivalent amounts in milligrams. This measure is similar to MED, but instead of measuring analgesic potency in dose, it is measured in weight—in this case, milligrams.
Expansion of Fentanyl

Figure B.22 shows the number of observations that contain various drugs or mixtures of drugs across five categories. The most common in the series are observations containing heroin, without fentanyl or other synthetic opioids. These observations show a sharp decline starting in 2019 after several years of relatively no change. It is not clear if the decline is related in all or part to the data reporting lags mentioned by DEA. That said, the number of fentanyl-only seizures continued to rise year over year through 2020, surpassing heroin-only observations. There was also a noticeable rise in the number of heroin with fentanyl seizures over this period and, to a lesser extent, the number of fentanyl with other synthetic opioid seizures. Events containing heroin with synthetic opioids were very low and have been omitted from most analysis here.

Figure B.22
Seizure Observations in STRIDE/STARLIMS, by Year

Although fentanyl-only seizures have continued to rise through 2020, heroin with fentanyl mixtures declined for the first time that year. It is possible that reporting lags obscure some additional heroin and fentanyl mixtures that occurred that year, but data here and reported in NFLIS suggest that heroin alone and heroin and fentanyl mixtures are declining in favor of fentanyl-only observations. The number of fentanyl only and heroin and fentanyl mixes remained similar from 2014 to 2018, but fentanyl-only seizures rapidly outpaced those of heroin and fentanyl mixtures from 2019 on.
When examining these seizure events across the four census regions in Figure B.23, one can see that heroin seizures declined in the Northeast much earlier than in other regions. In fact, heroin-only seizure observations peaked in 2014 and have declined each year since. By 2020, the numbers of heroin-only seizures in the Northeast had dropped by 85 percent from their peak six years prior. Fentanyl-only observations overtook heroin earlier in this region, starting in 2018, and heroin and fentanyl mixtures in 2020. Similar trends occurred about two years later in other regions. The West reports very few heroin-with-fentanyl observations compared to other regions, which report much higher shares. By 2020, fentanyl-only observations outnumbered those involving heroin only across all four regions.

**Figure B.23**

Seizure Observations in STRIDE/STARLIMS, by Census Region and Year

![Seizure Observations Chart](image)

SOURCE: Analysis of System to Retrieve Information from Drug Evidence (STRIDE) and STARLIMS data, 2013 through the first half of 2021, provided to the Commission.
**Formulation**

DEA data contain measures on formulation but not for all observations and mostly for powders and tablets. As shown in Figure B.24, observations containing fentanyl only are mostly comprised of tablets and powders. Tablets are most prevalent in observations reported as fentanyl only, which could reflect the growing trend toward counterfeit tablets that contain fentanyl. A large segment of heroin-only observations consists of gum or resin as well as rock. Geographic analysis shows that those gum or resin observations are most prevalent in the West, which corresponds to the bifurcation of the national heroin supply, with black and brown tar more common in the western United States and white powder in the East. Heroin and fentanyl mixtures are mostly in powder form.

**Figure B.24**

Seizure Observations in STRIDE/STARLIMS, by Formulation and Year

![Seizure Observations in STRIDE/STARLIMS, by Formulation and Year](chart)

SOURCE: Analysis of System to Retrieve Information from Drug Evidence (STRIDE) and STARLIMS data, 2013 through the first half of 2021, provided to the Commission.
Figure B.25 depicts a subset of seizure events that includes those under 1 g (to assess retail-level observations) across regions and for those containing fentanyl only or heroin and fentanyl mixes. Retail-level seizures are most likely to reflect important changes in drug markets given that purity has the greatest variation, drugs are most often found mixed with other drugs or diluents, and product has been reformulated (e.g., converted to smokable forms, pressed into tablets) for sale to consumers.

Observations show that heroin and fentanyl mixes are largely absent in the West. Again, given the prevalence of gum or tar in the West, dealers might be unable to readily mix powder fentanyl with heroin gums or resin. Instead, a large share of seizures in the West are for tablets consisting of fentanyl only. That said, in the Northeast a growing share of fentanyl-only observations have been found in tablet form. The emergence of tablets out West is of particular concern.

**Figure B.25**

**Observations of Events of No More Than 1 Gram in STRIDE/STARLIMS, by Formulation and Census Region**

Source: Analysis of System to Retrieve Information from Drug Evidence (STRIDE) and STARLIMS data, 2013 through the first half of 2021, provided to the Commission.
Over time, the distribution in raw weights (i.e., not adjusted for purity) in observations less than or equal to 1 g show declining median values for tablets containing fentanyl only (Figure B.26). Early in the time period, median weights for observations ≤1 g declined from nearly 1 g to about 120 mg, or about the weight of a standard pharmaceutical-grade tablet of oxycodone. Moreover, the distribution in raw weight of powder observations of fentanyl only has remained steady since 2018 at around 380 mg. This median weight is relatively close to that of heroin-only powder observations during the same period.

Figure B.26
Distribution of Raw Weights of Events of No More Than 1 Gram of Powder and Tablets, by Year

SOURCE: Analysis of System to Retrieve Information from Drug Evidence (STRIDE) and STARLIMS data, 2013 through the first half of 2021, provided to the Commission.
NOTE: Boxes cover the interquartile range of the distribution of raw seizure weights; lines extending outward show the variability outside the upper and lower quartile bounds; dots are the outliers. Observations are of seizures weighing more than 0.01 g but no more than 1 g.
**Heroin and Fentanyl Mixes**

One important measure to examine is where in the supply chain heroin is being mixed with fentanyl. As shown in the previous section, most heroin and fentanyl mixes are appearing in three of the four census regions. Figure B.27 shows that for heroin seizures, the smaller the raw weight, the greater the share of contamination with synthetic opioids. This trend has increased over time. In seizures under 10 g, about half include synthetic opioids as of 2020. About a third of seizures between 10 and 28.5 g were contaminated with fentanyl. A quarter of heroin observations larger than an ounce reported fentanyl contamination.

As an aside, a very small share of synthetic opioid observations appeared to also contain cocaine. Although DEA did not provide the Commission with the full series of cocaine observations, the data on observations containing synthetic opioids showed that less than 6 percent of seizures in a given year also included cocaine. The peak year, 2019, reported just fewer than 300 synthetic opioid/cocaine observations, almost all of which were in powder formulation.

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**Figure B.27**

**Percentage of Seizures of Heroin Mixed with Fentanyl, by Weight Category**

SOURCE: Analysis of System to Retrieve Information from Drug Evidence (STRIDE) and STARLIMS data, 2013 through the first half of 2021, provided to the Commission.
Morphine Equivalent

The Commission calculated total MME for heroin and fentanyl observations reporting purity measures and weights. This approach is a better way of accounting for purity and weight, factoring the different pharmacological factors of heroin and fentanyl by multiplying purity-adjusted weights by a factor of 3 for heroin and a factor of 50 for fentanyl. Using this measure can offer further apples-to-apples comparisons for examining the trends over time and across drugs. For example, if the median MME over time of a retail drug increases while price remains constant, then buyers are likely to purchase and consume more MME doses. Likewise, by converting measures to MME, the Commission was able to determine the relative prices of observations based on their pharmacological effect and not just weight. This information might matter in the fentanyl era.

Overall, there are 10,721 observations with heroin purity measures for heroin only and 2,150 observations with fentanyl purity measures for fentanyl only. In terms of heroin and fentanyl mixes, 2,308 observations contain purity measures for heroin but not fentanyl, 661 observations contain measures on fentanyl but not heroin, and 193 observations contain measures for both fentanyl purity and heroin purity.

For heroin and fentanyl mixes, the Commission added the total combined MME if purity for both drugs are reported; otherwise, it reports the MME content for just heroin or fentanyl. There were too few tablet observations, so analyses mostly reflect an examination of powder observations. This effort cannot account for the MME of other opioids, especially novel synthetic opioids of which little is known about their pharmacological properties. Nonetheless, by using a 50-MME conversion factor for fentanyl, the Commission is taking a conservative approach to adjusting for units of morphine.
Figure B.28 shows the quarterly distribution in MME across the three drug categories for the entire time period. Overall, there is an upward trend in total MME across the three drugs. The MME in fentanyl-only observations rose from 5.4 g in mid-2016 to over 15 g by the end of 2020. For heroin and fentanyl mixtures, MME rose from just over 1 g to 2.8 g over the same period. For heroin-only observations, MME rose from 4.7 g to nearly 12 g from mid-2016 to the last quarter of 2020. Fentanyl-only observations reported the most increase in MME and fentanyl/heroin mixtures the least, but these results could have occurred because these observations reflect the entire time period.

**Figure B.28**
Quarterly Distribution of Morphine-Milligram-Equivalent Totals, by Drug

SOURCE: Analysis of System to Retrieve Information from Drug Evidence (STRIDE) and STARLIMS data, 2013 through the first half of 2021, provided to the Commission.

NOTE: Q1 = quarter 1. Boxes cover the interquartile range of the distribution of raw seizure weights; lines extending outward show the variability outside the upper and lower quartile bounds; dots are the outliers. Observations are of seizures weighing more than 0.01 g. The data have been converted to morphine-milligram equivalents (MMEs) using a factor of 3 for heroin and of 50 for fentanyl.
Restricting the analysis to retail observations ≤1 g shows a similar trend across three drug categories, with fentanyl-only observations reporting the highest MME content. Figure B.29 shows the quarterly trend line of median MME concentrations for the three drug mixtures in log-scale. Heroin-only observations (green) report the most consistency in median MME over time. DEA’s analysis reported in the Fentanyl Signature Profiling reports, which samples a subset of observations for more-robust analysis, shows a similar upward trend in the purity of powder observations, rising from 5.3 percent to 8.7 percent between 2017 and 2019.

Figure B.29
Quarterly Median Morphine-Equivalent Grams, by Drug

SOURCE: Analysis of System to Retrieve Information from Drug Evidence (STRIDE) and STARLIMS data, 2013 through the first half of 2021, provided to the Commission.

NOTE: Observations are of seizures no more than 1 g in raw weight. The data have been converted to morphine-milligram equivalents (MMEs) using a factor of 3 for heroin and of 50 for fentanyl.
There is a positive clear relationship in observations for weight and price. This holds for calculated MME as well, with products containing more suspected MME valued more. When considering the share of MME in heroin and fentanyl mixtures consisting of fentanyl, Figure B.30 shows that fentanyl observations were less expensive in the amount of MME in an event. Here, observations below the fitted line are relatively cheaper, on average, per unit of MME; those above are more expensive. As shown, the majority of observations where a greater share of the MME was comprised by fentanyl were well below the fitted line. That said, one limitation to the interpretation below is that fentanyl’s MME might not be 50. An MME of less than 50 would suggest a smaller difference in cost per unit of morphine equivalent while an MME greater than 50 would suggest much less cost per unit of morphine.

**Figure B.30**
Morphine-Equivalent Units and Prices for Heroin and Fentanyl Mixtures

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SOURCE: Analysis of System to Retrieve Information from Drug Evidence (STRIDE) and STARLIMS data, 2013 through the first half of 2021, provided to the Commission.

NOTE: MME = morphine-milligram equivalent. It is possible that fentanyl’s MME is less (or more) than 50, which could change the true cost in terms of analgesic dose. Observations are of seizures of at least $1 in value and 0.01 g in raw weight. The data have been converted to MMEs using a factor of 3 for heroin and of 50 for fentanyl.
**Insights About Fentanyl Powder Prices**

There is little information about the price for illegally produced fentanyl in the United States and almost nothing about price trends. Using data from the DEA’s STRIDE/STARLIMS database, the Commission was able to analyze the prices paid for fentanyl powder at different market levels and how they have changed over time. Although the Commission does not have enough information to say anything definitive about retail prices (i.e., purchases involving up to 1 gram of powder containing some fentanyl), analyses of purchases of 10 to 100 grams suggest that prices declined from 2017 to 2020, possibly on the order of 50 percent; however, this decline appears to be largely driven by purchases made in the Northeast.

There are 2,299 observations with fentanyl powder as the primary drug with information on purity and price. Of these, 703 list fentanyl as the only substance in the event. Since none of these observations have a purity level of 100 percent, other powders were included in these purchases but not reported. Of the remaining 1,596 observations, most of the other powders were substances that could affect the level of intoxication and price (e.g., fentanyl analogues, tramadol). There were 484 observations that included other powders, but the Commission did not believe that they would have much of an effect on intoxication or price.\(^61\)

Because the Commission was interested in understanding the price of fentanyl powder, it focused on the 703 observations where fentanyl powder is the only substance and the 484 where the other substances are filler (\(n = 1,187\)). This series does not really pick up until 2016, and the vast majority of observations are >1 g to 100 g (Table B.6). Slightly more than 50 percent of the sample is from the Northeast, about 30 percent from the South, about 14 percent from the Midwest, and about 5 percent are from the West. Given the geography of fentanyl overdose deaths, this is not surprising. In terms of distribution by state, almost 50 percent of these observations come from five states: Connecticut, Maryland, Massachusetts, New York, and West Virginia.

### Table B.6

<table>
<thead>
<tr>
<th>Year</th>
<th>0–≤1</th>
<th>&gt;1–≤10</th>
<th>&gt;10–≤100</th>
<th>&gt;100</th>
<th>Percentage Change Across Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>6</td>
<td>13</td>
<td>1</td>
<td>0</td>
<td>1.7</td>
</tr>
<tr>
<td>2015</td>
<td>0</td>
<td>15</td>
<td>3</td>
<td>1</td>
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<td>7</td>
<td>37</td>
<td>35</td>
<td>3</td>
<td>6.9</td>
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<td>2018</td>
<td>26</td>
<td>82</td>
<td>100</td>
<td>11</td>
<td>18.5</td>
</tr>
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<td>2019</td>
<td>30</td>
<td>153</td>
<td>107</td>
<td>25</td>
<td>26.5</td>
</tr>
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<td>2020</td>
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<td>9.3</td>
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<td>10.2</td>
<td>42.5</td>
<td>41.5</td>
<td>5.9</td>
<td></td>
</tr>
</tbody>
</table>

SOURCE: DEA STRIDE/STARLIMS data provided to the Commission.

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\(^{61}\) Acetaminophen; aminopyrine; caffeine; chlorpheniramine, salt undetermined; dimethyl sulfone; diphenhydramine, salt undetermined; dipyrone; ibuprofen; naproxen, salt undetermined; niacinamide; phenacetin; and quinine, salt undetermined.
Purity by distribution level. Table B.7 presents a summary of the purity of fentanyl purchases by distribution level: 0.1 g to ≤1 g, >1 g to ≤10 g, >10 g to ≤100 g, and more than 100 g. The purity figures are interesting in that the mean values do not really change until the largest-size purchases: the means range from roughly 3.4 percent to 3.8 percent for the first three distribution levels and jump to over 6 percent for the purchases over 100 g. One should not put too much stock in this difference, however, given that the sample size for this largest weight category is only 70. The more important observation is how low the purity values are across all quantity levels.

Table B.7
Summary of the Purity of Fentanyl Purchases, by Distribution Level

<table>
<thead>
<tr>
<th>Raw Weight, in Grams</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>25th Percentile</th>
<th>50th Percentile</th>
<th>75th Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤1</td>
<td>121</td>
<td>3.78</td>
<td>2.68</td>
<td>1.9</td>
<td>3</td>
<td>4.4</td>
</tr>
<tr>
<td>&gt;1–≤10</td>
<td>504</td>
<td>3.35</td>
<td>3.27</td>
<td>1.4</td>
<td>2.4</td>
<td>4</td>
</tr>
<tr>
<td>&gt;10–≤100</td>
<td>492</td>
<td>3.72</td>
<td>4.23</td>
<td>1.0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>&gt;100</td>
<td>70</td>
<td>6.33</td>
<td>5.46</td>
<td>1.1</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

SOURCE: STRIDE/STARLIMS data provided to the Commission.

Assessing the purity-adjusted prices. When considering the price of fentanyl (or any other drug), it is important to consider purity. A “dime bag” of a white powder purported to be fentanyl tends to always be $10 (hence, “dime”), but the amount of fentanyl in that bag can change over time as market conditions change. Thus, for assessing trends over time and across location, it is best to think about how much people are paying for the pure amount of the drug in that bag.

The Commission does not have enough observations to apply the expected purity hypothesis method used to generate purity-adjusted prices for fentanyl, especially at different levels of the market. Indeed, with that model, the analysts would not estimate trends at the metropolitan statistical area (MSA) level unless it had at least 35 observations from an MSA; in this fentanyl powder subset of the data, the Commission had only 11 states with 35+ observations. Only three states have observations in the >1 g to ≤10 g group. For >10 g to ≤100 g, there is only one state with more than 35 observations: Massachusetts, with 165 observations (one-third of the total for that quantity level).

The Commission instead offers insights from three different approaches:

1. dividing the purchase price by the number of pure grams of fentanyl in the purchase for each observation and then presenting the descriptive statistics, by year and quantity level
2. calculating the ratio of the total amount spent on packages with fentanyl powder to the total amount of pure fentanyl purchased, by year and quantity level
3. using a regression-based approach that used the purchase price as the dependent variable, by quantity level.

The Commission focused on 2017–2020, given the small number of observations for the other years (and the 2021 data cover only part of the year). To reduce the role of outliers, the Commission limited the analysis to observations with purity ranging from 0.5 percent to 10 percent, which roughly corresponds to the 5th and 95th percentiles for purity for both of the distribution levels (see Table B.8). The Commission also dropped two clear outliers with real price per pure gram >$180,000.
Table B.8

Real Price per Gram of Pure Fentanyl Powder, in 2021 Dollars

<table>
<thead>
<tr>
<th>Weight, in Grams</th>
<th>Statistic</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1 to ≤10</td>
<td>N</td>
<td>59</td>
<td>79</td>
<td>149</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>6,871</td>
<td>5,154</td>
<td>4,300</td>
<td>4,262</td>
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<tr>
<td></td>
<td>25th percentile</td>
<td>3,661</td>
<td>2,705</td>
<td>1,675</td>
<td>1,516</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>5,466</td>
<td>4,099</td>
<td>3,228</td>
<td>3,121</td>
</tr>
<tr>
<td></td>
<td>75th percentile</td>
<td>8,552</td>
<td>6,483</td>
<td>4,737</td>
<td>5,662</td>
</tr>
<tr>
<td>&gt;10 to ≤100</td>
<td>N</td>
<td>71</td>
<td>89</td>
<td>100</td>
<td>107</td>
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<tr>
<td></td>
<td>Mean</td>
<td>4,255</td>
<td>3,597</td>
<td>3,266</td>
<td>2,649</td>
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<tr>
<td></td>
<td>25th percentile</td>
<td>2,159</td>
<td>1,648</td>
<td>1,225</td>
<td>1,137</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>3,678</td>
<td>2,735</td>
<td>2,070</td>
<td>1,921</td>
</tr>
<tr>
<td></td>
<td>75th percentile</td>
<td>5,463</td>
<td>4,484</td>
<td>3,728</td>
<td>3,381</td>
</tr>
</tbody>
</table>

SOURCE: STRIDE/STARLIMS data provided to the Commission.

Approach 1. The Commission began by looking at the price per pure gram within the Commission’s two main categories: (1) >1 g to ≤10 g and (2) >10 g to ≤100 g. Table B.8 shows the prices for the former are higher than the latter, which is consistent with prices getting higher as one moves down the supply chain. Focusing on the median to reduce the impact of outliers, the median price paid declines by 43 percent for purchases >1 g to ≤10 g and by 48 percent for purchases >10 g to ≤100 g. However, readers should be careful about drawing strong inferences from this table since it does not account for other factors that could influence the price paid (e.g., location).

Approach 2. Another approach for generating purity-adjusted price information is to divide the total amount spent on packages with fentanyl powder by the total amount of pure fentanyl purchased, by year and within each quantity category. This is the equivalent of weighting each observation by the number of pure grams in it, rather than weighting each observation equally. Table B.9 presents these results.

Table B.9

Total Expenditures/Total Pure Grams of Fentanyl, in 2021 Dollars, by Year and Quantity Level

<table>
<thead>
<tr>
<th>Weight, in Grams</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1 to ≤10</td>
<td>4,693</td>
<td>3,634</td>
<td>2,843</td>
<td>3,315</td>
</tr>
<tr>
<td></td>
<td>N = 59</td>
<td>N = 79</td>
<td>N = 149</td>
<td>N = 79</td>
</tr>
<tr>
<td>&gt;10 to ≤100</td>
<td>1,993</td>
<td>1,905</td>
<td>1,710</td>
<td>1,565</td>
</tr>
<tr>
<td></td>
<td>N = 71</td>
<td>N = 89</td>
<td>N = 100</td>
<td>N = 107</td>
</tr>
</tbody>
</table>

SOURCE: STRIDE/STARLIMS data provided to the Commission.

Unlike the previous approach, this method does not suggest the price has declined every year for the >1 g to ≤10 g group. Although one does see a steady decline for each year for the >10 g to ≤100 g level, the decrease is not as large as previously reported (here, it is closer to a 20-percent decline). Once again, the values for >1 g to ≤10 g are higher than they are for >10 g to ≤100 g, hovering around a factor of two, depending on the year.
Approach 3. The previous two approaches do not account for the fact that there could be something special about the cities where these purchases take place that could be influencing these prices. To get more insight into this, the Commission estimated models in which it controlled for the time-invariant factors specific to each city (i.e., city-level fixed effects). The Commission used a log-linear model:

$$\log(\text{RealTotalPrice}_{iyqc}) = \beta_0 + \beta_1 [(\log(\text{TotalRawWeight}_{iyqc}) + \log(\text{PctFentanyl}_{iycq})) + \beta_2 \text{FillFlag}_{iycq} + \alpha_y + \alpha_q + \alpha_c + \varepsilon_{iyqc},$$

where RealTotalPrice is the natural log of the inflation-adjusted price (in 2021 dollars) for purchase i in year y in quarter q in city c. As done in previous approaches to estimating purity-adjusted prices, the Commission operationalized pure grams of fentanyl as the sum of the natural log of the total raw weight of the purchase, TotalRawWeight, and the natural log of the purity of fentanyl in the purchase, PctFentanyl. The Commission also included an indicator variable, FillFlag, which equals 1 if DEA reports other powders in the package that is purchased. The models include year, quarter, and city-level effects (\(\alpha_y, \alpha_q, \text{and } \alpha_c\), respectively). The following tables show only the regression outputs \(\beta_1\) and \(\beta_2\) and the year fixed effects. Unless noted, all models cluster the standard errors at city level.

Table B.10 presents the regression results separately for the >1 g to \(\leq 10\) g (panel A) and >10 g to \(\leq 100\) g (panel B) categories. Focusing on the year coefficients (which are compared to 2017), they are all negative in panel A, but none is statistically significant at the 0.05 level. In contrast, the coefficients for 2019 and 2020 in panel B are negative and much more precise. The \(-0.63\) coefficient on the 2020 dummy variable suggests that, holding all other factors equal, the purchase prices in 2020 were 47 percent lower than they were in 2017 \([-47 = 100^* (\exp(-0.6328492) – 1)]\).

Then the Commission ran the models separately for the Northeast and the other three regions combined (Table B.11). Whereas the coefficient on 2020 in the model focused on the Northeast (panel A) is similar to what is in Table B.10, the coefficient is negative but nowhere close to statistical significance in the model focused on the other three regions (panel B). This suggests that much of the decrease observed is being driven by the purchases made in the Northeast.

Table B.10
Regression Results for the Entire Country, 2017–2020, by Quantity Level

| Variable | Coefficient | Robust Standard Error | T | P<|t| | 95% Confidence Interval |
|----------|-------------|-----------------------|---|----|------------------------|
| Panel A: >1 g to \(\leq 10\) g | | | | | |
| pureqty | 0.567878 | 0.1031023 | 5.51 | 0.000 | 0.364 | 0.771 |
| justfill | –0.0278039 | 0.1552287 | –0.18 | 0.858 | –0.334 | 0.278 |
| year 2018 | –0.3212422 | 0.2789751 | –1.15 | 0.251 | –0.872 | 0.229 |
| 2019 | –0.3392734 | 0.2503076 | –1.36 | 0.177 | –0.833 | 0.155 |
| 2020 | –0.5876465 | 0.3043752 | –1.93 | 0.055 | –1.188 | 0.0128 |
### Table B.11
Regression Results, by Quantity Level and Region

| Variable | Coefficient | Robust Standard Error | T     | P>|t|  | 95% Confidence Interval |
|----------|-------------|-----------------------|-------|------|--------------------------|
| **Panel A: >10 g to ≤100 g, Northeast region only** | | | | | |
| pureqty  | 0.532437    | 0.0453982             | 11.73 | 0.000 | 0.442                     | 0.623                     |
| justfill | –0.0223427  | 0.1044291             | –0.21 | 0.831 | –0.230                    | 0.186                     |
| year     |             |                       |       |      |                          |                          |
| 2018     | –0.0809897  | 0.0778966             | –1.04 | 0.302 | –0.236                    | 0.074                     |
| 2019     | –0.4306498  | 0.0933506             | –4.61 | 0.000 | –0.616                    | –0.245                    |
| 2020     | –0.6528422  | 0.1884235             | –3.46 | 0.001 | –1.028                    | –0.278                    |
| **Panel B: >10 g to ≤100 g, excluding the Northeast region** | | | | | |
| pureqty  | 0.4503924   | 0.170567              | 2.64  | 0.010 | 0.112                     | 0.789                     |
| justfill | –0.2285117  | 0.2304936             | –0.99 | 0.324 | –0.686                    | 0.229                     |
| year     |             |                       |       |      |                          |                          |
| 2018     | 0.1608502   | 0.5037527             | 0.32  | 0.750 | –0.840                    | 1.161                     |
| 2019     | –0.2634502  | 0.4615764             | –0.57 | 0.570 | –1.180                    | 0.653                     |
| 2020     | –0.3907431  | 0.7152133             | –0.55 | 0.586 | –1.811                    | 1.030                     |

**SOURCE:** STRIDE/STRLIMS data provided to the Commission.

**NOTES:** Log of price (lprice) is the dependent variable.

- For linear regression, observations = 366; F(7, 187) = null; Prob > F = null; $R^2 = 0.7207$; root MSE = 0.71753; standard error adjusted for 188 clusters in citynum.
- For linear regression, observations = 367; F(7, 172) = null; Prob > F = null; $R^2 = 0.8346$; root MSE = 0.43302; standard error adjusted for 173 clusters in citynum.
Limitations. As noted previously, standard approaches for assessing the purity-adjusted prices of illegally sold drugs cannot be applied here because of the small samples. Assuming the number of fentanyl purchases reported to STRIDE/STARLIMS increases over time, it might be possible to apply the expected purity hypothesis on fentanyl-only purchases in the future. As for purchases involving fentanyl and other intoxicating substances (e.g., heroin), the expected-purity-hypothesis method will need to be adapted or reconsidered.

The Commission also learned from DEA that the data extract analyzed might not have all the retail purchases that were reported in STRIDE/STARLIMS. Although the Commission does not put much focus on retail transactions in this analysis (because the sample sizes were so low), it could be possible to learn more about prices at this level if more data are made available.

Finally, it would be possible to estimate more sophisticated models to account for the skewness in the real price paid per pure gram. The Commission’s approach of taking the natural log to address this is not controversial, but other approaches could be more useful when trying to generate the predicted prices. More could also be done with respect to addressing outliers, but for the purposes of this analysis, limiting the focus on observations with purity ranging from 0.5 percent to 10 percent helps us rule out that the findings are driven by extremely large or small values.

Summary of Drug Enforcement Administration STRIDE/STARLIMS Data

The STRIDE/STARLIMS data series report that fentanyl-involved observations are largely overtaking heroin observations. This result varies by region, with the Northeast largely free of heroin-involved seizures for quite some time. Other census regions report declines in heroin observations with growing fentanyl observations. The West shows little heroin and fentanyl mixtures, perhaps due to the prevalence of tar or gumlike mixtures of heroin found in that part of the country. That said, there is a large number of observations of tablets containing fentanyl in the West.

The distribution of weights of fentanyl observations appears to be holding steady, but total morphine-equivalent grams are increasing in recent years. This increase largely coincides with DEA’s Fentanyl Signature Profile reports that show average purities rising from 5 to 9 percent between 2017 and 2019. A closer examination of heroin and fentanyl observations show that morphine-equivalent units are cheaper per dollar in observations where fentanyl comprises a greater share of MME.

Drug Enforcement Administration’s NFLIS

In August 2021, DEA provided the Commission a series of observations for heroin and synthetic opioid drug exhibit events recorded in NFLIS. These data are of individual event-level observations of drug exhibits generated each time a submission of a drug or sample is sent to a state or local laboratory for analysis. Most of these involved law enforcement–generated events, though some included blood samples, presumably from medical examiners’ offices. Most state labs report these individual events to NFLIS. Observations span between January 1, 2013, to December 31, 2020. There is some overlap in what is reported in STRIDE and what is reported in NFLIS, but the latter is a much larger convenience sample with about 20 times the numbers of observations containing heroin or synthetic opioids.

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62 Recorded events can include seizures, undercover buys, samples submitted to the lab from a medical examiner, or whenever law enforcement happens upon a drug.
The majority of events (approximately two-thirds of observations) in NFLIS would be considered retail level with weights less than 1 g. Thus, pairing the STRIDE/STARLIMS data with NFLIS should render a more complete picture of markets. Analysis here examines aspects of the full data series, with greater detail on observations that are ≤1 g.

These data allow for an examination of markets in transition. Data contain information on date of submission, state of submission, purity (if reported and for only the primary drug, though many values are missing), quantity, unit of measurement (e.g., grams, milliliters, or units), formulation (if reported, generally powder or tablets, though many are missing) and drugs reported in event. Extensive efforts were made to recategorize and collapse formulation into logical groupings and to calculate weight in grams. Observations not reporting any weight, weights with values of 0, or those that did not contain heroin, fentanyl, fentanyl-related compounds, or other novel synthetic opioids were dropped from some of the analyses the Commission conducted. This analysis includes about a million observations containing a drug of interest and report a weight greater than 0 g.

Analyses using NFLIS data are subject to several limitations. For one, the dates on observations are those submitted to the lab and not necessarily the date in which the seizure occurred. The Commission has been told that there is generally a six-month lag between when seizures take place and when they are analyzed by forensic labs and recorded in NFLIS, yet that time period varies by lab and jurisdiction. The majority of weight measures are reported in grams for powders, but this is not necessarily the case for nonpowder formulations, which are most commonly reported in units. Without knowing the average weight of a unit in these formulations, it is impossible to evaluate weight-based trends for many observations reported in tablet form.

Per discussion with those who manage the NFLIS database, the raw gross weights are reported in these data. These weights most often include the packaging and wrapping of drugs, and thus true weights of seizure observations are likely to be slightly smaller. There is also considerable missingness for measures of observations, with few observations reporting purity and many weight observations recorded as zero. It is also unclear what each observation truly represents. NFLIS managers explained to us that these data are submitted to NFLIS from state and local laboratories, so there could be considerable variation in sampling protocols or recording methods. For example, a single observation of a large seizure could be sampled, analyzed, and submitted rather than the full weight of the seizure event. In other cases, a seizure event might lead to multiple drug analyses if multiple drugs were encountered, thus elevating the counts of observations in a given time and place. Further, the reporting and sampling protocols might vary by jurisdiction or lab, further complicating an understanding of the data. For example, the Commission was told that for some jurisdictions, if an offender pleads guilty to the charge, that seizure event is not recorded by the lab and thus not reported to NFLIS.

COVID-19 and the subsequent physical-distancing requirements are likely to have affected data collection for 2020. Records show fewer observations toward the end of the series, which could bias measures for that year.

Counts over Time

Table B.12 shows the raw number of NFLIS observations by drug and year. These observations contain instances of heroin, fentanyl, fentanyl-related compounds, or novel synthetic opioids (i.e., synthetics that are not structurally related to fentanyl) irrespective of other drugs reported in observations. NFLIS managers also submitted tramadol observations to the Commission, which have been removed unless they contain the aforementioned types of drugs. Although fentanyl dominates the synthetic opioid observations, the Commission has combined fentanyl with fentanyl analogues (or fentanyl-related substances) and other nonfentanyl synthetic opioids into the category of synthetic opioids for analyses here.
### Table B.12
Number of NFLIS Observations Containing Heroin or Synthetic Opioids, by Drug and Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Heroin</th>
<th>Fentanyl</th>
<th>Fentanyl-Related Compound</th>
<th>Novel Synthetic Opioid</th>
<th>Cocaine</th>
<th>Methamphetamine</th>
<th>Sedatives</th>
<th>Cannabis</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>149,061</td>
<td>1,156</td>
<td>12</td>
<td>4</td>
<td>1,562</td>
<td>516</td>
<td>52</td>
<td>182</td>
</tr>
<tr>
<td>2014</td>
<td>166,718</td>
<td>6,961</td>
<td>89</td>
<td>6</td>
<td>1,625</td>
<td>693</td>
<td>42</td>
<td>141</td>
</tr>
<tr>
<td>2015</td>
<td>179,352</td>
<td>19,654</td>
<td>3,392</td>
<td>5</td>
<td>2,324</td>
<td>1,312</td>
<td>110</td>
<td>200</td>
</tr>
<tr>
<td>2016</td>
<td>185,117</td>
<td>46,803</td>
<td>10,527</td>
<td>1,014</td>
<td>3,944</td>
<td>2,165</td>
<td>311</td>
<td>246</td>
</tr>
<tr>
<td>2017</td>
<td>186,572</td>
<td>84,449</td>
<td>32,356</td>
<td>4,798</td>
<td>6,362</td>
<td>3,441</td>
<td>438</td>
<td>277</td>
</tr>
<tr>
<td>2018</td>
<td>179,920</td>
<td>127,467</td>
<td>26,994</td>
<td>1,431</td>
<td>7,181</td>
<td>3,897</td>
<td>377</td>
<td>444</td>
</tr>
<tr>
<td>2019</td>
<td>172,017</td>
<td>152,593</td>
<td>38,351</td>
<td>503</td>
<td>7,233</td>
<td>5,913</td>
<td>1,034</td>
<td>541</td>
</tr>
<tr>
<td>2020</td>
<td>119,366</td>
<td>149,336</td>
<td>15,013</td>
<td>625</td>
<td>4,748</td>
<td>5,228</td>
<td>1,926</td>
<td>281</td>
</tr>
</tbody>
</table>


NOTE: Full series reported even if weights were not reported. Drug counts contain heroin, fentanyl, fentanyl-related compounds, or other novel synthetic opioids and might not be exclusive across drug categories.

The data shown in the table are not mutually exclusive and numbers for 2020 were likely affected by COVID-19’s disruption to law enforcement and drug markets. However, there is an inverse relationship between heroin and fentanyl observations, with heroin observations peaking in 2017 and declining each year since. Overall, fentanyl observations continue to rise throughout the time period, though reported a slight decline in 2020 from the peak the previous year. Fentanyl-related compounds peaked in 2019 and declined substantially in the following year. Novel synthetic opioid observations peaked in 2017 and declined substantially in following years. Observations also containing cocaine or methamphetamine rose over much of this period, peaking in 2019. Observations containing sedatives (mostly benzodiazepines) have continued to rise throughout the series, reporting the highest numbers in 2020. Very few observations also contained cannabis.

Because not all observations are reported in gram weights, the Commission has included the full set of observations to examine trends over time before looking more closely at retail-level observations (i.e., those less than or equal to 1 g) that are reported by weights. Observations reported in tablet form are often not reported in weights, so the analysis here might skew toward powder observations. As shown in Figure B.31, the numbers of heroin-only observations show a downward trend with quarterly counts declining by two-thirds from late 2015 until the end of 2020. In contrast, there is a growing number of observations containing synthetic opioids (fentanyl, fentanyl-related compounds, or other novel synthetic opioids), including those containing mixtures with heroin. This trend largely resembles that shown in Figure B.22 from STRIDE/STARLIMS.

Synthetic opioid observations continued to rise throughout this time period (though quarterly counts decline around the time COVID-19 arrives), though counts have risen since mid-2020. Again, reporting delays in lab submissions could have been affected by COVID-19. The decline in observations occurring in late 2019 might reflect lags in processing during the first two quarters of 2020 when COVID arrived. The subsequent jump in observations in the third quarter of 2020 might reflect labs reporting backlogged events that were generated much earlier.
By mid-2019, roughly equal amounts of observations contained synthetic opioids and heroin. Synthetic opioid observations overtook heroin observations (not including heroin/synthetic opioid mixes) by the beginning of 2020. By the end of 2020, heroin-only and heroin/synthetic opioid observations were about equal.

**Fentanyl’s Arrival, by State**

From the previous discussion, it is fairly clear that the presence of synthetic opioids started to rise dramatically around 2013–2014. That said, the large growth in opioid seizures were observed in 2017 and later. The Commission explored where observations started appearing first. Figure B.32 shows the per capita (100,000) observations of heroin and synthetic opioid mixes and synthetic opioid–only observations. Heroin observations are excluded to visualize the growth in synthetic opioids over time. Population counts by state were obtained from the U.S. census for year 2016. Here, seizure counts are not restricted on weight and include all observations where synthetic opioids are detected both alone and mixed with heroin.
Synthetic opioid events first arrived east of the Mississippi River, most sharply in New England and parts of Appalachia. Since then, observations of synthetic opioids have largely remained geographically concentrated with a few exceptions. Seizures of synthetic opioids show a rise out west, but most prominently in Arizona, which now shows per capita rates that are near those for some states in the Midatlantic, including West Virginia, Virginia, and Maryland.

Ohio, parts of the Midatlantic, and New England show some of the highest rates of seizures for synthetic opioids. New Jersey stands out for having a large majority of synthetic opioid observations mixed with heroin. In contrast, most other states that report large per capita rates of synthetic opioids are not mixed with heroin. For example, in New England there are very little shares of synthetic opioids mixed with heroin. There remains a sizable share of synthetic opioid observations that contain heroin in Pennsylvania, Ohio, and Kentucky.

Examining a handful of states closely reveals a noticeable decline in the counts of heroin-only observations for all states. Figure B.33 shows trends for nine selected states that have been acutely affected by synthetic opioids as reported in drug overdose death data. Synthetic opioids arrived earliest in New Hampshire, almost immediately overtaking heroin and have grown ever since. Heroin observations in New Hampshire are almost nonexistent since

mid-2019. Heroin and synthetic opioid mixed seizure events have also trended down over time in favor of observations containing just synthetic opioids, such as fentanyl.

Figure B.33
Quarterly Seizure Observations per 100,000 Population for Heroin and Synthetic Opioids for Selected States

Other states show a similar inverse relationship but occurring later. Synthetic opioid observations overtook heroin in mid-2017 in Ohio, with the state retaining a sizable share of heroin/synthetic opioid seizures. Synthetic opioid–only seizures grew in 2020, while those also containing heroin fell. Maryland shows a similar trend, with synthetic opioid–only seizures overtaking heroin in the beginning of 2018 and heroin and synthetic opioid mixed observations later that year. New Jersey and Pennsylvania’s heroin supply continues to be highly penetrated by synthetic opioids, though synthetic opioid–only seizures have continued to rise in the last two years of the time period.

Last, Arizona, the only state in the figure west of the Mississippi River, shows that synthetic opioid seizure events overtook heroin in mid-2019, rising sharply since then. Unlike other states, there are very small counts of heroin
and synthetic opioid mixed seizures—a likely reflection of the fact that heroin sold in the western United States is largely of gum or tar consistency and thus harder to mix with powder fentanyl.

**Formulations**

An examination of formulations, or how the drug is formulated for sale (e.g., tablet, powder), shows other trends in supply. Here, observations are restricted to those that report certain formula criteria. As shown in Figure B.34, the vast majority of observations for all three categories of mixtures are for powder. Heroin and synthetic opioid mixtures largely involved powder, but a larger portion of synthetic opioid–only observations contained tablets or capsules. These results suggest that powder fentanyl is most commonly mixed with powder heroin while tablets and capsule formulations are more common for observations of synthetic opioids without heroin.

There appears to be a strong relationship with powder heroin and synthetic opioid mixes in every census region except the West. In contrast, the West shows a large number of tablet seizures for the full seizure set. Again, given the limitations of NFLIS reporting, it is unclear if tablet seizures, even when reported in gram weights, are truly encountered at retail or were samples of larger seizures but recorded with retail-level weights. For example, law enforcement seizes a large packet of counterfeit pills in Phoenix, Arizona, meant for wholesale out of state, but a couple of pills were sampled and analyzed at the lab, which records the observation weight of the sampled pills and not the full seizure event.

**Figure B.34**

*Quarterly Seizure Observations, by Drug and Formulation*

![Chart showing quarterly seizure observations for heroin, heroin/synthetic opioid mix, and synthetic opioid.](chart)

**NOTE:** Q1 = quarter 1.
Restricting the observations to those events reported in gram weights between 0 and 1 grams (i.e., those most likely to be retail) shows a substantial rise in the number of synthetic opioid tablet observations across all regions but most noticeably in the Midwest and West. Retail seizures incorporate broader insights about changing markets (i.e., where purities are at greatest variation, where mixtures with other drugs, different formulations, etc.). As Figure B.35 shows, in the West, tablet observations make up the majority of the observations. However, because observations reported in units are removed, this restricted data set might undercount the true nature of the tablet phenomenon.

Figure B.35
Census Region Seizure Observations of No More Than 1 Gram, per 100,000 People, by Drug and Formulation

NOTE: Observations include only seizures of 1 g or less.
**Purity and Weights at the Retail Level**

Focusing on events involving drug quantities of less than or equal to 1 gram for heroin and other synthetic opioids can show trends in reported purity and weights across different drug mixtures for observations at the retail level. The purity measures shown in Figure B.36 were reported on the primary drug of analysis. Again, most observations involve heroin (n = 5,842); fewer observations involved mixtures (n = 255) with slightly more for just synthetic opioids (n = 389). The low numbers of non-heroin observations could bias purity measures, though the trends shown in the figure suggest that purity measures for heroin and synthetic opioid mixtures might actually reflect synthetic opioid measures more than heroin given how close they are to synthetic opioid purity measures. Last, observations are for those where weight is reported in grams, so tablet observations reported in weights other than grams have been dropped.

**Figure B.36**

*Median and Mean Purity for Observations of No More Than 1 Gram, by Drug*

Nonetheless, purity measures for heroin-only observations were higher than those involving mixtures or those for just synthetic opioids. Overall, the mean was higher than the median measures of purity for all observations, but that was mostly the case for heroin. The median purity of heroin throughout the series was 29 percent. Overall, a noticeable downward trend from about 33 percent to 20 percent occurred between the first and last quarter of the time period. The median purities for observations involving synthetic opioids or heroin and synthetic opioid mixtures were closer to 3 percent throughout the time period, with much less variation over time, though purity measures for heroin/synthetic opioid events peak in 2017. The peak in purity measures early on for synthetic-only
observations might reflect lack of precision in testing and small observations given that time frame is about when these more potent alternatives were penetrating markets.

Figure B.37 illustrates some trends in retail seizures by census region. Observations of heroin and synthetic opioid mixtures were added to those for synthetic opioids because the purity measures were largely similar. Overall, the median purity of synthetic opioids is fairly consistent at less than 4 percent. The Midwest region reports high median purities early on in the time period, but measures fall sharply. The Northeast has the highest purity for synthetic opioids at 3.5 percent and also exhibits the highest median purity for heroin at 38.1 percent. Thus, greater purity measures might reflect regional patterns in user behavior given higher tolerance levels.

Figure B.37
Median Purity for Observations of No More Than 1 Gram, by Census Region and Drug

NOTE: Q1 = quarter 1. Purity is reported for the primary drug in each seizure. Measures are fitted with a smoothed line and largely exclude nonpowder formulations. Observations containing both heroin and synthetic opioids are shown in this figure as synthetic opioids.
The distribution of raw weights of suspected retail observations are shown in Figure B.38 which indicates substantially smaller median raw weights than those reported in STRIDE/STARLIMS. The difference seems reasonable given that NFLIS is largely comprised of retail-level seizures. The median weight of seizures for heroin (unadjusted for purity) show a rising trend in those seizures smaller than 1 g. The median weights rose from just under 110 mg to about 230 mg from the beginning of 2013 to the end of 2020. The observations involving heroin and synthetic opioid mixtures show greater variation but with median weights close to those of heroin and show a general upward trend since 2017. By the end of 2020, median raw weights for heroin and synthetic opioid mixtures were similar to those for heroin at 240 mg. Calculating purity-adjusted weights is limited given the few non-heroin observations that report measures on purity as well as the fact that NFLIS data report purity on only the primary drug and not those containing mixtures.

For synthetic opioid–only observations, median raw weights decline over time. Since early 2016, the weights of these seizures have fallen from a median of nearly 200 mg to about 130 mg.

Figure B.38
Quarterly Distribution of Raw Weights of Observations of Seizures of No More Than 1 Gram
Figure B.39 displays the annual distribution of retail seizures by census region, combining all synthetic opioid observations into a single category (most of these involved fentanyl). Across the census regions, the raw weights for both heroin and synthetic opioids show some variation, with overall rising weights in the South, yet general similarity in median weights and distribution between the two drugs. In the Northeast, the raw weights of observations containing synthetic opioids show greater interquartile ranges and slightly higher median weights compared to heroin, though heroin weight distributions show less variation from year to year. The distributions for heroin and synthetic opioids in the Midwest are nearly identical over time and show little year-to-year variation, except for a decline in the median weights for synthetic opioids since 2019.

**Figure B.39**

*Yearly Distribution of Raw Weights of Observations of Seizures of No More Than 1 Gram, by Census Region*


NOTE: Outliers have been omitted from this figure. Observations containing both heroin and synthetic opioids are shown in this figure as synthetic opioids. Raw weights are unadjusted for purity.
Morphine Equivalent at the Retail Level

Combining purity and weights can be used to estimate the MME for retail seizures. Here, the Commission examined observations for heroin or fentanyl between 0 and 1 grams that report measures on purity by multiplying three factors: purity, weight, and an MME constant specific to heroin and fentanyl. For these calculations, the Commission used an MME factor of 3 for heroin and 50 for fentanyl. The 50 MME is a conservative estimate given that the literature reports a range of 50 to 100. For heroin and fentanyl mixtures, there is no way of knowing the true content of the MME in the observation since purity measures on either heroin or fentanyl are reported. That said, when the primary drug is reported to be fentanyl, the Commission considered this a fentanyl observation; a similar approach is used for heroin. In this case, there are a total of 5,728 observations for heroin and 655 for fentanyl.

Overall, there is a noticeable increase in the median measures of morphine-equivalent grams for retail seizures involving fentanyl noticeably increases, as shown in Figure B.40. Morphine-equivalent grams nearly double between 2014 and 2020, increasing from about 500 mg to over 1 g. In contrast, median morphine-equivalent grams for heroin remained steady throughout the time frame at 390 mg.

Figure B.40
Morphine-Equivalent Grams of Observations with Raw Weights of No More Than 1 Gram

As shown in Figure B.41, the number of regional morphine-equivalent grams for fentanyl has risen across all census regions but most noticeably for the Northeast. The majority of fentanyl observations were reported in the Northeast, followed by the South. In these regions, the morphine-equivalent amount for fentanyl rose from about 500 mg to 1.2 g in the Northeast and from about 200 mg to 900 mg in the South. Median morphine-equivalent grams were relatively flat throughout the time period for the Midwest, though they declined from 1.5 g in 2015 to 0.5 g in 2017, rising again to more than 1.75 g by 2020. This fluctuation might reflect the low number of observations in this region. Very few observations of fentanyl contain measures on purity and weight in the West, making it hard to truly assess the trend in fentanyl-related observations in that region over time.

**Figure B.41**

**Morphine-Equivalent Grams of Observations with Raw Weights of No More Than 1 Gram, by Census Region**

In contrast, median morphine-equivalent measures for heroin show a relative decline in the Northeast and Midwest. The amounts were relatively unchanged in the South and West at around 280 mg and 500 mg, respectively. Morphine-equivalent amounts in seizures of heroin declined from 760 mg in 2013 to 460 mg in 2020 for the Northeast. For the Midwest, these amounts declined from about 1 g in 2013 to 120 mg in 2020. Across all regions for most years, observations containing fentanyl had more morphine-equivalent units than those for heroin by a factor greater than two. Again, these estimates are derived from a lower bound of fentanyl’s MME with a factor of 50; these estimates would be higher had the Commission used a larger conversion factor. Nonetheless, the MME in retail-level seizures involving fentanyl is increasing in several regions while those involving heroin are flat or on the decline.


NOTE: The data have been converted to morphine-milligram equivalents (MMEs) using a factor of 3 for heroin and of 50 for fentanyl. For fentanyl, N = 635. For heroin, N = 5,728.
Summary of Drug Enforcement Administration NFLIS Data

The NFLIS data offer an important perspective into retail market trends for heroin and fentanyl. The data show that fentanyl is expanding in heroin markets, often displacing heroin. These trends vary by geographic region, with areas east of the Mississippi River still most affected by fentanyl’s encroachment. Some states report almost no heroin observations free of synthetic opioids. Overall, every region outside of the western United States has large numbers of observations involving synthetic opioids. Most of those appear in powder formulation and are sometimes mixed with heroin. The West reports almost no powder mixtures of fentanyl but a larger share of synthetic opioid observations in pill formulation than observed in other census regions. This regional variation in formulation could reflect the powder versus nonpowder formulations for heroin, with the latter being harder to mix with powder fentanyl and more prevalent west of the Mississippi River.

In terms of the amounts and purities of retail observations containing fentanyl, there is a downward trend in raw weights, though purity remains fairly stable toward the latter half of the time period analyzed. That said, there is an upward trend in the morphine-equivalent units in seizures observed. This could suggest that dosing per unit is becoming more precise and consistent toward smaller product of higher purity. DEA’s Fentanyl Signature Profiling reports note increased purity over time.

Health Canada Drug Analysis Service

To help validate U.S. seizure information, the Commission obtained seizure data from Canada, which has been acutely affected by synthetic opioids in illegal drug markets in similar ways to the United States. Canada’s Drug Analysis Service (DAS), part of Health Canada, partners with law enforcement agencies across the country to test over 120,000 samples of seized drugs each year, making these seizure analyses available in public reports. Each seizure event includes measures for up to eight different substances detected, the province where the seizure occurred, its formulation (e.g., powder or tablet), the date seized, and the date it was received by DAS. The data are analytically much cleaner when recording specific fentanyl compounds or other novel synthetic opioids and come with supporting codebooks, something that neither STRIDE/STARLIMS nor NFLIS offer. Because of this, the Commission could easily examine trends in analogues or other fentanyl-related compounds that are not easy to assess in U.S. seizure data.

That said, these data do not contain measures on weights or price, with many missing measures on purity. Further, the public series start in 2018, preventing a more robust analysis prior to that year. Observations reported in this section cover the time period from 2018 to the first quarter of 2021, showing trends that illustrate changes in the drug supply that are remarkably similar to those described from U.S. seizure data. The same limitations apply to DAS when it comes to making inferences about convenience samples generated nonsystematically by law enforcement.

The majority of seizure events involving synthetic opioids occurred in British Columbia and Ontario, which is unsurprising given that these provinces have faced a worsening overdose problem involving synthetic opioids. Unfortunately, the lack of measures on weights prevents a more robust analysis specific to retail or wholesale seizures.

Counts over Time

Figure B.42 shows the quarterly counts of synthetic opioid seizures, including their mixtures with heroin, across Alberta, British Columbia, Ontario, and the rest of Canada. As shown, almost no heroin-only seizures occur in British Columbia, though these remain in Ontario. The share of seizures containing a mixture of heroin and synthetic opioids has declined to almost zero in British Columbia since the beginning of 2020, though that share was declining over time. In fact, throughout the time period, about 94 percent of heroin observations in British Columbia contain synthetic opioids. This largely aligns with what subject-matter experts recounted regarding transitioning street markets in western Canada.

Figure B.42

Synthetic Opioid and Heroin Seizures in Canada, by Quarter

Across most Canadian markets, the number of seizures involving synthetic opioids without heroin are rising, and this is especially true for Ontario and British Columbia. The former retains some heroin-only observations, but the latter has seen heroin vanish almost entirely from seizure events. British Columbia is the worst affected province. With Ontario having about three times the population of British Columbia, the number of synthetic opioid seizures in British Columbia are higher per capita. (The number of seizures is not adjusted for population.)

DAS only began reporting data on formulation starting in 2019, and the vast majority of observations are of powder formulation when reported. That said, the fentanyl observations reported in tablet form are more frequently reported in Ontario than British Columbia. In contrast to the U.S. series, tablet formulations are much less frequently reported for the Canadian DAS series.
Purity and Formulation

In terms of purity measures over time, substantially more seizure observations contain measures on purity in British Columbia than any other province. Again, without weights attached to observations, it is impossible to know if these are retail- or wholesale-level observations. That said, the Commission plotted the quarterly median and mean purity measures for fentanyl in both provinces. Figure B.43 shows that median purity of fentanyl across the two provinces fluctuates from about 1 to 10 percent. The median purity is slightly higher in British Columbia than Ontario, with the median at about 6 percent versus 5 percent throughout the series. The mean purity is slightly higher at 8.6 percent and 7.6 percent, respectively. Compared to the DEA Fentanyl Signature Profiling Program, these purity values are not far off, as DEA has reported a mean purity of fentanyl seizures at 8.7 percent for 2019. Given the short time period during which DAS seizure data report purity, it is hard to draw any overall trends in measures, though there was a sharp increase in purity starting in 2020, which might reflect a COVID effect due to decreased retail-level buys in street markets.

**Figure B.43**

**Purity of Fentanyl Seizures, by Quarter**

![Graph showing purity of fentanyl seizures in British Columbia and Ontario by quarter from Q1 2018 to Q1 2021.](image)

**British Columbia**
(N = 1,139)

**Ontario**
(N = 175)

**Measure**
- Mean
- Median

**Quarter**
Q1 2018, Q1 2019, Q1 2020, Q1 2021


NOTE: Q1 = quarter 1. Purity analysis of a seizure is reported for only the primary drug identified.
In addition to upward trends in synthetic opioids, there has been a shift in the types of opioids reported in drug seizure data. Figure B.44 shows that carfentanil is the most common fentanyl analogue reported in the DAS series, with a peak of over 900 observations in the first quarter of 2019. It should be noted that almost all carfentanil observations before 2020 were of “residues,” meaning they were of small amounts and might not reflect the true nature of a baggie of powder or a counterfeit tablet. The number of seizures including fentanyl analogues declined throughout 2019, but a considerably large spike in the number of acetylfentanyl events occurred in the second quarter of 2021. Other fentanyl analogues have shown less of a trend, with some entering and exiting the DAS data at the national level. In contrast, there has been a noticeable rise in the numbers of nonfentanyl synthetic opioids, in this case the benzimidazole series, which are not fentanyl analogues but wholly different compounds. Benzimidazoles first appeared in 2019 with brorphine, followed by isotonitazene and then etodesnitazene in 2020. The second half of 2020 reported a large increase in the number of events involving these drugs, with events jumping nearly fivefold between the second and third quarters of that year. In 2021, DAS reported the first instances of protonitazene and metoitazene.

**Figure B.44**

*Number of Fentanyl Analogues and Benzimidazoles, by Quarter*

![Graph showing number of fentanyl analogues and benzimidazoles by quarter](image-url)
Drug markets across provinces are changing in other important ways. In recent quarters, there has been a noticeable rise in the numbers of synthetic opioid seizures (mostly fentanyl) involving benzodiazepines. Co-ingestion of opioids, especially highly potent synthetic opioids, with benzodiazepines increase risk of death.

Figure B.45 shows a sharp rise from the beginning of 2019 through the first quarter of 2021 in the numbers of benzodiazepine/synthetic opioid seizures, particularly in Ontario and British Columbia. Benzodiazepine seizures absent synthetic opioids were relatively stable over this period (not shown), but fentanyl/benzodiazepine seizures have continued to rise. Approximately a third of synthetic opioid seizures (predominately fentanyl) in Ontario, a quarter in Alberta, and a fifth in British Columbia also contained a benzodiazepine in first quarter of 2021. In the majority of cases, benzodiazepines mixed with fentanyl are uncontrolled or novel benzodiazepines and are more frequently found in powder form instead of tablets. For example, Etizolam, a novel benzodiazepine not approved for use in Canada or the United States, is the most common benzodiazepine in these events. It is suspected that many of these novel chemicals are also illegally manufactured.64

Figure B.45
Synthetic Opioid Seizures That Contain Benzodiazepines, by Province

NOTE: BZD = benzodiazepine. Q1 = quarter 1.

Seizure data from Canada can also show other crucial trends in market evolution. The DAS data do contain measures on purity for a subset of observations. Unfortunately, without weight measures, it is impossible to determine if these were retail or wholesale seizures. Figure B.46 shows the distribution of purity of fentanyl seizures in British Columbia by quarter from 2018 to the first quarter of 2021 overlaid with the overdose death counts in that province. A clear correlation is evident between the purity measures and death counts. The mean purity of fentanyl seizures and the overdose death count in the same month has a correlation coefficient of 0.6, suggesting that deaths rise and fall in tandem with purity.

Figure B.46
Quarterly Distribution of Purity of Fentanyl Seizures and Overdose Deaths in British Columbia


NOTE: Q1 = quarter 1. Purity analysis of a seizure is reported for only the primary drug identified. Mean purity is indicated as a red box. N = 1,139. At the time of analysis, British Columbia Coroners Service had not released fentanyl-related death counts for quarter 4 of 2020 and beyond; however, the majority of the province’s drug deaths involve fentanyl.
Summary of Health Canada Drug Data

The Canadian seizure data provided by DAS show remarkably similar trends in transitioning markets when compared to U.S. seizure data. For one, the number of seizures for heroin absent synthetic opioids is declining and also varies by region—that is, some provinces are highly affected by fentanyl while others are not. In some places, such as British Columbia, almost no heroin is found untainted by synthetic opioids. In terms of highly affected provinces, there appears to be relatively similar purity values compared with national estimates from DEA. DAS data do not allow for market segmentation by weight, so it is unclear how retail markets have trended in recent years. One area where the United States and Canada appear to differ is in the availability of counterfeit tablets. Although observations reported as tablets appear in DAS, they do not appear to be as prevalent as the number of events in the United States for some regions in recent years.

The DAS data series is clean and concise; the drug codes are easy to extract, which facilitates examination of other trends in specific drug substances that are emerging in drug markets. As shown in the previous sections, a growing share of synthetic opioid seizures in Canada also contain benzodiazepines. The U.S. NFLIS data show a similar trend in mixtures of drugs containing both synthetic opioids and novel benzodiazepines.
Appendix C
MODELING THE ILLEGAL SUPPLY SYSTEM FOR SYNTHETIC OPIOIDS

The goal of this appendix is to present a simple but valid characterization of the illegal supply chain for synthetic opioids that are manufactured in the People’s Republic of China (PRC) or Mexico and consumed in the United States. Compared to the supply chains for plant-based drugs like cocaine and heroin, little has been published on the supply networks for fentanyl and other synthetic opioids, especially in terms of prices (for precursors and finished products) and quantities. The appendix begins with a short discussion of the traditional objectives of drug supply reduction, then elaborates on the multi-echelon supply chains for drugs, highlighting the similarities and differences with the markets for synthetic opioids. It then pulls together information from multiple sources (e.g., stakeholder interviews, seizure data, online markets, and media reports) to help build and calibrate the characterization. It then ends with a summary of the limitations of applying traditional drug supply reduction efforts to illegally manufactured synthetic opioids.

Understanding how supply networks operate, as well as describing the possible variations in different groups or strategies, can identify possible responses that target vulnerabilities. Further, a conceptual description of the supply chain may also offer a sobering analysis of the possible limits of supply-side interventions aimed at cheap and available synthetic opioids.

THE TRADITIONAL OBJECTIVE OF SUPPLY-SIDE INTERVENTIONS

Can existing supply-reduction tools, strategies, and efforts be effective in reducing the availability and increasing the price of drugs such as fentanyl sold in illegal markets? The answer to this question is central to informing future policy development and understanding how traditional supply reduction strategies work and provides context for the challenges explored later in this appendix.

Supply reduction, which refers to interventions to curtail the production, distribution, and retail sale of drugs, is a key pillar of drug policy. It often involves drug law enforcement and is therefore seen as the remit of law enforcement investigations and prosecutions. Supply reduction, however, has a broader reach that includes restrictions over precursor chemicals or other equipment to limit the production of drugs, diplomatic engagements to reduce source-country supply through institution building or eradication, or alternative livelihood programs that convince rural farmers to cease cultivating poppy or coca.

Prohibition can deter some from engaging in the criminal activities of drug production and distribution, but seizures of product or arrests of dealers do not necessarily constrain the amount of drugs produced or distributed. A kilogram of fentanyl seized at the upper levels of the market does not result in one less kilogram consumed. Product that is seized and dealers who are arrested can be replaced. Instead, the key underlying objective of supply...
reduction is to affect the prices of drugs sold in illegal markets. Drug prices rise when drug production, trafficking, and illegal retail activities become more costly. Supply-reduction actions that can help raise price include loss of product from drug seizures and destruction of clandestine labs and asset forfeitures. But nonmonetary costs are more important, such as the risk to producers, traffickers, and distributors from arrest, prosecution, and violence (both from law enforcement and competing criminal actors).

In addition to shipping greater amounts of drugs or finding means to avoid detection, suppliers offset nonmonetary costs by demanding greater compensation in the form of higher prices, eventually passing on those increased costs to the consumer. The primary inputs for drugs such as cocaine and heroin (coca or poppy) account for approximately 1 percent to 2 percent of the retail price. For illegally manufactured synthetic opioids, which are made from chemicals, the share is even less. Most of the price users pay compensates costs incurred later in the supply chain. Thus, efforts to reduce supply and prohibit drugs drive up the cost of production and, in turn, prices. Higher prices can discourage initiation of drug use (especially in price-sensitive populations, such as youth) and reduce the amount of a drug consumed by current users, perhaps making them more amenable to available treatment options.

Efforts to dismantle drug trafficking networks, seize illegal proceeds, interdict product at ports of entry (POEs) or in street markets, arrest and incarcerate dealers, place controls over necessary chemical inputs, and reduce diversion of medications from the licit prescription system are all strategies of supply reduction that should increase price. Without supply-reduction efforts, the price of street drugs would be substantially lower. Yet, overdose deaths in the United States continue to rise, and an examination of retail-level seizures indicates that fentanyl is increasingly displacing heroin in parts of the country. These developments suggest that the effectiveness of supply-control efforts (to exert upward pressure on price) to date has been limited when addressing this new threat.

OVERVIEW OF SUPPLY CHAINS FOR SYNTHETIC OPIOIDS

It is helpful to depict the supply chain for illegally manufactured synthetic opioids in two broad streams: (1) traditional transnational criminal organizations (TCOs) that illegally import finished product to the United States and (2) clandestine laboratories that illegally manufacture synthetic opioids from chemical precursors. The two streams are connected by the availability of chemical inputs (in the United States, mostly purchased from legitimate suppliers, occasionally purchased from criminals). The flow of product is subject to seizures, interdictions, and asset forfeitures. The cost of the drug is influenced by the price of raw materials or by the cost of production.

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1 Drugs are sold in markets, and participants in those markets (e.g., dealers and consumers) respond to economic incentives, such as price. Therefore, considerable attention is paid to purity-adjusted price, or the price of a pure gram or kilogram of a drug, along the supply chain. See Thomas Babor, Jonathan Caulkins, Griffith Edwards, Benedikt Fischer, David Foxcroft, Keith Humphreys, Isidore Obot, Jürgen Rehm, Peter Reuter, Robin Room, Ingeborg Rossow, and John Strang, *Drug Policy and the Public Good*, New York: Oxford University Press, 2010.


5 Cannabis legalization in states in the United States, even under federal prohibition, and in Canada has coincided with rapid price collapses (especially per milligram of THC) as firms have been able to seek economies of scale, and invest in capital improvements and research and development. See Rosanna Smart and Rosalie Liccardo Pacula, “Early Evidence of the Impact of Cannabis Legalization on Cannabis Use, Cannabis Use Disorder, and the Use of Other Substances: Findings from State Policy Evaluations,” *American Journal of Drug and Alcohol Abuse*, Vol. 45, No. 6, 2019.
States (referred to in the discussion as TCO), and (2) direct imports of finished synthetic opioids via the mail and express consignment carrier (ECC) systems, from orders placed over the internet (referred to as internet). Each stream is likely to incur different operational costs and structures, and thus potential vulnerabilities, so each warrants a closer examination.

Methods

In this research into the illegal supply chain for synthetic opioids, the methods by which drugs enter the United States and are distributed to users are important considerations that build on previous research that published models of multi-echelon supply chains for drugs, as well as other illegal products. Work by the Commission adopted a similar analytical approach to understand the illegal supply chain of synthetic opioids by looking at each step in the process (e.g., raw material, processing, exporting, importing, retail). This work characterizes the movement of synthetic opioids through multiple supply chain paths. For each step of the supply chain, data from various sources—in this case, undercover buy data provided to the Commission by federal law enforcement (see Appendix B for more information), media sources, and other data points drawn from interviews conducted for this report—were analyzed to produce estimates of prices, taking into account purity levels. This analysis was further informed by information on interdiction and seizures gleaned from media reports, the literature, and interviews conducted during this work (especially interviews of federal law enforcement personnel and others knowledgeable about interdiction and illegal drug production). Findings from these endeavors, including results produced during the modeling exercise, provide insights for understanding the challenges faced by traditional drug supply-reduction efforts.

Illegal Supply Chain of Synthetic Opioids Through TCOs

Supply chains for more traditional, usually agricultural-based drugs (e.g., heroin, cocaine) are shown in Figure C.1, which illustrates the components of a typical TCO-led supply chain. All stages of this supply chain and the flow of contraband from one stage in the supply chain to the next are illegal. These supply chains typically begin with raw agricultural materials supplied by farmers that are then processed (often by laborers who sell their services or harvest to TCOs) prior to export into the United States. After being smuggled into the United States via various means, the product is purchased or transferred to distributors at the wholesale level, then further divided or adulterated into smaller increments to the retailer (e.g., a street dealer) who sells the product to users (after perhaps adulterating or dividing even further).

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6 Domestic clandestine synthesis and manufacturing can occur, but the Commission did not include it in this analysis for two reasons. First, clandestine fentanyl synthesis in the United States is not an immediate concern. Second, by taking the “extremes” of the TCO and internet streams, one can assume that clandestine fentanyl synthesis in the domestic United States incurs costs and revenues that fall between the TCO and internet streams.

Figure C.1  
**Representation of a Typical TCO Supply Chain, Agriculture-Based Drugs**

Figure C.2 depicts a typical supply chain for synthetic opioids involving TCOs. Instead of beginning with agricultural raw materials as for plant-based opioids, the synthetic opioid supply chain begins with chemical precursors (often manufactured in the PRC but also potentially in India) as raw materials. Raw material supply in the form of precursors may be controlled or uncontrolled depending on time and circumstance, whereas agricultural production of raw materials for heroin and cocaine is almost always controlled and illegal.

Figure C.2  
**Representation of a Typical TCO Supply Chain, Synthetic Opioids**

Illegal precursors largely include the smuggling of controlled chemicals or the shipping of uncontrolled chemicals that have no other legitimate use other than manufacturing of fentanyl. In the TCO model, precursors are acquired by Mexican TCOs and then cooked and processed into synthetic drugs for smuggling into the United States, where, in a series of steps similar to the TCO-based supply chain for agricultural drugs, they may be further distributed via wholesale to retailers and ultimately to users.
Illegal Supply Chain of Synthetic Opioids Through Direct Online Sales

Until relatively recently, fentanyl was shipped via a set of online suppliers, typically in the PRC, to distributors or end buyers in the United States. Figure C.3 illustrates the key elements of this online supply chain for synthetic opioids broadly. It differs from the TCO-based supply chain in numerous respects. Unlike the case with TCOs, both the supply of precursor raw materials and drug cooking and processing occurs in the PRC, where all entities may or may not be acting illegally or with criminal intent.

Figure C.3
Key Elements of a Typical Online Synthetic Opioid Supply Chain

Until 2019, many fentanyl analogues were not controlled, and thus producers were committing no statutory crime in the PRC. Additionally, online sales enable retailers and wholesalers to directly import synthetic opioids into the United States via carrier, mail, or international freight, thereby bypassing production in Mexico and smuggling into the United States. Last, because synthetic opioids such as fentanyl have low production costs and a very high morphine equivalence per unit, ordering quantities smaller than those observed in the TCO-based chain more easily avoids detection and incurs less risk than for more traditional illicit drugs.

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8 Morphine equivalence is a rough conversion in terms of an opioid’s analgesic properties. Clinicians use this to determine dosing across opioids benchmarked to morphine.
LITERATURE ON ILLEGAL SUPPLY CHAINS

A large literature on illegal supply chains exists. This research builds most directly from the body of research on multi-echelon drug supply chains that originated in the 1980s, when researchers began publishing reports using a multi-echelon structure, populated with empirical data. In some of the first work on drug supply chains, authors depicted the structure of drug prices, according to echelons in the supply chain. They labeled echelons: farmgate, processed, export, import, and retail (Table C.1). Some of these echelons continue to exist in the synthetic drug era, but others are eliminated or shift in their nature. For drugs manufactured from agricultural materials, the farmgate was an appropriate label for the echelon where raw materials are produced. In the shift to synthetic manufacture of opioids, raw materials come from chemical companies that make the precursors.

Table C.1
Structure of Drug Prices in 1980, Price per Pure Kilogram, in 1980 Dollars

<table>
<thead>
<tr>
<th>Echelon</th>
<th>Heroin</th>
<th>Cocaine</th>
<th>Marijuana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmgate</td>
<td>350–1,000</td>
<td>1,300–10,000</td>
<td>7–18</td>
</tr>
<tr>
<td>Processed</td>
<td>6,000–10,000</td>
<td>3,000–10,000</td>
<td>55</td>
</tr>
<tr>
<td>Export</td>
<td>95,000</td>
<td>7,000–20,000</td>
<td>90–180</td>
</tr>
<tr>
<td>Import</td>
<td>220,000–240,000</td>
<td>50,000</td>
<td>365–720</td>
</tr>
<tr>
<td>Retail</td>
<td>1.6 million–2.2 million</td>
<td>650,000</td>
<td>1,250–2,090</td>
</tr>
</tbody>
</table>


This terminology for supply chain echelons is adapted to this research and generalized for the highest echelon as supply of raw materials, whether the materials are grown or made in a factory. However, the shift to synthetic opioid production over heroin results in substantial restructuring of the supply chain. Traditionally, the plant-based drug trade has an hourglass shape, with many primary producers at the top and many retail-level dealers at the bottom (Figure C.4). The bottleneck occurs at the point of trafficking as drugs are moved from the mountains of Mexico overland and across the U.S.–Mexico border or from Afghanistan through Iran to Europe. A global shift to illegally produced synthetic opioids lops off that top half, turning that figure into a pyramid: Many dealers remain at the bottom, but only a handful of chemists or cooks are making fentanyl or other synthetic opioids.

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Following the work conducted by Reuter and Kleiman (1986), research in a number of successive articles adopted the construct of echelons within the United States for drug distribution that are similar to echelons considered in licit supply chains. Recent work by Caulkins and Reuter (2020) analyzing the drug supply in British Columbia examines the structure of supply chains and offers assumptions about drug prices at echelons. The authors described key parameters in their research to include the prices and price markups at each echelon of the supply chain (Table C.2).

### Table C.2

**Stylized Model of Heroin Market Loosely Based on British Columbia, 2010**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Heavy Users</th>
<th>Retailers</th>
<th>Wholesalers</th>
<th>Importers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of individuals or organizations</td>
<td>10,000</td>
<td>1,000</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Amount bought in each purchase, in kilograms</td>
<td>0.0004</td>
<td>0.028</td>
<td>0.5</td>
<td>12.5</td>
</tr>
<tr>
<td>Purchase price per gram, in 2020 Canadian dollars</td>
<td>160</td>
<td>80</td>
<td>40</td>
<td>20</td>
</tr>
</tbody>
</table>


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The authors make the key assumption that the price of drugs doubles at each echelon, which can be described as having a multiplier of 2.0. The price of raw heroin is assumed to be $160,000 per kilogram, in 2010 Canadian dollars. The authors make broad assumptions about the size of purchase batches at each echelon. Heavy users are understood to buy drugs in the fraction of a gram, retailers purchase drugs in countable grams, wholesalers buy drugs on the order of kilograms, and importers buy drugs in batches of tens of kilograms. Estimates of the current supply chains for synthetic opioids in the United States follow the assumptions made by Caulkins and Reuter given their recent understanding of the market in British Columbia and elsewhere. In addition, other analysis suggests that fentanyl, often concealed in baggies sold as heroin, may not be that different in terms of the raw weight of items purchased at each echelon. Further, prior work provides an example of how price markups between echelons in a supply chain may be considered both multiplicative and additive.

DATA USED IN SUPPLY CHAIN ANALYSIS

Data are used to populate parameters and relationships in the supply chain analysis from research literature and government sources, interviews, media reports, and internet markets. Two factors stand out the most about the supply chain for synthetic opioids. First, the drugs are manufactured in labs with chemicals that are widely available. The drugs can be made cheaply, with modest labor requirements, and anywhere that raw materials and know-how exist. This characteristic distinguishes synthetic opioids from heroin and drugs made from agricultural products, which rely on availability of arable farmland and large populations of farmers to produce the needed crops.

Second, synthetic opioids of concern, such as fentanyl, are much more potent per volume and weight than heroin. Among opioids, fentanyl is understood to be approximately 25 times more potent than heroin, with respect to its analgesic, or pain-reducing, properties. Other synthetic opioids, including some fentanyl analogues, can be hundreds of times more potent than fentanyl. This potency allows a high dollar-value amount of synthetic opioids to be moved more cheaply and to avoid detection more easily than other drugs.

Raw Materials

The Commission gained information from interviews and Drug Enforcement Administration (DEA) reports about the methods used to illegally manufacture synthetic opioids. The Commission searched internet markets to find prices for the precursors necessary to produce fentanyl using a simple and common method. Sourcing materials from a U.S. vendor preferred by academic and professional chemists, the precursor chemicals necessary to produce 1 kg of fentanyl could be purchased for $2,000. These estimates are likely higher, reflecting the higher quality and nature of sourcing from reputable chemical companies in North America. Chemicals used in research are generally desired to be very pure, such as 99 percent or 99.9 percent pure, to ensure quality and consistency in results. If


16 Sigma-Aldrich, homepage, undated; Alibaba, homepage, undated.
illegal manufacturers are not as stringent in quality requirements, raw materials could be purchased, at 98-percent purity, for example, from other internet markets far more cheaply. Using an internet market with vast sales internationally, precursors to make fentanyl could be purchased for as little as $20, though that was one estimate on the lower end.\textsuperscript{17}

As fentanyl has grown in use in the current epidemic, the demand for heroin may have decreased, and so too has the demand for opium gum derived from opium poppies. Poppy growers, heroin refiners, and smugglers are likely shut out as production transitions. Early indicators suggest that opium production is declining sharply in Mexico. After four years of annual increases, the Office of National Drug Control Policy (ONDCP) reports that poppy cultivation and heroin production has halved from a relative peak in 2017 of 44,000 hectares of poppy and 111 tons of heroin to 23,000 hectares and 59 tons in 2020.\textsuperscript{18}

The price for opium gum, as reported by farmers, has decreased sharply from greater than $1,000 per kilogram. Prices have been reported in the range of $300 to $600.\textsuperscript{19} In the calculations in this research, the Commission used $500 per kilogram as an input. Recipes for converting opium gum to heroin estimate that the ratio of gum to heroin is 12 to 1.\textsuperscript{20} On this basis, omitting costs of other supplies, the Commission calculated the raw materials for heroin to cost $6,000 per kilogram. As an input to the multi-echelon model, the Commission did not explicitly estimate costs of equipment and labor in the “cooking and processing” of agricultural and synthetic opioids.

Drug Prices and Purities in Traditional Trafficking

After accounting for the prices of raw materials at the start of the supply chain, less data are available for prices at intermediate supply chain echelons. Media reports of fentanyl cooks or producers describe the prices of drugs when they are processed in Mexico, moved to the U.S. border, imported to southwestern cities such as Los Angeles and Phoenix, and then moved to northern cities for distribution at wholesale. Some seizure data show prices; the Commission can note prices from seizures at the U.S. border and in wholesale and retail quantities. Seizure data also shows purities for some observations. With all price data on synthetic opioid observations in the System to Retrieve Information from Drug Evidence (STRIDE), the sample size is small compared to the size of the total U.S. drug market, so the Commission needed to acknowledge uncertainty in these generalized price estimates.\textsuperscript{21}

According to interviews and documents reviewed, when fentanyl emerged in seizures in packages arriving by air destined for the United States, the purity was high, in the range of 50 to 90 percent. However, the purity of fentanyl coming into the United States from Mexico in powder form was observed in the range of 5 to 10 percent on average. Fentanyl is also observed to come into the United States in counterfeit pill form, and its purity is even

\textsuperscript{17} The Commission looked at several online chemical vendors, including clear-net advertisements for known fentanyl precursors sold by manufacturers in the PRC. See Appendix E for additional information.


\textsuperscript{19} “Opium Prices Plummeted as Much as 80% in 2018, Hurting Farmers,” Mexico News Daily, March 18, 2019. The United Nations Office on Drugs and Crime continues to report declining poppy production since 2017, but no price data on heroin or opium in Mexico.

\textsuperscript{20} Guillermo Andrés Ospina, Jorge Hernández Tinajero, and Martin Jelsma, Poppies, Opium and Heroin: Production in Colombia and Mexico, Amsterdam: Transnational Institute, February 2018.

\textsuperscript{21} For one, deriving price and purity estimates from seizures has many limitations. Seizures are not random samples but convenience samples that may change depending on the flow of drugs, interdiction efforts, or other countermeasures. Further, the Commission was unable to rigorously assess price trends for synthetic opioids from the STRIDE series as very few observations exist containing price and purity. As a result, estimates of price and purity may not reflect the true figures.
lower. The common form of fentanyl in pill form is counterfeit oxycodone marked “M30.” Each pill contains approximately 1.5 to 2 mg of fentanyl, making them 1% to 2-percent pure. \(^{22}\)

A media interview with a fentanyl cook in Sinaloa, Mexico, provided insight into prices for drugs at processing and subsequent echelons. \(^{23}\) The Commission was unable to confirm the veracity of cited figures, but numbers seem to be plausible and fall in line with figures cited by law enforcement elsewhere. \(^{24}\) After processing fentanyl to mix it with heroin, the cook quotes a price in central Mexico of $10,000 per kilogram. When moved to the U.S. border in Tijuana, the price is $17,000 per kilogram. Upon import to the United States, in Los Angeles the price rises to $25,000 per kilogram. In New York, the kilogram may be worth as much as $45,000.

From DEA analysis and other data analyzed here, seizures of wholesale (1 kg or more) amounts of fentanyl in the United States are observed to be 8-percent pure. Seizures of fentanyl at retail are observed to be approximately 2% to 4-percent pure. Seizures of heroin at retail are observed to be approximately 30-percent pure, which is a slight decrease in recent years.

Internet Marketplace Data

Empire was a prominent darknet marketplace in 2020 until it closed in August of that year. At that time, it had more listings for opioids than did other available marketplaces combined. \(^{25}\) Research literature reports data on its listings. \(^{26}\) Researchers counted approximately 15,000 listings for heroin, 6,600 listings for oxycodone, 1,600 listings for fentanyl and fentanyl analogues (which were aggregated in the report), and 900 listings for nonfentanyl synthetic opioids. The number of unique vendors was not consistently listed in the report, but it was reported that there were 34 vendors for nonfentanyl synthetic opioids, with an average of approximately 20 listings per vendor.

Pricing data were included for some of the listings. When prices were included, they ranged from $1 per gram to $5,000 per gram, although these extreme values appeared to be outliers. On average, heroin sold for approximately $40 per gram at wholesale volumes and $90 per gram in smaller retail volumes, though purity data were not confirmed in listings. Vendors advertised available supply and appeared to have between 100 g and several kilograms available. Nonfentanyl analogues were priced similarly as heroin and with similar availability. Data for fentanyl and fentanyl analogues were less complete; the Commission inferred their pricing, and availability was similar.

Listings in 2020 between June and August on Empire show 17 nonfentanyl opioids, many of which were newly marketed for sale as drugs for consumption. Fourteen of these nonfentanyl opioids were not advertised for sale on Empire and other marketplaces in 2019. Nine of the opioids were not previously observed in National Forensic

\(^{22}\) Interview 2, July 27, 2021. By the Commission’s own calculations, a standard M30 pill has a gross weight of approximately 120 mg. A 1.5-mg concentration of fentanyl in 120 mg results in 1.3-percent purity.

\(^{23}\) The Commission created the estimates of prices for drugs in Central Mexico, Mexico Border, Import, and Wholesale based on information from the news video with a cartel cook (Paulina Gómez Wulschner, title unknown, video, Univision, November 5, 2020). The Commission estimated the wholesale price based on the cartel reference to the cost of drugs in New York. The Commission understands that there is great spatial variance in drug prices and use this data point to describe a location distant from the southern U.S. border.

\(^{24}\) The Commission’s own analysis of large fentanyl seizures in the four southwestern border states suggest wholesale importer prices that align with media accounts of $25,000 for a kilogram of fentanyl containing less than 10-percent purity.

\(^{25}\) The darknet is part of the internet that is out of reach for average users for a variety of reasons. Darknet content is explicitly excluded from search engines or behind security walls. See Appendix E for more information.

Laboratory Information System (NFLIS) seizure data. The synthetic opioids with the most listings on Empire in 2020 were 2-MAP-237, etazene, SPM-003, U-47,700, and U-48,800. Of these drugs, only the last two have been reported in NFLIS seizure data.

In 2021, the Commission found a marketplace on the clear net with listings for drugs, advertised as research chemicals. This internet marketplace includes listings for approximately 200 chemicals, with narrative descriptions of the effects of taking the drugs recreationally. Twenty-eight drugs were sold as opioids, all of which were nonfentanyl synthetic opioids. Prices for the opioids on the clear-net website were listed in quantities from 1 g to 1 kg. The median price for 1 g of drugs was $180, and the median price for 1 kg of drugs was $12,500. Again, purity measures were not confirmed but were reported to be of higher concentration.

Data from 2020 and 2021 characterizes the supply chain for opioids purchased over the internet. Shipping prices from marketplaces were not accounted for. Perhaps they should be included with respect to retail shipments, where purchases are made in the hundreds of dollars, compared to purchases of wholesale amounts that are made in tens of thousands of dollars. On the other hand, shipping costs may be reflected by the higher per-weight prices of drugs at smaller purchase volumes. Nonetheless, shipping prices are likely negligible.

**Volume of Drugs Imported to the United States**

From seizure data, the southwest border today represents the route by which most illegally imported synthetic opioids enter the United States. As recently as 2018, a large fraction of the purity-adjusted fentanyl seizures (i.e., adjusting the weights of seizures by purity) were made at mail or other express consignment facilities that originated from the PRC. (For context, seizures were on the order of 60 pure kilograms of fentanyl, and total U.S. consumption is estimated on the order of thousands of kilograms.) The seizure data from the U.S. Customs and Border Protection (CBP) quantities adjusted for purity for fiscal year (FY) 2018 indicates a higher quantity seized through mail and express than from land points of entry (POEs) or crossings seized by the U.S. Border Patrol. As a result, even though the direct shipments of synthetic opioids via mail or express carriers from the PRC or other locations remain a possible concern should trends change, so does the potential for the manufacturing of them in the United States through precursor chemicals. Yet, more traditional and established supply chain systems involving TCOs is highly relevant for availability and prices within the United States, discussed later in this appendix. One should recognize, however, that seizures reflect flow and enforcement.

Seizure data from CBP indicate that in 2017 about two-thirds of the seizures at POEs were from international mail or express carriers. Although seizures by the U.S. Border Patrol and at POEs along the southwest border constituted over 80 percent of the gross weight, the gross weight is not purity adjusted. Fentanyl seized via border

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27 The clear net, also known as the surface web or open web, accounts for approximately 5 percent of internet content that is publicly available or indexable by common search engines such as Google.

28 More information on Customs and Border Protection data on seizures can be found in Appendix B.

29 Bryce Pardo, Jirka Taylor, Jonathan P. Caulkins, Beau Kilmer, Peter Reuter, and Bradley D. Stein, The Future of Fentanyl and Other Synthetic Opioids, Santa Monica, Calif.: RAND Corporation, RR-3117-RC, 2019. See also Appendix B for more information on the breakdown of synthetic opioid seizures arriving in the United States.

30 Bryce Pardo, Jirka Taylor, Jonathan P. Caulkins, Beau Kilmer, Peter Reuter, and Bradley D. Stein, The Future of Fentanyl and Other Synthetic Opioids, Santa Monica, Calif.: RAND Corporation, RR-3117-RC, 2019, Table 2.2.


32 Based on analysis of CBP provided Seized Assets and Case Tracking System (SEACATS) data from 2014 through 2020. Seizure data presented here are approximate because of rounding and excluding of very small quantity categories of seizures (e.g., northern border).
crossings typically is no more than 10-percent pure and often lower than 5 percent, whereas the online sales from the PRC often are near pure (at least those arriving prior to 2019). Adjusted for an assumption of 7-percent and 95-percent purity, respectively, CBP seizures in 2017 from mail and express carriers would account for 158 kg of pure fentanyl, whereas the southwest border would account for approximately 66 kg. The typical seizures at international mail facilities (IMFs) are small, with the median size typically around 10 g, though the average size is larger due to a handful of large seizures. Express carriers typically have much larger quantities among the seizure data. Tables C.3 and C.4 summarize the trends in seizures for calendar years 2017 and 2020, showing the overall shift in suspected flow from the PRC as the primary source to Mexico.

Packages containing kilograms of drugs arriving via ECCs are observed, which suggests this route continues to be an important vector. Small amounts of synthetic opioids are presently arriving via international mail, on the order of grams or tens of grams. This supply route may persist as a method of bringing compact potent synthetics into the United States in the future due to the anonymity it provides.

Presently, the dominant route appears to involve synthetic opioids trafficked over the southwest border by traditional TCOs. Purity-adjusted fentanyl seizures at the southwest border account for 70 percent of CBP seizures, with 30 percent from IMFs and ECCs. However, seizures are not solely a representation of flow. If the interdiction rate at the southwest border in 2020 was significantly higher than at IMFs and ECC inspections, then the apparent high volume of drugs seized could reflect the higher success rate at the southwest border rather than solely be a reflection of the underlying flow of drugs.33

Table C.3
Summary 2017 CBP Seizures of Fentanyl and Analogues, by Aggregated POE Classification

<table>
<thead>
<tr>
<th>Aggregated POE</th>
<th>Seizures</th>
<th>Weight, in Kilograms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percentage of Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Raw (percentage of total)</td>
</tr>
<tr>
<td>Border Patrol, Southwest, and Northern Border</td>
<td>154</td>
<td>24</td>
</tr>
<tr>
<td>International Mail Facilities (IMFs)</td>
<td>311</td>
<td>49</td>
</tr>
<tr>
<td>Express Consignment Carriers (ECCs)</td>
<td>113</td>
<td>18</td>
</tr>
<tr>
<td>Other</td>
<td>57</td>
<td>9</td>
</tr>
</tbody>
</table>

SOURCE: Analysis of CBP SEACATS data, 2014–2020, provided to the Commission.
NOTES: Border Patrol data are included even though Border Patrol is not a point of entry. Percentages are approximate. Purities of seizures are assumed to be 7 percent for those occurring by land (Border Patrol, southwest, and northern border) and 95 percent for those arriving by air (IMFs, ECCs).

a Purity for other categories can vary significantly.

33 If the interdiction rate at the southwest border were 240 percent of the rate at IMFs and ECCs, the actual flow of synthetic opioids would be approximately equal.
### Table C.4
Summary 2020 CBP Seizures of Fentanyl and Analogues, by Aggregated POE Classification

<table>
<thead>
<tr>
<th>Aggregated POE</th>
<th>Seizures</th>
<th>Weight, in Kilograms</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percentage of Total</td>
<td>Total Raw (percentage of total)</td>
<td>Average Seizure</td>
<td>Purity Adjusted (percentage of total)</td>
</tr>
<tr>
<td>Border Patrol, Southwest, and Northern Border</td>
<td>1,218</td>
<td>85</td>
<td>3,340 (97)</td>
<td>2.74</td>
<td>234 (70)</td>
</tr>
<tr>
<td>International Mail Facilities (IMFs)</td>
<td>141</td>
<td>10</td>
<td>6 (0)</td>
<td>0.04</td>
<td>6 (2)</td>
</tr>
<tr>
<td>Express Consignment Carriers (ECCs)</td>
<td>57</td>
<td>4</td>
<td>103 (3)</td>
<td>1.81</td>
<td>98 (28)</td>
</tr>
<tr>
<td>Other</td>
<td>20</td>
<td>1</td>
<td>14 (0)</td>
<td>0.7</td>
<td>&lt;10 (&lt;3)</td>
</tr>
</tbody>
</table>

**SOURCE:** Analysis of CBP SEACATS data, 2014–2020, provided to the Commission.

**NOTE:** Purities of seizures are assumed to be 7 percent for those occurring by land (Border Patrol, southwest, and northern border) and 95 percent for those arriving by air (IMFs, ECCs).

### SUPPLY CHAIN FOR SYNTHETIC OPIOIDS IN 2021: TRADITIONAL TRAFFICKING

The first modeling effort focuses on the illegal manufacture of synthetic opioids in Mexico and their distribution to consumers in the United States. These estimates are informed with data points but are not exact. Despite the uncertainty, available data clearly show the disparity in revenues between plant-based opiates, such as heroin, and illegally produced synthetic opioids, such as fentanyl. Fentanyl is used as the benchmark for synthetic opioids since it predominates seizures from Mexico. The costs associated with the echelons of the supply chain are shown in Table C.5, adapting terms from other supply chain modeling to reflect location characteristics of the synthetic opioid supply coming from Mexico. Purity declines as it passes from one echelon to the next—that is, drugs are most pure at their point of production and least pure at their point of consumption. To generalize the data in the table to opioids broadly, purity at echelons is included. The data depict an aggregate of markets in Mexico and the United States.
Table C.5
Supply Chain Prices at Each Echelon for Powder Heroin and Fentanyl, Mexican Drug-Trafficking Organizations

<table>
<thead>
<tr>
<th>Echelon</th>
<th>Heroin</th>
<th>Fentanyl</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Raw Price per Kilogram, in Dollars</td>
<td>Purity-Adjusted Price per Kilogram, in Dollars</td>
</tr>
<tr>
<td>Producer(^a)</td>
<td>6,000</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Processor(^b)</td>
<td>10,000</td>
<td>12,500</td>
</tr>
<tr>
<td>Exporter</td>
<td>17,000</td>
<td>28,300</td>
</tr>
<tr>
<td>Importer</td>
<td>25,000</td>
<td>41,700</td>
</tr>
<tr>
<td>Wholesaler</td>
<td>45,000</td>
<td>75,000</td>
</tr>
<tr>
<td>Retailer</td>
<td>50,000</td>
<td>125,000</td>
</tr>
<tr>
<td>User</td>
<td>120,000</td>
<td>300,000</td>
</tr>
</tbody>
</table>

NOTES: Figures on the prices per kilogram are best guesses informed by law enforcement. Additional research can improve these estimates. Cultivators of poppy and the laboratories that make fentanyl precursors are excluded. Purity for inputs to heroin at chemist or producer and processor levels is assumed at 80 percent. Thereon, heroin purity is to be 60 percent for exporters, importers, and wholesalers based on seizure data analyzed. Retailer purity is estimated at 40 percent. Purity for inputs to fentanyl at chemist or producer is assumed to be 80 percent. Thereon, fentanyl purity is estimated to be 8 percent until reaching the retailer, at which point it is estimated to be 3 percent. Purity-adjusted prices do not account for variation in potency according to morphine-equivalent amount.

\(^a\) Producer here refers to someone who synthesizes heroin or fentanyl from primary inputs, such as poppy or precursor chemicals.

\(^b\) Processor refers to someone who prepares and bundles heroin for export or processes fentanyl into diluted formulations (i.e., pills) prior to export.

\(^c\) Ratios are for raw prices, not purity-adjusted prices.

\(^d\) The amount of precursor material needed to synthesize a kilogram of fentanyl depends largely on yields of reactions. Here, the Commission assumed a 20-percent reaction yield.

Combining the cost estimates for powder opioids (setting aside counterfeit pills and ignoring tar heroin) in the United States with the information gained from interviews and news reporting helps to create a multi-echelon characterization of the supply chain for synthetic opioids between Mexico and the United States. An increasing string of price estimates for drugs calibrated with information from news reporting for the price for drugs in New York (distant from the southern border) is $45,000 per kilogram with the retail price, established from the estimate that users pay $60 per day for drugs, which is drawn from recent knowledge of opioid markets in North America. These costs are also aligned with a cost multiplier between echelons near to 2, as used in the research of the British Columbia heroin market in 2010. The data in the table are stated as estimates of the prices paid by the actors at the echelons. Producers and users are included in the supply chain to help make that point.

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As a reasonable estimate, a price point of $200 of precursors might be needed to produce 1 kg of illegal fentanyl. Using the Gupta synthesis method, which is now believed to be the most common means of making fentanyl, it could take as much as 2 kg of 4-piperidone to yield 1 kg of fentanyl. Other required reagents needed in the process are common, inexpensive, just as substitutable, and easily obtained (their associated costs are omitted from this analysis).

The next step is to compare the markups characterized in this research for the current synthetic opioid market, differentiating across different illegally manufactured opioids. The purity-adjusted prices for drugs sold as a mix of heroin and fentanyl are omitted; however, they can be inferred to be between the prices for heroin and fentanyl. The term multipliers is used as a synonym to the parameter for multiplicative cost increases—that is, the price of the drug is “multiplied” at each stage of the echelon.

As shown in Table C.5, at earlier stages in the supply chain, prices realized are magnitudes less per kilogram of drugs handled than the prices paid at later stages such as wholesale to retail, and retail to users. The price markups in echelons from import through retail are modeled as multiplicative, representing the risks and labor required. A notable implication of the calculations is that TCOs in Mexico can retain more revenues when supplying fentanyl than heroin. The poppy laborers in Mexico lose out mostly in the form of lost revenues selling opium to heroin processors. Total potential production for heroin in Mexico is currently estimated at 59 metric tons. The loss of revenue to farmers might total an additional $350 million should the entire poppy economy dry up as TCOs stop buying opium from peasant farmers. When TCOs export heroin, $6,000 per kilogram is provided to poppy farmers for opium gum. In net, TCOs retain nearly $6,000 more per kilogram when producing, processing, and exporting fentanyl compared to heroin, due to lower costs of raw materials.

In contrast, the precursor manufacturers (in this case, chemical manufacturers in the PRC) gain perhaps $1 million to $10 million for precursors sold to manufacturers of fentanyl in Mexico. At the moment, fentanyl appears to produce much greater cost savings for Mexican TCOs than it generates revenue for Chinese chemical producers. This would suggest that Chinese chemical and pharmaceutical manufacturers are not earning extensive revenues in exporting fentanyl precursors. The amount of precursors needed to supply global markets is likely to be in the low tens of metric tons, assuming that total global annual consumption is in the low- to middle-single-digit metric tons. An estimate of the prices per kilogram of fentanyl precursors are unsubstantial, perhaps at $100 a kilogram based on a review of online chemical vendors explored in Appendix E. Assuming reaction yields of 20 percent, which is reasonable based on the chemical synthesis literature, it is possible to produce 1 kg of fentanyl from about 2 kg of precursor. Thus, total revenues for sales in precursors might be under $10 million after accounting for lower synthesis yields in Mexico and seizures at POEs.

Over the course of a large volume of drug sales, revenues retained by TCOs increase by hundreds of millions of dollars, but the current prices might not reflect long-term prices. For the TCOs, which control the supply chain

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35 Per analysis of fentanyl seizures, DEA now reports that the Gupta method is the most common synthesis route used in illegally manufactured fentanyl, mostly coming from Mexico. See Appendix D for more information.

36 Assuming a scenario of 20-percent yields, which is about half of the maximum reported in the literature under ideal laboratory conditions.

37 Empirically, there is no means to determine whether price markups for illegal supply for fentanyl or synthetic opioids are additive or multiplicative. It is assumed here that they are multiplicative, given that the price of drugs sold is related to the costs associated with risks in supply. See Jonathan P. Caulkins and Peter Reuter, “How Drug Enforcement Affects Drug Prices,” Crime and Justice, Vol. 39, 2010.


39 See Appendix B for rough estimates of total U.S. annual consumption of fentanyl.
from producer to importer (and perhaps further down in some places), the revenue retained in the short to medium term increases greatly by a shift in production from heroin to fentanyl. The system is not in equilibrium, however, since there is little to stop market entry from other competitors (both emergent TCOs in Mexico and perhaps entrepreneurs in the United States who can figure out how to import or produce synthetic opioids for further distribution). It is possible that over time, prices at lower market levels fall, reducing TCOs’ net revenues in the long run.40

Implications for Profit Motivation

The difference in retained resources, between the supply chains between heroin and fentanyl, is the greatest for purchases of raw materials, and revenues retained by TCOs. One can first address impacts of changes in the revenue for purchases of raw materials. If the market for opioids in North America shifts fully from heroin to synthetic opioids, the impact on farmers who grow opium poppies will be catastrophic. Farmers and laborers who grow and harvest opium will lose hundreds of millions in revenue related to the poppies needed to manufacture the amount of heroin estimated for this model.

With a shift in manufacturing from heroin to fentanyl, TCOs gain that revenue by absorbing savings on raw material prices.41 There will be effects on other echelons of the supply chain as well. Those effects are not estimated based on the assumptions made in the model in these tables, that prices and markups between echelons are the same after import, despite differences in the opioids trafficked. This may not be a realistic assumption; assuredly, there are price differences when fentanyl is sold instead of heroin, especially in powder form. Future analysis should incorporate additional price data and account for differences in the way drugs are consumed in regions across the United States, and how revenues are affected when drugs are trafficked in pill form. Presently, there are limitations given that STRIDE observations involving fentanyl are limited but suggest little variation in the price of a raw kilogram of fentanyl or heroin trafficked into the United States from Mexico.42

40 The long-term cost-reducing technological innovations offered by synthetic opioids, which allow easy entry to manufacture or distribution, will tend to reduce aggregate illegal market income because of competition and inelasticity of demand. It is hard for TCOs to prevent price declines because they do not hold monopoly power over the market. One possible way for TCOs to increase market power, and thus avert a substantial loss in revenue, would be to extend operations further downstream (e.g., wholesale and retail) where markups are greatest. However, extending operations in the domestic United States would attract greater law enforcement scrutiny, exposure, and other related costs of operation. It is uncertain at this time if Mexican TCOs would want to pursue such efforts to sell fentanyl directly to buyers in the streets of Philadelphia, New York, or elsewhere. Another strategy might be to try to expand the customer base, and perhaps the move by TCOs into manufacturing and trafficking counterfeits reflects this. However, these are only speculations offered by the Commission.

41 The Commission attached the label TCO to many of the echelons to depict TCO operations spanning Sinaloa, to Tijuana and Los Angeles, and to northern cities such as Chicago. The Congressional Research Service reports that TCOs can be thought of as associated and quasi-autonomous organizations. In the multi-echelon supply chain construct, activities that are associated with cartels in reporting may be performed by distinct and geographically separated groups, who coordinate activities and share profits through internal transactions (June S. Beittel, Mexico: Organized Crime and Drug Trafficking Organizations, Washington, D.C.: Congressional Research Service, R41576, July 28, 2020).

42 Presently, there are limits to using observations from DEA’s undercover buy data set (STRIDE/STARLIMS), but per the Commission’s analysis, the median price of 1 kg of fentanyl (about 9-percent pure) and 1 kg of heroin (about 60-percent pure) both cost $25,000 in the four states that border Mexico. It is possible that TCOs do not differentiate between the cost of trafficking raw amounts, but the purity-adjusted price of morphine equivalence will vary considerably between the two.
SUPPLY CHAIN FOR SYNTHETIC OPIOIDS IN 2021: INTERNET MARKETPLACE

Data from the darknet listings from 2020 and the clear-net (open-internet) listings from 2021 suggest that customers around the world can order a gram of synthetic opioids for a few hundred dollars. Online sales in the open internet vary in the amount transacted as buyers generally can purchase nearly pure amounts varying from 1 g to 1 kg, which is roughly 1,000 to 1 million person-days of use for someone consuming 10 mg of pure fentanyl a day.43 In essence, even single-gram transactions from chemical vendors in the clear net can be low-level wholesale amounts. In this case, an individual spending $200 can obtain 1 g of synthetic opioids at an assumed purity of 95 percent, which is a lower bound on purity for chemicals advertised coming from a chemical vendor in the PRC. One gram is equivalent to 0.035 oz., so 1 g of powder can easily be shipped along with several pieces of paper and an envelope for the stamp price of a 1-oz. flat letter.

There is limited information about the behavior of individuals who purchase drugs on the internet, and there could be fewer production echelons to consider, as online vendors (which generally appear to be chemical producers in the PRC) sell directly to low-level wholesalers who then utilize one or two layers of lower-level retailers to distribute synthetic opioids to consumers.44 A simple narrative shows the potential profit. The size in raw weight of bags of fentanyl sold to users might be approximately 0.1 g of fentanyl. Retail seizures of fentanyl are observed to be approximately 2- to 4-percent pure. That suggests that each retail bag contains 3 mg of fentanyl, so 1 gram of 95-percent pure fentanyl is enough for at least 300 such bags. If each bag sells for $10, that $200 internet purchase can yield well over $3,000 in retail revenues. There is little monetary barrier to entry to begin selling drugs in this quantity; the initial investment in product is modest, at $200. This poses a substantial challenge to supply reduction.

For retail sellers, the theoretical potential savings are even greater since, as depicted in Table C.5, there is a price equivalent to $1,700,000 per pure kilogram. Retail sellers of illegal opioids traditionally have often been heavy consumers themselves and often live fairly chaotic lives, so it is not clear that they have the stability or wherewithal to make consistent online purchases. For that reason, the discussion above assumes the online customer is a low-level wholesaler.

Profit incentives increase when moving to purchasing larger amounts of synthetic opioids sold online. Observed kilogram prices of some synthetic opioids on the clear net are typically around $12,500 for product that is of greater than 95-percent purity. This is far below the cost of importing drugs at the gram level through international mail or through traditional overland smuggling. In the TCO supply chain, 1 kg of pure fentanyl would be priced at $500,000 at the wholesale echelon. A lone actor or small group of individuals could not easily enter the market using the traditional drug-trafficking stream without an existing network of retail dealers and without a great amount of start-up capital.

Thus, at present there appears to be two very different prices for similar amounts of fentanyl at wholesale, with what might seem like the safer distribution method (online purchase and package delivery) being much less

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43 Sales on the darknet are typically for much smaller amounts and often at lower purities. Listings analyzed by the Commission included the sale of counterfeit tablets, which are not as pure as powders.

44 Some may purchase for use and nothing more, though it is clear that some individuals source online to further distribute downstream. However, little empirical research has been done on online importers and distributors. Some appear to process powder into counterfeit tablets for further distribution on darknet marketplaces. For more, see Kristin M. Tennyson, Charles S. Ray, and Kevin T. Maass, Fentanyl and Fentanyl Analogues: Federal Trends and Trafficking Patterns, Washington, D.C.: U.S. Sentencing Commission, January 2021.
expensive than when purchasing from (potentially violent) conventional drug traffickers. It is something of a puzzle how and why that should be, and it might not be sustainable in the long run. It would seem logical for wholesale dealers to sever their prior business relationships with conventional drug suppliers and switch to online sourcing, and it is not clear why that has not happened more widely.

In the online supply stream, however, a small group could obtain 1 kg of highly pure synthetic opioids for a modest investment and distribute product further downstream using darknet marketplaces, cryptocurrency, and mail delivery systems, reaping enormous profits. Although retail prices in the TCO supply chain would support a value of more than $1 million for the drugs purchased over the internet, an importer would need to find 100 retailers willing to pay $10,000 each. Alternatively, individuals purchasing wholesale quantities of synthetic opioids on the internet could charge substantially lower prices and still make a large profit on their investment. See Table C.6 for prices for online suppliers.

Table C.6
Supply Chain Prices for Online Supply in Synthetic Opioids, in Dollars per Kilogram

<table>
<thead>
<tr>
<th>Echelon</th>
<th>Wholesale Quantity&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Retail Quantity&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Raw</td>
<td>Purity Adjusted</td>
</tr>
<tr>
<td>Producers&lt;sup&gt;c&lt;/sup&gt;</td>
<td>200</td>
<td>Not modeled</td>
</tr>
<tr>
<td>Importer</td>
<td>12,500</td>
<td>13,200</td>
</tr>
<tr>
<td>Wholesaler&lt;sup&gt;d&lt;/sup&gt;</td>
<td>45,000</td>
<td>450,000</td>
</tr>
<tr>
<td>Retailer</td>
<td>50,000</td>
<td>1,700,000</td>
</tr>
<tr>
<td>User&lt;sup&gt;e&lt;/sup&gt;</td>
<td>100,000</td>
<td>3,400,000</td>
</tr>
</tbody>
</table>

NOTES: Purity at the user level is assumed to be 3 percent. Importers buying retail-level quantities are doing so at 95-percent purity. Importers buying wholesale-level quantities are doing so at 95-percent purity and distributing it at 10-percent purity to wholesalers, who then distribute it to retailers at the 3-percent level.

<sup>a</sup> Wholesale importer imports a kilogram quantity of synthetic opioids for further distribution to distributors who then further retail them downstream to users.

<sup>b</sup> A retail importer imports a gram quantity and directly sells to users.

<sup>c</sup> Producer here refers to individuals or firms that produce and sell finished synthetic opioids.

<sup>d</sup> Wholesale distributors obtaining product from importers are doing so at 10-percent purity, which is substantially less than someone importing a retail level amount at 95-percent purity.

<sup>e</sup> The raw price per kg to the user for retail quantities imported online is less than the raw price per kg to the retailer for retail quantities imported online. This is because the potency sold to users is closer to 3 percent versus the 95-percent purity level for those importing retail quantities.

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45 In fact, this has been documented to occur, as federal authorities have prosecuted several cases involving small groups of highly skilled individuals who import wholesale amounts of product from the PRC, dilute it for retail sales, and then use the darknet and domestic mail system to distribute. For more, see Kristin M. Tennyson, Charles S. Ray, and Kevin T. Maass, Fentanyl and Fentanyl Analogues: Federal Trends and Trafficking Patterns, Washington, D.C.: U.S. Sentencing Commission, January 2021; see also District of Utah, U.S. Attorney’s Office, U.S. Department of Justice, “Shamo Sentenced to Life in Prison After Conviction for Organizing, Directing Drug Trafficking Organization,” press release, Salt Lake City, October 15, 2020.
TOWARD COSTS, BENEFITS, AND RISK-INFORMED DECISIONS

The leadership of the U.S. government on all levels is concerned about the evolution of the synthetic opioid epidemic. Organizations across the federal governments, as well as state, local, tribal, and territorial governments, are dedicated to mitigating the threat that drugs pose to Americans. In the U.S. Department of Homeland Security (DHS) and the U.S. Department of Justice (DOJ), as well as local governments, organizations collaborate closely to abate the supply of synthetic opioids available in the United States. Although these organizations share a common goal, they have unique roles and direct their resources toward different processes that make up the whole of a mitigation strategy.

Seizures Represent a Small Portion of the Drug Supply

Earlier research estimated the portion of the drug supply that was seized by law enforcement, which calculated the total seized amount, and compared it to the total inferred amount of drugs imported to the United States. Kleiman and Reuter estimated (perhaps generously) that around 25 percent of the cocaine shipped to the United States was seized, in aggregate and across law enforcement agencies. They estimated that between 10 and 22 percent of marijuana shipped to the United States was seized. Assuming that manufacturers would ship drugs to the United States to replace those that were seized, the authors calculated what would be the effect on the price of drugs at retail if seizures were doubled. The authors estimate that doubling seizures would hypothetically amount to a 13-percent increase in drug costs.46

Options to Increase Seizures

Organizations in the United States invest vast resources in seizing drugs. One can observe the seizures of drugs by CBP organizations, seized by Office of Field Operations (OFO) officers at land border entry points, by Border Patrol officers in areas near to borders, and by OFO officers at IMFs. One can compare the seizures of synthetic opioids at these locations by these organizations.

The Commission analyzed the potential to increase seizures of fentanyl and other synthetic opioids coming into the United States. The Commission presents a simple analysis comparing the recent seizure data with the staffing levels of personnel for the modes and locations of entry. The Commission analyzed the effect that marginal increases may have on seizure levels.

Seizures by CBP largely occur at points of entry along the southwest border, at IMFs, ECC depots, and by the U.S. Border Patrol between points of entry.47 Although it may seem obvious, it is worth noting that the seizure of fentanyl or other synthetic opioids by CBP officers represents a very small portion of CBP total activities. As a result, any calculation of effectiveness for seizures of these substances should not be interpreted as a measure of their overall effectiveness but rather a method for projecting the expected increase (or decrease) in seizures based on staffing changes.


47 Synthetic opioids are also seized by local law enforcement. Data describing these seizures are available and used in this research to understand trends in the type of opioids observed, form (i.e., pill or powder), mixtures with other drugs, purity, chemical markers that indicate how the drugs are manufactured, and their points of origin. Although the Commission interprets these data to be representative of the drug supply and seizures in the United States, it understands the data to represent only a portion of the drugs seized, and the Commission does not know what portion it represents. CBP seizure data represent the total number of seizures and can be used to project the counts and volumes of future seizures.
Table C.7 compares the seizures and their purity-adjusted weights in 2020 by CBP with their point-of-entry method with the approximately 2020 staffing levels of CBP agents and officers for those POEs. The analysis indicates that the purity-adjusted weight of the seizures per staff at the southwest-border POEs and the IMFs are the largest, albeit with a significantly higher number of seizures per staff at IMFs. Consistent with total number of seizures, the seizure counts and volumes per staff are much lower at northern-border POEs and by the Border Patrol in the northern sectors.

Table C.7
Comparing 2020 CBP Seizures of Fentanyl and Analogues with POE Classification

<table>
<thead>
<tr>
<th>POE</th>
<th>Agents and Officers</th>
<th>Seizures</th>
<th>Weight, in Kilograms</th>
<th>Seizures per 100 Agents</th>
<th>Weight per 100 Agents, in Kilograms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Raw</td>
<td>Purity Adjusted</td>
<td>Raw</td>
</tr>
<tr>
<td>Southwestern Border POEs</td>
<td>7,500</td>
<td>932</td>
<td>2,909.7</td>
<td>203.7</td>
<td>38.8</td>
</tr>
<tr>
<td>Northern Border POEs</td>
<td>3,900</td>
<td>68</td>
<td>7.6</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>International Mail Facilities (IMFs)</td>
<td>170</td>
<td>141</td>
<td>5.8</td>
<td>5.5</td>
<td>3.4</td>
</tr>
<tr>
<td>Border Patrol</td>
<td>19,470</td>
<td>218</td>
<td>422.8</td>
<td>29.6</td>
<td>2.2</td>
</tr>
</tbody>
</table>


NOTE: Purity-adjusted weights are approximated based on average purity level of seizures. Purity at border points of entry and by Border Patrol is assumed to be 7 percent on average, and purity at IMFs is assumed to be 95 percent on average, as observed in seizure data. Officer counts at IMFs and northern- and southwest-border POEs are approximate 2021 levels.

In addition to seizing drugs at the points of entry and along the border, interdiction within the United States occurs and affects the overall rate and quantity of seizures. Data from NFLIS for 2020 show more than 5,000 kg of drugs seized containing fentanyl or other novel synthetic opioids (unadjusted for purity). These data do not, however, represent all of domestic seizures and come from a wide variety of law enforcement organizations. More narrowly, the U.S. Postal Inspection Service (USPIS) seized 218 kg of synthetic opioids (unadjusted for purity) from 425 seizures in FY 2020. Given that the average purity level is likely similar to those at the wholesale import level of 7 percent noted above, with approximately 1,200 USPIS agents, this translates into a seizure rate of 35.4 per 100 agents, raw weight of 18.2 kg per 100 agents, and purity-adjusted weight of 1.3 kg rate per 100 agents. These rates per staff are roughly comparable to those at CBP’s southwest border. Again, it is worth emphasizing that USPIS agents perform a variety of law enforcement activities, not simply limited to the interception of illegal drugs.

48 U.S. Postal Inspection Service, “What Do United States Postal Inspectors Do?” webpage, undated. However, not all USPIS personnel are dedicated to drug law enforcement and must investigate other crimes.
In addition to assumptions about the volume of fentanyl itself, the analysis in this section assumes a linear increase in seizures with added personnel. This assumption seems reasonable for modest increases in personnel due to the fact that inspections are largely a function of personnel resources. A large shift in personnel could have nonlinear effects. For specific increases in staffing, one should weigh the benefits of additional personnel at specific POEs with their seizure volumes, along with competing demands of the many other activities those agents perform.

However, this analysis is limited by the fact that seized fentanyl can be easily replaced with additional fentanyl, much more so than heroin, which relies on plant-based inputs that take time to mature and harvest. Therefore, assuming any appreciable effect on seizures discounts TCO efforts to ship more or engage in other countermeasures, including increasing the purity and decreasing the load of product smuggled, to reduce seizure rates. Law enforcement cannot assume that traffickers will not adapt to increased interdiction efforts.

**Options to Increase Prices**

Research literature has considered how seizures of drugs may lead to price increases for users. A fundamental relationship between seizures and prices was published in the context of marijuana seizures.\(^4^9\) One can use this formula to project how the current supply chain for synthetic opioids may be affected by changes in interdictions. The assumptions taken from their earlier work may not translate to synthetic opioids, which has a shorter replacement time due to its production advantages, but nonetheless, this illustration shows how increases in seizures may have only a modest effect on price.

The Commission considered the current estimated price for fentanyl at export, which is the location in the supply chain where the majority of seizures take place—at land points of entry—as well as the amount of fentanyl seized. The analysis can be performed at greater fidelity by explicitly accounting for seizures at locations in the interior of the United States in addition to seizures at the border. However, the calculations are robust at a high level, and general implications for policymaking are consistent when assumptions change across a range of reasonable values.

The Commission used inputs of 4,000 kg of fentanyl seized, raw weight (unadjusted for purity) to represent seizures in 2020. The Commission estimated the annual U.S. consumption to be 5 metric tons of pure fentanyl, which is consistent with other analyses described in Appendix B. The Commission projected how increasing the amount of fentanyl seized would cause prices paid by users to increase (see Figure C.5).

The Commission projects that increasing the amount of fentanyl seized by 50 percent, which amounts to an increase in seizures of from 4,000 kg to 6,000 kg, would cause prices for fentanyl to increase by approximately 5 percent.

This analysis is based on the assumption that fentanyl manufacturers are able to produce more drugs and would increase their shipments of drugs to replace the drugs seized. The Commission acknowledges that this assumption complicates interpretation of the effectiveness of drug seizures. If one understands TCOs in Mexico to have the ability to traffic more drugs to the United States in response to an increase in seizures, it is complicated to describe how seizing drugs from the supply chain may lead to a direct decrease in drug use. One can infer that a temporary shortage of drugs occurs when drugs are seized.

DRUG DEALERS MAY ADAPT TO DEFEAT MITIGATION POLICIES

Reuter and Kleiman note that the costs to smuggle drugs into the United States remain small, relative to the retail prices of drugs. If U.S. law enforcement organizations were to increase their ability to make seizures, such as at the border, drug smugglers could adapt by shipping drugs in a higher number of smaller packages or by increasing the purity of drugs that are smuggled. Presently, seizures of counterfeit pills are 1- to 2-percent pure. Traffickers could easily increase the purity and reduce the size of drugs smuggled as packages cross the border, converting drugs to tablets or retail-grade product once in the United States. This adaptation would have costs for the dealers, including establishing processing facilities and other distribution hubs, but they would still be able to make sizable profits with modified practices. Alternatively, should interdiction become so successful that Mexican TCOs no longer are able to supply the United States, what is to stop someone from domestically producing fentanyl with precursor inputs?

To understand how the supply chain for synthetic opioids may function in the future, it is helpful to consider that low production costs, coupled with historic precedent and emerging trends in Canada, might result in a shift in where fentanyl is produced. An individual with basic skills in chemistry and the connections to illegal drug distribution could begin to supply local drug markets. Therefore, it is useful to describe a set of models (simplified descriptions) of the infrastructure for manufacturing, distributing, and selling drugs. These parameters and relationships are used to project the costs and benefits of options to intervene in the supply of synthetic opioids and to better anticipate the behavior and decisions of supply chain actors in response to policy interventions, changes in the market for drug purchases, and evolutions in technology. Research was conducted

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on the costs and burden of establishing drug-making facilities at various levels of sophistication. It is unclear if these costs are reflective outside of the United States, though one could assume such fixed costs in the PRC or Mexico would be substantially lower.

The estimated cost to establish a range of fentanyl production facilities is based on facility costs, equipment costs, and raw material (or input) costs. Facility costs were obtained from discussions with industry experts who establish new labs for pharmaceutical and biological research and production laboratories. These experts have extensive experience in establishing and equipping professional laboratory spaces to meet U.S. Food and Drug Administration (FDA) standards. The bill of material for equipment was based on media reporting and interviews with fentanyl cooks in Sinaloa, Mexico, and a 2019 White House ONDCP advisory. The cost of building a lab can be considered a fixed start-up cost to the manufacture of drugs. Once a lab is established, the cost to produce drugs will be related to the costs of raw materials.

Facility Costs

Facility costs include caseworks (or lab furnishings); the establishment of heating, ventilation, and air-conditioning (HVAC); air filtration systems; negative pressure environments; gowning and degowning entry and exit rooms; and other environmental controls for safety and cleanliness. Depending on the type of lab, all or none of these investments will be made. It is assumed that a lab is 200 square feet in size, and the Commission provides costs per square foot and installation times based on actual lab construction for the “FDA trial lab” and “university lab” illustrations. The “kitchen lab” and “jungle lab” estimates were made in consultation with the same professional lab experts after showing them photographs of such labs in the field. The estimated facility costs for each of the lab types as well as installation times (in days) are shown in Table C.8.

### Table C.8

**Estimated Costs to Establish Lab Facilities**

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Cost per Square Foot, in Dollars</th>
<th>Size, in Square Feet</th>
<th>Facility Cost, in Dollars</th>
<th>Installation Time, in Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDA trial lab, including state-of-the-art HVAC and filtration systems, negative pressure, and a gowning/degowning entry/exit room</td>
<td>500</td>
<td>200</td>
<td>100,000</td>
<td>180</td>
</tr>
<tr>
<td>University lab, including HVAC with filtration and fume hoods</td>
<td>250</td>
<td>200</td>
<td>50,000</td>
<td>90</td>
</tr>
<tr>
<td>Kitchen lab, including at least one fume hood or dedicated venting system</td>
<td>15</td>
<td>200</td>
<td>3,000</td>
<td>7</td>
</tr>
<tr>
<td>Jungle lab, assuming that the land is free but that there might be incidental costs for security</td>
<td>1</td>
<td>200</td>
<td>200</td>
<td>1</td>
</tr>
</tbody>
</table>

SOURCE: Cost, size, and installation data are based on interviews with experts in pharmaceutical and biotechnology firms and were verified with pricing from laboratory equipment companies.

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The “FDA trial lab” costs are approximately $500 per square foot, which is an average cost per square foot based on 2020 and 2021 construction costs. A 200-square-foot “FDA trial lab” will take approximately 180 days to establish and will be suitable for conducting the most rigorous experiments subject to FDA oversight, or in the case of manufacturing synthetic opioids, ensuring the highest quality product, including steps to refine and purify synthetic opioids. The “university lab” will cost approximately $250 per square foot and take 90 days to complete. This lab will be high quality but with fewer controls, no negative pressure, and no gowning and degowning entry and exit rooms.

The “kitchen lab” could be built for approximately $50 per square foot at the high end, with much lower costs being achieved if safety, air quality, and cleanliness are not priorities. Adding a fume hood would add between $2,500 (used) and $15,000 to the total cost of the “kitchen lab” but would provide much better exhaust and safety conditions than venting through static tube venting that is typically found in a “kitchen lab.” Finally, the “jungle lab” facility costs could be as little as $0, but the Commission has estimated the costs to be $1 for the purposes of its estimation, with an assumption that some small bribes or other security measures might be necessary to keep the location secret.

**Lab Equipment Costs**

The 2019 ONDCP “Advisory to the Chemical Manufacturing Industry on Illicit Activity and Methods Related to the Manufacturing of Fentanyl and Synthetic Opioids” is used as a bill of materials (or equipment list) to estimate the cost to equip a high-end lab. All of this equipment may be ordered from a single website in one hour, though would-be producers are likely to separate purchases to not arouse suspicion. The estimated cost for all of the necessary materials in the ONDCP advisory is approximately $65,000 (Table C.9). However, the equipment on the same list may be purchased and used for between $15,000 and $35,000.

The “university lab” equipment setup may be slightly less than the “FDA trial lab,” but depending on the lab’s funding, they could be comparable. What the Commission would consider to be an adequate lab equipment setup for a “university lab” would cost approximately $43,000 (see Table C.10).

However, a “kitchen lab” or “jungle lab” is less likely to have all this material, and there is evidence based on recent journalism that a “jungle lab” may be equipped for as little as $300.

In short, the low start-up costs and small footprint of different clandestine synthesis laboratories pose substantial challenges to counterdrug efforts should illegal imports of fentanyl decline due to improved interdiction, or source-country controls increase risks enough to disrupt supply. Emerging clandestine fentanyl synthesis laboratories in Canada offers perhaps a peek into the future, and the United States has had a history of clandestine fentanyl manufacture, albeit often short or small relative to today’s problem.

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53 Avantor, homepage, undated.

### Table C.9

**Estimated Cost of Equipment Listed in the 2019 ONDCP Advisory Bill**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Size</th>
<th>Number of Units</th>
<th>Per Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buchner funnel</td>
<td>≥12 cm diameter</td>
<td>1</td>
<td>850.00</td>
<td>850.00</td>
</tr>
<tr>
<td>Filter paper</td>
<td>≥12 cm diameter</td>
<td>100</td>
<td>0.21</td>
<td>21.00</td>
</tr>
<tr>
<td>Separatory funnel</td>
<td>≥2 L</td>
<td>1</td>
<td>750.00</td>
<td>750.00</td>
</tr>
<tr>
<td>Erlenmeyer flask</td>
<td>≥2 L</td>
<td>6</td>
<td>33.33</td>
<td>200.00</td>
</tr>
<tr>
<td>Round bottom flask</td>
<td>≥2 L</td>
<td>1</td>
<td>250.00</td>
<td>250.00</td>
</tr>
<tr>
<td>Heating mantle</td>
<td>≥2 L</td>
<td>1</td>
<td>450.00</td>
<td>450.00</td>
</tr>
<tr>
<td>Reactor, pilot plant</td>
<td>≥2 L</td>
<td>1</td>
<td>25,000.00</td>
<td>25,000.00</td>
</tr>
<tr>
<td>Distillation column (any length)</td>
<td>Joint sizes: 19/22, 24/40, 35/50, or ball point</td>
<td>1</td>
<td>200.00</td>
<td>200.00</td>
</tr>
<tr>
<td>Condenser (any length)</td>
<td>Joint sizes: 19/22, 24/40, 35/50, or ball point</td>
<td>1</td>
<td>150.00</td>
<td>150.00</td>
</tr>
<tr>
<td>Organic glassware kit</td>
<td>Joint sizes: 19/22, 24/40, 35/50, or ball point</td>
<td>1</td>
<td>50.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Column, chromatography</td>
<td>≥6 cm diameter, any length</td>
<td>1</td>
<td>1,000.00</td>
<td>1,000.00</td>
</tr>
<tr>
<td>Rotary evaporator and chiller</td>
<td>Any size or make</td>
<td>1</td>
<td>13,000.00</td>
<td>13,000.00</td>
</tr>
<tr>
<td>Funnel, addition</td>
<td>≥2 L</td>
<td>1</td>
<td>500.00</td>
<td>500.00</td>
</tr>
<tr>
<td>Magnetic stirrer</td>
<td>Any size or make</td>
<td>1</td>
<td>2,000.00</td>
<td>2,000.00</td>
</tr>
<tr>
<td>Hotplate with magnetic stirrer</td>
<td>Any size or make</td>
<td>1</td>
<td>500.00</td>
<td>500.00</td>
</tr>
<tr>
<td>Pill press</td>
<td>5,000 pills per hour</td>
<td>1</td>
<td>20,000.00</td>
<td>20,000.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>64,921.00</strong></td>
</tr>
</tbody>
</table>

*SOURCE: The equipment list is from ONDCP, “Advisory to the Chemical Manufacturing Industry on Illicit Activity and Methods Related to the Manufacturing of Fentanyl and Synthetic Opioids,” 21st Century Drug Trafficking: “Manufacturing Advisory” on Fentanyl and Other Synthetic Opioids, tab A, August 21, 2019. Product information and costs were retrieved on December 1, 2021, from Avantor, homepage, undated.*
Table C.10

Estimated Cost of University Lab Equipment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Number of Units</th>
<th>High Cost, in Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot plant reactor (10 L)</td>
<td>1</td>
<td>15,000.00</td>
</tr>
<tr>
<td>Evaporation coil setup, rotary (5 L)</td>
<td>1</td>
<td>8,000.00</td>
</tr>
<tr>
<td>Hotplate with magnetic stirrer (11 in.)</td>
<td>1</td>
<td>1,500.00</td>
</tr>
<tr>
<td>Heating mantle (large)</td>
<td>1</td>
<td>1,500.00</td>
</tr>
<tr>
<td>Rotary evaporator and chiller</td>
<td>1</td>
<td>13,000.00</td>
</tr>
<tr>
<td>Column, chromatography</td>
<td>1</td>
<td>1,000.00</td>
</tr>
<tr>
<td>Organic glassware kit</td>
<td>1</td>
<td>50.00</td>
</tr>
<tr>
<td>Magnetic stirrer</td>
<td>1</td>
<td>2,000.00</td>
</tr>
<tr>
<td>Digital balance (scale)</td>
<td>1</td>
<td>500.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>42,550.00</strong></td>
</tr>
</tbody>
</table>

SOURCE: The equipment list is from ONDCP, “Advisory to the Chemical Manufacturing Industry on Illicit Activity and Methods Related to the Manufacturing of Fentanyl and Synthetic Opioids,” 21st Century Drug Trafficking: “Manufacturing Advisory” on Fentanyl and Other Synthetic Opioids, tab A, August 21, 2019. Product information and costs were retrieved on December 1, 2021, from Avantor, homepage, undated.

LIMITATIONS TO TRADITIONAL SUPPLY REDUCTION

Considering the changing supply chain for illegally manufactured synthetic opioids (i.e., more condensed, quicker to respond to interdiction, cheaper to produce and easier to distribute online and by mail, etc.), it is appropriate to ask how traditional supply reduction apply to this problem. Illegally supplied synthetic opioids presents novel challenges for supply-reduction efforts. However, it is important to understand that supply-reduction efforts aimed at more traditional drugs, such as heroin, have also met with limited success as the price of both cocaine and heroin are notably lower than they were decades ago.55

Other efforts focused on disrupting production in source countries have also run into obstacles. Local production costs are minuscule compared to final drug prices because of the huge markups along the supply chain. Even if it is possible to raise primary production costs substantially, the effect on retail prices could be much less.56 Regarding interdiction, drug traffickers have an incentive to use elaborate countermeasures. Supply disruptions are often

55 Jonathan P. Caulkins, Peter Reuter, Martin Y. Iguchi, and James Chiesa, How Goes the “War on Drugs”? An Assessment of U.S. Drug Problems and Policy, Santa Monica, Calif.: RAND Corporation, OP-121-DPRC, 2005; Gregory Midgette, Steven Davenport, Jonathan P. Caulkins, and Beau Kilmer, What America’s Users Spend on Illegal Drugs, 2006–2016, Santa Monica, Calif.: RAND Corporation, RR-3140-ONDCP, 2019. Although it is unknown how much lower drug prices would have been in the absence of supply-reduction efforts, it is important to recognize that drug prices are a function of other factors as well.

overcome through alternative means of sourcing, transport, and routes. Domestic law enforcement efforts are also limited because drugs and dealers are often easily replaced through the diffuse drug distribution networks.

This is not to say that supply-reduction efforts cannot produce positive results. For instance, supply-reduction efforts could be particularly helpful in tackling nascent and emerging drug markets. In recent history, this includes successfully shutting down emergent illegal fentanyl laboratories in North America in the 1990s and 2000s. However, the effectiveness of supply reduction in mature and well-established markets with developed distribution networks and easy replacement of removed actors and goods is more limited, even before the onset of synthetic opioids.

Condensed Supply Chains and Collapsing Prices

Despite some past disruptions, the move from heroin to fentanyl by illegal suppliers is having important consequences for the supply chain and drug supply-reduction responses. Eliminating layers in the supply chain and increasing production efficiency all point to radical transformations (see Figure C.1). From a supply-reduction standpoint, these developments present new challenges but may also severely limit the ability with which traditional efforts can affect the price of drugs sold in markets.

Removal of primary layers, such as cultivators or processors, means that criminal groups in Mexico that move from heroin to fentanyl are able to cut costs, keeping more earnings. Further, Mexico-based manufacture of counterfeit tablets, which are ready for retail distribution and require no further dilution or processing, removes additional steps that occur in the United States and might allow TCOs greater control over product distribution.

Condensed supply chains and production of cheaper alternatives is likely to reduce prices of drugs sold in retail markets. Prices for illegally supplied fentanyl may already be declining. In analyzing data on drug seizures by law enforcement agencies, the Commission finds that the purity-adjusted price for fentanyl at the mid-upper levels of the market, which means purchases involving 10 g to 100 g of raw powder, fell on the order of 50 percent between 2017 and 2020. The data do not provide enough information to know whether this is a decline in the retail price or whether this decline applies to counterfeit tablet as well as powder formulations. Additional analyses suggest that this price decline for purchases of powder in the 10 g–to–100 g range is driven by purchases made in the northeast


62 By quantity level, the Commission compared the mean and median price per pure gram over time, as well as regressed the price on pure grams purchased with year and city-level fixed effects. This was also divided by the total amount spent by the total amount of pure fentanyl purchased. This is the equivalent of weighting each observation by the number of pure grams in it, rather than weighting each observation equally. See Appendix B for additional details.
region of the United States, where markets are most saturated and closer than other parts of the country to becoming mature fentanyl markets.

Applying Supply-Reduction Interventions to Synthetic Opioids

Traditional supply-reduction tools aimed at heroin can be adapted to varying degrees to the problem of illegally supplied synthetic opioids, as Table C.11 summarizes. That said, across all levels, the challenges are greater when it comes to reducing synthetic opioid supply.

Table C.11
Possible Supply-Reduction Options Aimed at Various Market Levels

<table>
<thead>
<tr>
<th>Market Level</th>
<th>Supply Reduction Tool</th>
<th>Opportunities</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary production of inputs</td>
<td>Precursor controls; enhanced scheduling of entire drug or chemical structures; strengthening industry oversight and encouraging industry to report on movements of chemicals. Targeting vendors that openly transact in chemicals online</td>
<td>Illegal production emanates from supply of precursors and new drugs, lending to leverage points in supply; targeting online vendors who openly advertise online to deter online sourcing</td>
<td>Difficult to impose greater (national and international) chemical controls and extend schedules; might face difficulties to improve oversight of large industries in Asia. Chemical controls could displace production to new chemicals/substances Enhancing online surveillance and regulation might require oversight of internet platforms</td>
</tr>
<tr>
<td>Processing</td>
<td>Enhance controls over equipment needed to manufacture counterfeit tablets</td>
<td>Have been suggested to reduce illegal manufacture of counterfeit tablets in Canada</td>
<td>Could be challenging given reliance on limited enforcement in the PRC and Mexico; might encourage greater domestic production if successful</td>
</tr>
<tr>
<td>Trafficking</td>
<td>Enhance detection capabilities and threat prediction for inbound packages, containers, vehicles, and individuals</td>
<td>Ports of entry could become harder targets</td>
<td>Traffickers might adapt by moving higher purity product; shift to other penetrative means</td>
</tr>
<tr>
<td>Wholesale distribution</td>
<td>Target the most egregious of distributors handling potent chemicals, counterfeit tablets, or mixtures containing non-opioids</td>
<td>Targeting online distribution, most harmful suppliers (e.g., those that mix with stimulants)</td>
<td>Could be resource intensive, requiring substantial analysis and information</td>
</tr>
<tr>
<td>Retail distribution</td>
<td>Target the most egregious of retailers handling potent chemicals, counterfeit tablets, or mixtures containing non-opioids</td>
<td>Increasing operational risks for more dangerous dealers</td>
<td>Could be resource intensive, requiring substantial analysis and information</td>
</tr>
</tbody>
</table>
Production and Processing

In terms of the raw inputs, as noted earlier, there are no cultivators in the production of synthetic opioids. Instead, efforts would require a focus on policing chemical manufacturers who might not be violating laws in their home countries. The precursors needed to produce fentanyl are widely available, with many not controlled internationally, in the United States, or by country-specific laws in the PRC, India, or Mexico.

This means authorities will need to conduct investigations into improper handling or transferring of chemicals as well as more frequent unannounced inspections to examine operations and records rather than eradicate swaths of illegal crops. Given smaller production quantities, there are also substantially fewer laboratories to target (alternatively, dismantling major processing operations could disrupt supply to a greater degree assuming TCOs do not stockpile inventory as insurance against seizures). Greater focus should also be placed on constraining the ability with which producers can openly transact or advertise chemicals online using internet platforms. Enhanced controls over equipment needed to manufacture counterfeit tablets is another regulatory option, though it may be limited given the low cost of some tableting machines and the ingenuity of some criminal suppliers to circumvent regulations.

 Trafficking

Interdiction remains an available but perhaps diminished tool, as trafficking loads can be smaller in weight, and the risk can be spread out over more border crossings. Because fentanyl is synthetic, the total elapsed time from deciding to produce and obtaining finished product can be days or weeks, depending on delivery delays for precursors, which is much shorter than a full growing season needed for any plant-based drugs. That means the supply chain for fentanyl can respond faster to interdiction or production disruption successes. Consequently, there is little to be gained by increasing the risk of interdiction at the border when considering how cheap synthetic opioids are to make and how easily they can be concealed.

The fact that Mexican TCOs are trafficking in low-purity fentanyl should give one pause. Traditionally, drugs trafficked over the border were at their highest purity, often upward of 80 percent or more depending on the drug as smuggling in smaller volumes at greater purity reduces risks. Yet, fentanyl trafficked from Mexico is often found in purities less than 10 percent. The increasing amounts of counterfeit tablet seizures, which are closer to 1 percent in purity, suggests that it is profitable for TCOs to smuggle counterfeit pills that are 99-percent filler.

Powder formulations of fentanyl from Mexico also do not approach the purity levels seen in the product coming by mail from the PRC. Over time, should TCOs be affected by interdiction in ways that reduce their earnings, they

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63 Examples include inspectors reviewing the records of chemicals in and out of facilities, reviewing lists of licensees to determine who, if any, have prior rule violations, examining logs of employees who have access to labs, etc.

64 Heroin seizures in the four southwestern border states larger than 1 kg have an average purity of 60 percent according to analysis of STRIDE data done for this report. It is closer to half that amount by the time it reaches retail.


66 A standard oxycodone tablet has a gross weight of 135 mg, and DEA’s analysis, reported in various Fentanyl Signature Profiling Reports, of counterfeit pills suggests that they may contain as much as 2 mg of fentanyl, meaning they have an estimated average purity of about 1 to 2 percent.

67 There are several possible explanations for why TCOs may be trafficking in counterfeit tablets containing minute quantities of fentanyl. One is that their manufacture is easier to conceal in Mexico given lacking enforcement over drug production and importation of tableting machines; product quality and consistency can be assured when manufacturing at industrial scale; or new products, such as counterfeit tablets, offer opportunities to enter new markets by attracting individuals who are reluctant to use heroin.
could take steps that will further complicate interdiction. One option is to smuggle smaller volumes of fentanyl at higher purities. Smaller volume might encourage other means of getting fentanyl across the border, including the use of unmanned aerial vehicles or reliance on greater use of body packing.\footnote{A push to circumvent border detection by smuggling small amounts of pure fentanyl in body cavities should be given consideration in light of the potential life-threatening consequences this might have on low-level drug couriers should concealed drugs enter the bloodstream.}

Implementation of such options might suggest refocusing interdiction efforts from final products to precursor compounds. A focus on maritime container and air cargo shipments departing the PRC or arriving in Mexico could concentrate interdiction efforts where loads of precursors are largest, most pure, and in conveyances that might present fewer harmful countermeasures—that is, misidentifying or secreting shipments of fentanyl precursors is less harmful than concealing pure fentanyl in body cavities to get it across the border. However, this type of counternarcotics approach necessarily relies on the capacities and efforts of Chinese authorities, who might be reluctant to comply, and Mexican authorities, who face internal challenges of drug-related violence and corruption.

\textit{Wholesale and Retail Distribution}

Targeting wholesalers remains an option, but the use of synthetic opioids that are not included in existing drug control schedules might limit the ability to prosecute these individuals in some instances due to the challenges of prosecuting a case under the Federal Analogue Act.\footnote{Public Law 99-570, Anti–Drug Abuse Act of 1986, October 27, 1986, Title I, Anti-Drug Enforcement; Subtitle E, Controlled Substance Analogue Enforcement Act of 1986.} Retail distribution disruption is equally challenging given the expanding use of online platforms and mail order services.

In fact, mail order delivery makes it much harder for domestic drug enforcement officers to reduce both wholesale and retail levels of supplies used in opioid manufacture. Because buyers and sellers could use legitimate supply channels and the internet to facilitate transactions, traditional law enforcement efforts, such as building cases through buy-busts of open-air transactions, have limited utility. Instead, improving ways to screen mail and packages within Fourth Amendment protections against unlawful search and seizures might be a more fruitful approach. Efforts aimed at wholesale distribution might be more socially beneficial if they focus on the most egregious actors—those who transact in novel synthetic opioids that are more potent, the most violent, those who manufacture or distribute counterfeit tablets, and those who mix with non-opioids.

Retail distribution might require an entirely new focus, as an unknown but consequential share of synthetic opioids are not sold in street markets that provide opportunities for law enforcement interventions to disrupt transactions, increase search times, or deter buyers from finding sellers. Instead, retail drug law enforcement might benefit from swiftly investigating overdose deaths resulting from synthetic opioids or collecting and analyzing seizures to better inform market trends.\footnote{However, concerns remain over how not to increase severity of punishment for low-level dealers who may not be aware of what they are handling.}

\textit{Money Laundering}

Focus on money-laundering services to seize illegal proceeds remains a laudable but limited tool for disrupting TCOs. Although the move to synthetic opioids presents some challenges as some share of online transactions utilize cryptocurrency or wire transfers that are below common suspicious activity reporting thresholds, total revenues generated from illegal exportation of synthetic opioids or related precursor chemicals are relatively small.
Nevertheless, efforts to seize suspected proceeds or freeze accounts of shell companies in Mexico suspected of importing precursors can be disruptive to criminals.

In general, adaptations and additional approaches will need to be considered to increase the effectiveness of supply-reduction efforts. All tools identified offer opportunities, but employing them will not be without challenges (see Table C.11). Synthetic opioids have profoundly changed the playing field, and traditional supply reduction cannot be the only response. As such, even as illegal supply is addressed, approaches to reduce demand for illegally manufactured synthetic opioids by offering medication for opioid use disorder need to be an integral part of responding to the current opioid crisis.
Appendix D

CHEMICAL SYNTHESIS AND EMERGING TECHNIQUES FOR SYNTHESIS AND DETECTION

OVERVIEW AND RESEARCH QUESTIONS

This appendix documents the synthesis of fentanyl and other synthetic opioids to illustrate the differences in production techniques and the varied nature of manufacturing routes and chemical inputs. The research builds on the existing literature based on chemical synthesis and explores the extent to which fentanyl compounds can be manufactured. In short, several synthetic opioid compounds are highly potent and chemically versatile, allowing them to be easily manipulated in various ways that circumvent the law. Further, use of precursors that are common and easily substitutable confound supply-reduction efforts aimed at restricting access to chemicals. Structural manipulation of compounds can challenge detection capabilities, as existing technologies might not be effective at detecting newer substances, and new drugs might not be explicitly prohibited in drug control schedules, which can sometimes limit the prosecution of suppliers. Last, synthesis of drugs such as fentanyl is increasingly made easier and more accessible to nonchemists.

This appendix explores several research questions related to the production of synthetic opioids, fentanyl in particular, including the following:

- What have been the trends in synthesis of fentanyl and how do synthesis routes differ in terms of inputs or technical expertise required?
- What types of precursor chemicals are used to make fentanyl or other synthetic opioids and how available are they?
- What other emerging synthetic opioids have been detected in recent years and how do they compare to fentanyl in terms of potency or ease of production?
- What are the possible future methods of producing synthetic opioids?

Answers to some of these questions can better inform the mechanisms of chemical synthesis of these opioids and offer a critical understanding of future control efforts over precursors (or the limitations therein) and means to detect novel synthetic opioids.

FENTANYL SYNTHESIS

The Main Synthetic Approaches to Fentanyl

Today, the synthetic approaches used by illegal fentanyl manufacturers are robust and can be readily applied by low-skill chemists to produce fentanyl at large scale with sufficient purity. Over time, the methods reported in the research literature have improved, making synthesis easier and less dangerous to the chemist. These advances in synthesis are likely to have contributed to the expansion of illegal fentanyl production. Presently, starting materials used in synthesis routes, with few exceptions, are used widely in industry and academia and so they are both available and unregulated. Moreover, precursors are readily substitutable, enabling evasion of regulatory controls and the easy manufacture of fentanyl analogues (drugs with minute differences in chemical structure and potency). The laboratory infrastructure required for these synthetic approaches is also widely available. Standard laboratory equipment (e.g., beakers, flasks, and separation kits) can be purchased on the commercial market and specialized equipment that requires expertise to handle (e.g., a Schlenk line) is not required. Also, there are few impediments to substituting rudimentary construction buckets or kitchenware for reaction flasks, although yields could suffer.

The illicit production of fentanyl is typically carried out using one of five known methods: Janssen, Valdez, Gupta, Siegfried, and Dieckmann. Details regarding these synthetic pathways are shown in Table D.1. These manufacturing routes differ slightly in the number of unique steps, the number of purification steps, the production yields, and the specific precursors used. All precursors listed in Table D.1 are uncontrolled in the United States and elsewhere and are widely available through legitimate commercial sources. Further, in most cases, shortages of one specific precursor can be readily substituted with an alternative reagent. Some reagent substitutions can lead to identical products (e.g., using 2-bromoethylbenzene instead of 2-chloroethylbenzene), but using structural analogues of precursors will generate structural analogues of fentanyl. Subject-matter experts have indicated that further innovations to improve and/or simplify these production routes are not needed: Their synthetic ease, achievement of sufficient yields of fentanyl, and high availability, high substitutability, and low cost of starting materials and laboratory infrastructure render them readily adoptable.
Table D.1
Details Regarding the Common Synthetic Pathway Used to Produce Fentanyl

<table>
<thead>
<tr>
<th>Method</th>
<th>Number of Steps</th>
<th>Synthetic Difficulty</th>
<th>Yield, as a Percentage</th>
<th>Precursors</th>
<th>Precursor Availability</th>
<th>Precursor Substitutability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Janssen</td>
<td>3</td>
<td>Moderate</td>
<td>~10</td>
<td>1-benzyl-4-piperidone; aniline; lithium aluminum hydride; propionic anhydride; 2-chloroethylbenzene</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Valdez</td>
<td>3</td>
<td>Moderate</td>
<td>73–78</td>
<td>4-piperidone; 2-bromoethylbenzene; aniline; propionic anhydride</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Gupta</td>
<td>1</td>
<td>Low</td>
<td>&gt;60</td>
<td>4-piperidone; phenylacetaldehyde; aniline; propionyl chloride</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Siegfried</td>
<td>3</td>
<td>Low</td>
<td>Near 100</td>
<td>4-piperidone; 2-bromoethylbenzene; aniline; propionyl chloride</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Dieckmann</td>
<td>4</td>
<td>Moderate</td>
<td>?</td>
<td>Methyl acrylate; phenylethylamine; p-xylene; propionic anhydride</td>
<td>High</td>
<td>Moderatef</td>
</tr>
</tbody>
</table>


NOTES: Solvents have been excluded.

a Synthetic difficulty was assessed on a three-point scale consisting of low, medium, and high—see text for details on the assessment.

b Identical starting materials are indicated via font color.

c Reaction yields were specified in the cited literature sources and are calculated by dividing the amount of product obtained in the manufacturing process by the theoretical yield (the amount of product that can be produced by a reaction under specified conditions).

d Precursor availability was assessed on a three-point scale consisting of low (not available commercially), medium (available commercially with restrictions), and high (available commercially with no restrictions).

e Precursor substitutability was assessed on a three-point scale consisting of low (not substitutable), medium (substitutions with other precursors would have significant effects on the manufacturing process), and high (substitutions with chemically similar precursors is anticipated to have little to no effect on the manufacturing process).

f Methyl acrylate is required to construct the fentanyl backbone.

Chemical expertise is required to handle specific reagents that could react violently with water or ignite when exposed to ambient air and perform purification steps that can improve synthetic yields and purities. However, in general, the manufacturing processes detailed in the table can produce large quantities of fentanyl by people with only the skills required for rudimentary additions and heating of easily manipulated reagents.

11 Interview 13, August 10, 2021.
12 Interview 52, September 22, 2021.
Drug Enforcement Administration (DEA) Fentanyl Signature Profiling Program (FSPP) reports indicate that the average fentanyl purities are less than 10 percent (highly pure samples that originate from the People’s Republic China [PRC] are excluded), so purification steps are likely being skipped by illicit manufacturers with little economic consequence.\(^{13}\)

The Commission assessed the difficulty of each synthetic route on a three-point scale consisting of low, medium, and high. Specific placement along this spectrum is a function of the number of steps, the complexity of the equipment, the degree to which purification is required, and the skill required to safely handle the starting materials and necessary equipment. None of the paths used to manufacture fentanyl are rated as “high” synthetic difficulty.\(^{14}\) The Janssen and Valdez methods are assessed as “medium” synthetic difficulty due to the number of steps, the need for purification, and their utilization of potentially noxious starting materials.\(^{15}\) The synthetic pathways that do not necessitate difficult purification steps and use easily handled reagents are rated as “low”; these include the Siegfried and Gupta methods. Indeed, instructions for the Siegfried and Gupta methods are available on the internet and can easily be followed by rudimentary cooks with minimal chemical expertise.

Chemical analysis of the impurities in seized fentanyl can often be used to identify the synthetic approach that was used in the manufacture. This is because of the slight variations between each of these pathways (combined with poor use of purification procedures) that can lead to the presence of process-specific impurities.\(^{16}\) If the seized fentanyl is pure enough such that impurities are present in exceedingly low concentrations, however, forensic detection methods might not be sensitive enough to identify the synthetic route. Figures D.1 and D.2 show the trends for methods used to synthesize fentanyl powders and tablets, respectively, seized by the DEA as reported in the DEA FSPP database and related information. The Gupta method appears most frequently in both powder and tablet exhibits, likely due to its synthetic ease. Notably, significant uncertainty regarding manufacturing route is reported.\(^{17}\)


\(^{14}\) An exemplary synthetic pathway that would be assessed to be of “high” synthetic difficulty is the synthesis of LSD. LSD’s synthesis requires numerous steps (8 – >20, depending on synthetic scheme), significant chemical expertise to handle noxious starting materials and complicated equipment (e.g., steel hydrogenation bombs), and many purifications to achieve sufficient yields. See, for example, Edmund C. Kornfeld, E. J. Fornefeld, G. Bruce Kline, Marjorie J. Mann, Dwight E. Morrison, Reuben G. Jones, and R. B. Woodward, “The Total Synthesis of Lysergic Acid,” Journal of the American Chemical Society, Vol. 78, No. 13, July 1, 1956; and Rentaro Kanno, Satoshi Yokoshima, Motomu Kanai, and Tohru Fukuyama, “Total Synthesis of (–)-Lysergic Acid,” Journal of Antibiotics, Vol. 71, No. 2, February 2018.

\(^{15}\) Interview 13, August 10, 2021.


In addition to impurities from the synthetic route, 70 percent of fentanyl tablets contained acetaminophen, dipyrone, lactose, or mannitol (which are used as filler to make counterfeit tablets), according to a January 2020 DEA analysis. Dipyrone, in particular, is only observed in Mexico-sourced heroin. The growing prevalence of this “signature mix” of adulterants and diluents signals Mexican transnational criminal organizations’ (TCOs) expanded involvement in illicit fentanyl pill production and has been increasing in recent years.

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18 Acetaminophen and dipyrone are widely available medications used to treat fever and low pain; lactose and mannitol are commercially available sugars.

Trends in Fentanyl Samples

DEA’s FSPP offers insights into the purity or concentration of fentanyl in powder and counterfeit tablet seizures. These measures are not representative of the market, given the limitations of how seizures are generated (i.e., nonrandom samples). Further, DEA’s samples exclude highly pure seizures from the PRC (which were commonly intercepted at mail and express consignment carrier ports of entry up until 2019) and report mean purity instead of median, and so the resulting data might overestimate the purity of drugs sold at retail. Nonetheless, both the mean purity of fentanyl powders and fentanyl content of tablets have increased from 2017 to 2019.
In powder formulations, the mean purity for the entire series has risen from just over 5 percent to nearly 9 percent (Table D.2). For samples less than 1 kg, the mean purity also has risen from 2.8 percent to 5.1 percent over that period. DEA assessed that

the overwhelming majority of the fentanyl powder exhibits analyzed were fentanyl HCL, which is associated with illicit fentanyl production, and did not appear to represent direct fentanyl shipments from China to the United States, which are typified by exceedingly high purity.  

Indeed, this high-purity fentanyl (purity exceeding 50 percent) is rarely encountered, and the market is dominated by fentanyl with purities less than 10 percent.

In powder observations, the FSPP shows that a substantial share of samples also contain heroin. However, that share has declined year over year from 30 percent to 22 percent. The ratio of fentanyl to heroin in these observations has also changed in the FSPP sampling, with declining shares of fentanyl relative to increasing shares of heroin. However, given that FSPP does not report this by market segment (e.g., retail vs. wholesale), this trend is difficult to interpret.

In tablet formulations, the concentration has risen from 1.3 mg in a typical tablet to 1.8 mg.

Synthesis of Fentanyl Analogues

Historical advancements in synthetic chemistry, the ease of synthesizing fentanyl, and the wide availability of exchangeable starting materials have facilitated the availability of numerous structural analogues of fentanyl listed in Table D.3. Indeed, most of the recent innovations in the academic literature regarding the synthesis of fentanyl were intended to illustrate novel syntheses of novel analogues and their pharmacokinetic profiles, incidentally providing illegal manufacturers with novel products to pursue. Subject-matter experts largely attribute the presence of fentanyl analogues to PRC-based manufacturers who were attempting to skirt regulations via the synthesis of unregulated yet potent drugs similar to fentanyl. New analogues also present challenges to detection technologies that rely on spectral libraries, as their chemical characteristics will go unrecognized. However, tightened production restrictions in the PRC appears to have discouraged fentanyl analogue generation. Mexican TCOs are largely focusing their efforts on “classic” fentanyl, although a select few fentanyl analogues have been encountered in seizures of product transported over the southwest border, and the DEA tends to identify about three new fentanyl analogues (in product transported across the southwest border) each year.

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23 Interview 2, July 27, 2021; interview 54, October 1, 2021.
24 Interview 52, September 22, 2021.
27 Interview 7, August 3, 2021.
### Table D.2
Measures of Fentanyl Observations Reported in Fentanyl Signature Profiling Reports

<table>
<thead>
<tr>
<th>Measure</th>
<th>Powders</th>
<th>Tablets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exhibits</strong></td>
<td>692</td>
<td>940</td>
</tr>
<tr>
<td><strong>Weight, in kilograms</strong></td>
<td>1,177</td>
<td>1,481</td>
</tr>
<tr>
<td><strong>Fentanyl content</strong></td>
<td>5.3%</td>
<td>5.6%</td>
</tr>
<tr>
<td><strong>Range of fentanyl</strong></td>
<td>0.1–97.8%</td>
<td>0.1–96.8%</td>
</tr>
<tr>
<td><strong>Mean purity &lt;10 g</strong></td>
<td>2.5%</td>
<td>2.6%</td>
</tr>
<tr>
<td>(n = 72)</td>
<td>(n = 65)</td>
<td></td>
</tr>
<tr>
<td><strong>Mean purity &lt;1 kg</strong></td>
<td>2.8%</td>
<td>2.8%</td>
</tr>
<tr>
<td>(n = 288)</td>
<td>(n = 404)</td>
<td>(n = 161)</td>
</tr>
<tr>
<td><strong>Mean purity ≥1 kg</strong></td>
<td>6.6%</td>
<td>7.9%</td>
</tr>
<tr>
<td>(n = 332)</td>
<td>(n = 468)</td>
<td>(n = 342)</td>
</tr>
<tr>
<td><strong>Percentage detected with heroin</strong></td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td><strong>Percentage range of fentanyl to heroin</strong></td>
<td>4.8 to 16.4</td>
<td>3 to 18.9</td>
</tr>
<tr>
<td><strong>Percentages of diluents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactose</td>
<td>55</td>
<td>41</td>
</tr>
<tr>
<td>Mannitol</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Inositol</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Dipyrones</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td><strong>Fentanyl-related exhibits</strong></td>
<td>143</td>
<td>63</td>
</tr>
</tbody>
</table>

Table D.3
Number of Seizures Containing Fentanyl and Fentanyl Analogues, as Identified by the U.S. Drug Enforcement Administration

<table>
<thead>
<tr>
<th>Molecule</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl</td>
<td>877</td>
<td>1,873</td>
<td>2,723</td>
<td>4,384</td>
<td>4,323</td>
</tr>
<tr>
<td>Acetyl fentanyl</td>
<td>112</td>
<td>59</td>
<td>188</td>
<td>413</td>
<td>160</td>
</tr>
<tr>
<td>Carfentanil</td>
<td>17</td>
<td>70</td>
<td>37</td>
<td>62</td>
<td>43</td>
</tr>
<tr>
<td>Valeryl fentanyl</td>
<td>10</td>
<td>0</td>
<td>16</td>
<td>41</td>
<td>25</td>
</tr>
<tr>
<td>Butyryl fentanyl</td>
<td>13</td>
<td>25</td>
<td>27</td>
<td>24</td>
<td>19</td>
</tr>
<tr>
<td>4-fluoroisobutrylfentanyl</td>
<td>20</td>
<td>74</td>
<td>109</td>
<td>28</td>
<td>6</td>
</tr>
<tr>
<td>Methoxyacetylfentanyl</td>
<td>0</td>
<td>49</td>
<td>59</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>2-furanylbenzylfentanyl</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>p-fluorofentanyl</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2-furanylfentanyl</td>
<td>142</td>
<td>284</td>
<td>35</td>
<td>43</td>
<td>1</td>
</tr>
<tr>
<td>N-methyl norfentanyl</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>N-benzyl-p-fluoro norfentanyl</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4’-methyl acetyl fentanyl</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>b’-phenyl fentanyl</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Norfentanyl</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3-methylfentanyl</td>
<td>2</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2-thiofuranylfentanyl</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>o-fluorofuranyl fentanyl</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>p-fluorofuranyl fentanyl</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>p-fluorobutyryl fentanyl</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Acryl fentanyl</td>
<td>13</td>
<td>43</td>
<td>6</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>o-fluorofentanyl</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Benzyl fentanyl</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>o-methylacetylfentanyl</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Benzoyl fentanyl</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Benzyolbenzyl fentanyl</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Acetyl norfentanyl</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Despropionyl p-fluorofentanyl</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Over the past five years, fentanyl has been the predominant synthetic opioid encountered by DEA agents. Of the 4,595 synthetic opioid identifications confirmed by DEA in 2020, 94 percent were fentanyl (Table D.3). However, structural analogues of fentanyl present a persistent risk, with the discrete risk of individual drugs fluctuating year over year, though overall instances of analogue identification have declined starting in 2019.

Acetyl fentanyl, carfentanil, valeryl fentanyl, and butyryl fentanyl are the most predominant fentanyl analogues, representing 3.5 percent, 0.94 percent, 0.54 percent, and 0.41 percent of fentanyl identifications in 2020, respectively. Figure D.3 shows the molecular structures of these analogues, with the modifications from the fentanyl backbone highlighted in bold. From 2016 to 2020, at least 12 other structural analogues of fentanyl were typically identified yearly, although these each tend to be identified in fewer than ten seizures (less than about 0.2 percent of total yearly seizures).

**Figure D.3**

**Molecular Structures of Fentanyl Analogues**

![Molecular Structures](image)

**NOTE:** Variation from fentanyl background is indicated in bold.
Figure D.4 highlights the chemical components of fentanyl that are readily substitutable. Minute structural differences between analogues can drive significant changes in pharmaceutical profiles and affect law enforcement–detection capabilities. For example, acetyl fentanyl exhibits less than one-third the potency of fentanyl, while carfentanil is 100 times as potent as fentanyl. The synthetic methods used to achieve these analogues are readily available (e.g., in the patent literature), are reliant on easily accessible starting materials, and are slight variations of the strategies used to produce “classic” fentanyl and so are similarly characterized by high synthetic ease.

Figure D.4
Locations for the Potential Synthetic Modifications of Fentanyl

Trends in Fentanyl Precursors

Each of the popular fentanyl synthesis pathways (Valdez, Gupta, Siegfried, Janssen, and Dieckmann) can readily accommodate substitutions among starting materials. For example, the Valdez method requires four key reagents: 4-piperidone, 2-bromoethylbenzene, aniline, and propionic anhydride. Each of these reagents has many structural analogues that are readily available on the open market, that display similar reactivity, and that require little alteration to the manufacturing process. Use of these structural analogues as starting materials will yield structural analogues of fentanyl. Figure D.5 shows just three of the many structural variants of each reagent; this small sample


30 Interview 26, August 19, 2021.
of substitutable starting materials can be combined to yield 81 different fentanyl analogues. The reagents used in the Gupta, Siegfried, Janssen, and Dieckmann methods are just as substitutable and accessible. Masked precursors,\textsuperscript{31} such as 1-boc-4-piperidone (which can be used in optimized fentanyl synthetic routes or be easily converted to 4-piperidone), are also emerging.\textsuperscript{32}

**Figure D.5**

Example Substitutions of the Starting Materials for the Valdez Method to Generate Structural Analogues of Fentanyl

<table>
<thead>
<tr>
<th>Valdez Method Starting Materials</th>
<th>Example Alternative Reagents</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-piperidone</td>
<td>2-methylpiperidin-4-one</td>
</tr>
<tr>
<td>(2-bromoethyl)benzene</td>
<td>Tetrahydro-4H-thiopyran-4-one</td>
</tr>
<tr>
<td>Aniline</td>
<td>Benzyl bromide</td>
</tr>
<tr>
<td>Propionic anhydride</td>
<td>1-(bromomethyl)-2-methylbenzene</td>
</tr>
<tr>
<td></td>
<td>4-(trifluoromethyl)aniline</td>
</tr>
<tr>
<td></td>
<td>3,4-(methylenedioxy)aniline</td>
</tr>
<tr>
<td></td>
<td>Acetic anhydride</td>
</tr>
<tr>
<td></td>
<td>Butyric anhydride</td>
</tr>
</tbody>
</table>

\textsuperscript{31}“Masked” precursors are defined as “chemical substances specifically designed to disguise controlled precursors from which controlled precursors can easily be obtained. They may include derivatives of controlled precursors with varying degrees of complexity.” For additional information, see Office on Drugs and Crime, United Nations, *Global Synthetic Drugs Assessment 2020*, November 2020d.

\textsuperscript{32}Interview 7, August 3, 2021; interview 52, September 22, 2021; Office on Drugs and Crime, United Nations, *Global Synthetic Drugs Assessment 2020*, November 2020d.
The regulation of starting materials has historically been a driving force for identifying and using alternative reagents. Indeed, illegal manufacturers’ use of nonscheduled precursor chemicals has emerged in response to NPP and 4-ANPP being placed under international control in 2017. In particular, U.S. and Mexican law enforcement have reported increased seizures of 4-anilinopiperidine (4-AP), which can serve as an immediate precursor to 4-ANPP through a one-step chemical reaction. Whereas 4-AP is a list I chemical in the United States and in Mexico, as of 2021, it was not controlled in the PRC.

The Commission’s analysis of commercially available precursor chemicals indicates that more than 3,100 chemicals can be used in the manufacturing process for fentanyl and fentanyl analogues. These precursors can be combined to produce nearly 2 million analogues that are highly similar to fentanyl’s chemical structure, and another 60 million compounds that are highly similar to the structures of known fentanyl analogues. Accounting for the probability of reaction success decreases the scale of resulting compounds but still leaves more than 1.7 million analogues highly similar to fentanyl and 44 million analogues highly similar to known fentanyl analogues. The synthetic route most widely used by illicit manufacturers, the Gupta method, is also the most accommodating of starting material substitutions: This pathway alone can theoretically produce more than 650,000 structurally unique fentanyl analogues that are highly similar to fentanyl.

Figure D.6 shows the number of theoretically substitutable precursors available for each precursor in the Valdez, Siegfried, Janssen, and Gupta methods. In total, 3.7 billion structural analogues of fentanyl are feasible. Applying a cost ceiling of $1 per gram of precursor, which the research analysis has found to approximate the cost of starting material acquisition, narrows the scale of theoretically possible fentanyl analogues to about 1 million; a cost ceiling of $10 per gram of precursor allows producers to manufacture tens of millions of structurally unique fentanyl analogues. Using increasingly stringent thresholds would lead to smaller chemical spaces, but the number of available fentanyl analogues would still be at least in the hundreds of thousands. Needless to say, the manipulation of the fentanyl structure could produce a vast array of similar analogues (though the pharmacology of all cannot be known until consumed).

33 Interview 52, September 22, 2021; interview 54, October 1, 2021.
34 Office on Drugs and Crime, United Nations, Global Synthetic Drugs Assessment 2020, November 2020d.
37 Starting materials were defined from a list of 106,750 buyable molecules pulled from the catalogs of Sigma-Aldrich, Enamine, and WuXi Labnetwork. Precursors were selected if they matched the structural backbone of one of the reagents from the Gupta, Valdez, Siegfried, or Janssen method. Computational modeling was then used to filter out precursors that would likely not lead to a fentanyl analogue. Additional filters were applied to the newly selected building blocks: (1) the difference in molecular weight and number of atoms from the original fentanyl precursors were limited to 200 g per mole and six atoms; (2) molecules with cross-reactive moieties that would likely interfere with downstream reactions were removed (e.g., ketone or amino groups on the phenalkyl halides); and (3) molecules that had multiple sites that could undergo the same reaction—and therefore may not enable selective syntheses—were removed. See Connor W. Coley, Regina Barzilay, Tommi S. Jaakkola, William H. Green, and Klavs F. Jensen, “Prediction of Organic Reaction Outcomes Using Machine Learning,” ACS Central Science, Vol. 3, No. 5, 2017, for additional background on this analysis.
38 The pharmacology of the overwhelming majority of these theoretical fentanyl analogues is likely unknown.
Figure D.6
Precursor Substitutability, by Production Method

A. Building-block SMARTS expansions

\[ \text{O=C\text{-}NC\text{-}N} \]

<table>
<thead>
<tr>
<th>SMARTS</th>
<th>Matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>17</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>680</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>1,346</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>1,180</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>198</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>4</td>
</tr>
</tbody>
</table>

B. Valdez/Siegfried

\[ \text{O=C\text{-}N} \]

<table>
<thead>
<tr>
<th>SMARTS</th>
<th>Matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>6,120</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>7,221,600</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>1,429,676,800</td>
</tr>
</tbody>
</table>

C. Janssen 1961

\[ \text{O=C\text{-}N} \]

<table>
<thead>
<tr>
<th>SMARTS</th>
<th>Matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>9,640</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>37,760</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>25,676,800</td>
</tr>
</tbody>
</table>

D. Gupta 2010

\[ \text{O=C\text{-}N} \]

<table>
<thead>
<tr>
<th>SMARTS</th>
<th>Matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>10,620</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>7,221,600</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>1,429,676,800</td>
</tr>
</tbody>
</table>

E. Gupta 2005

\[ \text{O=C\text{-}N} \]

<table>
<thead>
<tr>
<th>SMARTS</th>
<th>Matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>12,314</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>14,294,520</td>
</tr>
<tr>
<td>O=C\text{-}C\text{-}N(X)\text{-}N\text{-}CC1cccc1;\text{C}\text{-}C\text{-}1</td>
<td>2,830,314,960</td>
</tr>
</tbody>
</table>

NOTE: SMARTS is a language used to specify chemical substructures using rules that are extensions of Simplified Molecular Input Line Entry System (SMILES), a chemical notation style. The left pane (A) shows the identification of substitutable precursors to synthesize fentanyl and its analogues via the methods shown in the right pane. B shows the Valdez and Siegfried methods. C shows the Janssen method. D shows the 2010 Gupta method, and E shows the 2005 Gupta method.
SYNTHESIS OF NONFENTANYL SYNTHETIC OPIOIDS

Although fentanyl and its analogues remain the most commonly seized synthetic opioids and account for the greatest number of overdose deaths, nonfentanyl synthetic opioids are beginning to emerge in the United States, Canada, and Europe. These drugs include cyclohexylbenzylamides, nitrobenzimidazoles, phenethylpiperidine-benzimidazolones, diphenethylpiperazines, thiambutenes, and cinnamylpiperazines. In general, the synthetic pathways required to manufacture these drugs are robust, simple to follow, and utilize readily substitutable, widely available starting materials that facilitate the production of structural analogues. Unlike fentanyl, these emerging synthetic opioids have no legitimate medical uses. Publicly accessible synthesis plans to these synthetic opioids appear straightforward and amenable to a combinatorial diversification in a manner similar to the synthesis routes to fentanyl, further increasing the chemical diversity of the future of illegal supply of synthetic opioids. Their emergence is largely the result of academic spillover, as descriptions of their manufacturing processes and potencies were initially made available in academic journals. New synthetic opioids, particularly those that are uncontrolled, present significant challenges to law enforcement agencies (particularly with regard to detection). Details about these nonfentanyl synthetic opioids are highlighted in Table D.4.

DEA seizure data are available for brorphine, isotonitazene (a nitrobenzimidazole) and the cyclohexylbenzylamides U-47700, isopropyl U-47700, U-49900, and U-48800 (Table D.5). Both brorphine and isotonitazene first emerged in 2019. The identification of U-47700 and its structural analogues (referred to as the “U-series”) peaked in 2017–2018 and have rapidly declined since. U-47700 has been the most commonly identified cyclohexylbenzamide, followed by the structural analogues isopropyl U-47700, U-49900, and U-48800.

Figure D.7 shows the number of new synthetic opioid compounds encountered each year as reported by national and regional early warning systems to the United Nations Office on Drugs and Crime (UNODC). As shown, the emergence of new fentanyl analogues jumped in 2015, peaking at nearly 140 different fentanyl analogues in 2018. In total, nearly 180 different novel synthetic opioids were reported. Starting in 2019, the numbers of new fentanyl analogues begin to decline, a trend that has continued each year. In 2019, UNODC reported that countries first started encountering nitrobenzimidazoles (e.g., isotonitazene), which have continued to appear since. The number of new U-series synthetic opioids (U-47700, U-48800, etc.) rose from 2015 to 2018 but have declined since 2019. It is likely that national controls, especially in the PRC in 2019, had some effect in reducing the introduction of new fentanyl analogues.

---

39 Interview 54, October 1, 2021.
41 Interview 2, July 27, 2021.
### Table D.4
Emerging Synthetic Opioids

<table>
<thead>
<tr>
<th>Synthetic Opioids</th>
<th>Drug Class</th>
<th>Year First Reported</th>
<th>Controlled Under the Controlled Substances Act?</th>
<th>Potency Relative to Fentanyl</th>
<th>U.S. Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-47700, isopropyl U-47700, U-49900, U-48800</td>
<td>Cyclohexylbenzamides</td>
<td>2015&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Yes&lt;sup&gt;a&lt;/sup&gt;</td>
<td>~2x lower&lt;sup&gt;b&lt;/sup&gt;</td>
<td>46, as of 2016&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Isotonitazene, N-desethylisotonitazene, metonitazene, etonitazene, etazene</td>
<td>Nitrobenzimidazoles</td>
<td>2019&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Yes&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Up to 1.4x higher&lt;sup&gt;e&lt;/sup&gt;</td>
<td>49, as of August 2020</td>
</tr>
<tr>
<td>Brorphine</td>
<td>Phenethylpiperidine-</td>
<td>2019&lt;sup&gt;f&lt;/sup&gt;</td>
<td>Yes&lt;sup&gt;f&lt;/sup&gt;</td>
<td>1x&lt;sup&gt;f&lt;/sup&gt;</td>
<td>7, as of July 2020&lt;sup&gt;g&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>benzimidazolones</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MT-45</td>
<td>Diphénylpiperazines</td>
<td>2013&lt;sup&gt;h&lt;/sup&gt;</td>
<td>Yes&lt;sup&gt;i&lt;/sup&gt;</td>
<td>1x&lt;sup&gt;j&lt;/sup&gt;</td>
<td>2, as of 2016&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>Piperidylthiambutene</td>
<td>Thiambutenes</td>
<td>2019&lt;sup&gt;k&lt;/sup&gt;</td>
<td>No</td>
<td>13x lower&lt;sup&gt;k&lt;/sup&gt;</td>
<td>Unknown</td>
</tr>
<tr>
<td>2-methyl-AP-237, AP-237</td>
<td>Cinnamylpiperazines</td>
<td>2019&lt;sup&gt;l&lt;/sup&gt;</td>
<td>No</td>
<td>1,000x lower&lt;sup&gt;k&lt;/sup&gt;</td>
<td>2, as of June 2021&lt;sup&gt;l&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**NOTES:** Centers for Disease Control and Prevention fatality data do not specify the drug attributed to a fatality, so current mortality data are unavailable.


<sup>c</sup> Drug and Chemical Evaluation Section, Diversion Control Division, DEA, “Isotonitazene,” August 2020.


<sup>f</sup> Drug and Chemical Evaluation Section, Diversion Control Division, DEA, “Brorphine,” July 2021.


Table D.5
The Number of DEA Seizures of Nonfentanyl Synthetic Opioids in the United States

<table>
<thead>
<tr>
<th>Molecule</th>
<th>Class</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isotonitazene</td>
<td>Nitrobenzimidazole</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Brorphine</td>
<td>Phenethylpiperidine-benzimidazolones</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>U-47700</td>
<td>Cyclohexylbenzamides</td>
<td>50</td>
<td>186</td>
<td>42</td>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>Isopropyl U-47700</td>
<td>Cyclohexylbenzamides</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>U-49900</td>
<td>Cyclohexylbenzamides</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>U-48800</td>
<td>Cyclohexylbenzamides</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>


NOTE: Isotonitazene encounters are first quantified in the 2020 DEA Annual Emerging Threat Report, but other DEA reporting indicates that isotonitazene was first encountered in 2019. See Drug and Chemical Evaluation Section, Diversion Control Division, DEA, “Isotonitazene,” August 2020, for additional details.
Table D.6 summarizes the production methods that yield these nonfentanyl synthetic opioids. In general, the synthetic pathways required to manufacture these drugs are robust and simple to follow, and they utilize readily substitutable, widely available starting materials that facilitate the production of structural analogues. The processes to produce MT-45 and piperidylthiambutene utilize one-step, one-pot reactions and are particularly easy for unskilled manufacturers to execute. The manufacture of cyclohexylbenzylamides, nitrobenzimidazoles, phenethylpiperidine-benzimidazolones, diphenethylpiperazines, and cinnamylpiperazines are readily accommodating of structural analogues, while the synthesis of piperidylthiambutene is constrained to a specific set of reagents that are likely challenging to find adequate substitutes for.

### Table D.6

*Characteristics of Synthetic Pathways to Yield Emerging Nonfentanyl Synthetic Opioids*

<table>
<thead>
<tr>
<th>Opioid</th>
<th>Number of Steps</th>
<th>Synthetic Difficulty</th>
<th>Yields</th>
<th>Precursors</th>
<th>Precursor Availability</th>
<th>Precursor Substitutability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexylbenzamides</td>
<td>3</td>
<td>Moderate</td>
<td>?</td>
<td>Cyclohexanone; potassium cyanide; dimethylaniline; lithium aluminum hydride; acyl chloride</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Nitrobenzimidazoles</td>
<td>3</td>
<td>Low</td>
<td>16–83%</td>
<td>1-bromo-4,4-dinitrobenzene; diethylethylenediamine; ammonium sulfide; 2-(4-isopropoxyphenyl)acetic acid</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Brorphine</td>
<td>5</td>
<td>Moderate</td>
<td>55%</td>
<td>1-fluoro-2-nitrobenzene; N-boc-4-aminopiperidine; hydrazine; carbonylidiimazole; trifluoroacetic acid; benzyl bromide</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>MT-45</td>
<td>1</td>
<td>Low</td>
<td>20–70%</td>
<td>Benzyl bromide; 1-cyclohexylpiperazine; benzaldehyde</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Piperidylthiambutene</td>
<td>1</td>
<td>Moderate</td>
<td>?</td>
<td>2-thienyl-lithium; ethyl 2-aminobutyrate</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>


* Synthetic difficulty was assessed on a three-point scale consisting of low, medium, and high.
EMERGING SYNTHESIS TECHNIQUES

Academia and industry are leveraging new synthetic approaches to synthesize new compounds and novel derivatives of known compounds easier, faster, and at higher yields, results of high interest to clandestine operators. Yet, the adoption of these emerging tools by illicit manufacturers is uncertain; the methods currently used already allow untrained personnel to synthesize opioids in sufficient quantities and purities using readily available starting materials. These emerging routes, however, might provide alternatives that allow producers to evade regulations on starting materials and laboratory infrastructure. Further, these approaches can boost production capacities, improve concealment from law enforcement, and increase the number of synthetic pathways available. Some of these advances might be accessible only to those with higher skill sets, but overall, improvements in technology or methods are likely to make illegal manufacture easier or more efficient.

Computational Discovery of Novel Synthetic Opioids and Fentanyl Analogues

The definition and exploration of large chemical spaces has been a focus of cheminformatics analyses for several decades, originally starting as a theoretical exercise to understand how many stable chemicals were possible. One generally accepted estimate is that there are $10^{60}$ biologically relevant small molecules, compared to the roughly $10^9$ that are currently commercially available. Current cheminformatics efforts target the identification of starting materials that can achieve desired final products.

The tools of cheminformatics and computer-aided synthesis planning are precisely intended to streamline the synthesis of new molecules to aid in discovery. This field is nascent, but a plethora of tools for computer-aided retrosynthesis are available that attempt to identify routes to target compounds with any given structure. These tools are maturing rapidly, and the level of human expertise required to operate them is continually declining. Currently, a significant degree of chemistry expertise is still required to translate recommendations into practice—for example, by the identification and optimization of suitable reaction conditions (e.g., reagents, solvents, temperatures). However, with the parallel maturation of laboratory automation it is likely inevitable that chemical synthesis from planning to execution be entirely automated and within the reach of unskilled operators in the mid-to far term. The same technology that is poised to revolutionize small-molecule drug discovery carries these inevitable risks of enabling criminals or those interested in synthesizing novel psychoactives to access pharmacologically active compounds for illicit purposes.

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43 Special Testing and Research Laboratory, DEA, “Fentanyl Signature Profiling Program Report,” October 2019b.
Flow Chemistry

Flow chemistry is an emerging chemical manufacturing process that relies on the continuous processing of starting materials and chemical products using pumps and piping. Flow chemistry is maturing rapidly; while significant research and development efforts are pursuing its broad application across chemical processes, large pharmaceutical firms are using flow chemistry to produce 33 to 50 percent of their drug portfolios. Current flow synthesis processes significantly reduce requirements for starting materials (particularly solvents), minimizes required purification steps, reduces overall reaction times, maximizes reproducibility, and can be hosted within small footprints. Indeed, end-to-end syntheses of complex pharmaceutical agents with multiple inline purifications and postsynthesis steps have been hosted within refrigerator-sized platforms (1 m × 0.7 m × 1.8 m, 100 kg).

Active research efforts within academic communities have sought to manufacture opioids using flow chemistry. In 2010, researchers used flow techniques to synthesize tramadol, a mild drug for pain reduction. Use of flow chemistry processes enabled the achievement of 96-percent reaction yields and facilitated the use of hazardous starting materials that in traditional chemical production require specialized expertise. This process is anticipated to be a relatively easy way to achieve large-scale industrial manufacturing. Emerging (nonfentanyl) pharmaceutically relevant synthetic opioids have also been produced using publicly available flow synthesis methods.

Large-scale implementation of flow chemistry by illicit opioid manufacturers could significantly reduce their manufacturing footprint and starting material requirements while improving their manufacturing yields and purities. However, the threat of flow chemistry adoption in the near term is likely low, especially from criminal actors who lack a background in chemistry, the technical skill set, and start-up capital. Although flow equipment is commercially available, producers would require at least temporary internal expertise to design and optimize opioid synthesis routes in flow, overcome process integration challenges, and establish control systems and process monitoring strategies. Additional obstacles include the optimization of pumping strategies, the reliable achievement of high-pressure capabilities, and robust chemical compatibility of system components.

Synthetic Biology

Synthetic biology describes the application of science, technology, and engineering to facilitate and accelerate the design, manufacture, and/or modification of genetic materials in living organisms. Genetic engineering, the targeted modification of the genome, is a synthetic biology tool that facilitates the targeted design of organisms to yield specific characteristics, including the expression of non-native-specific enzyme activities.

Recent advancements in techniques have enabled the biological engineering of yeast strains capable of producing complicated organic molecules using only simple sugars and water as inputs. These techniques have included complex, multistep organic syntheses to yield chemicals relevant across the chemical industry, ranging from antimalarials to scents, industrial chemicals, and fuels. U.S.-based efforts (funded primarily by the National Institutes of Health) have extended this work toward using synthetic biology to produce opioid compounds to decrease painkiller manufacturers’ dependence on poppy supplies. To this end, U.S.-based researchers have engineered yeast to produce the opioids thebaine and hydrocodone with sugar as the sole chemical starting material.

The ability of illicit opioid manufacturers to utilize synthetic biology in the short term is likely limited due to the required scientific expertise and current limitations of synthetic biology. The production of thebaine and hydrocodone from yeast and sugar required the expression of more than 20 enzyme activities from plants, mammals, bacteria, and yeast, some of which were newly discovered. Additional research would be required to identify necessary strains and biosynthetic pathways to produce other opioids. Further, synthetic biology pathways produce products at scales several orders of magnitude below that of modern manufacturing processes, and access to yeast strains capable of producing controlled substances are restricted by DEA.

Over the long term, however, synthetic biology might become appealing to nefarious chemical manufacturers. Indeed, yeast bioengineering research could be generating a drug source that is self-replicating and easy to grow, conceal, and distribute. Bioinformatics, the application of big-data analysis to complex biological systems, has been improving rapidly and is generating new knowledge that can guide bioengineering efforts. Simultaneously, other advanced bioengineering capabilities (e.g., the gene-editing technique CRISPR) are becoming accessible to nonexperts.

Autonomous Chemistry Systems

Several autonomous chemistry systems are emerging with long-term expectations of improving synthetic processes while reducing talent requirements. However, they are currently technologically immature and require significant expertise and resource investments, and so the risk of adoption in the near to midterm by illicit manufacturers is low. Autonomous chemistry systems currently under development include autonomous process optimization, high-throughput experimentation, and cloud-based labs. Successful implementation of these processes would provide manufacturers with highly efficient, cost-effective, clandestine routes to synthesize significant quantities of fentanyl. However, current barriers to implementation, which include the availability of highly advanced equipment and specialized personnel, are likely insurmountable for illicit fentanyl producers.

EMERGING DETECTION AND IDENTIFICATION METHODS

Synthetic opioids, such as fentanyl, challenge available drug detection efforts for two important and distinct reasons. First, fentanyl and many other synthetic opioids are highly potent given their higher morphine equivalence: one ounce of fentanyl can substitute for a kilogram of heroin. This makes detection challenging because smaller quantities can be easily concealed in parcels or letters as well as secreted away in false panels or on the body. Second, many novel synthetic opioids are harder to detect and confirm by conventional technologies and protocols that are typically reliant on a referent library of previously encountered substances to identify an unlabeled or unknown powder. However, emerging detection and identification methods tailored to synthetic opioids show promise for bolstering capabilities.

Emerging Detection Methods

The biggest gap in current nonintrusive inspection and trace detection technologies is their inability to detect and identify unknown, not previously encountered threats. Indeed, current techniques’ reliance on libraries (e.g., spectral libraries) limit their ability to detect substances to those that have been thoroughly characterized by laboratories. Using current identification methods, it takes approximately one year to separate the various compounds in a seizure and identify their unique chemical signatures. This section focuses on the emerging technologies to identify unknown targets and expedite the characterization of new synthetic opioids.

61 Autonomous process optimization allows the implementation of a range of predefined process parameters to improve results such as reaction yield, product selectivity, and catalyst turnover number. For more details, see Melodie Christensen, Lars P. E. Yunker, Folarin Adedeji, Florian Häse, Loïc M. Roch, Tobias Gensch, Gabriel dos Passos Gomes, Tara Zepel, Matthew S. Sigman, Alán Aspuru-Guzik, and Jason E. Hein, “Data-Science Driven Autonomous Process Optimization,” Communications Chemistry, Vol. 4, No. 1, August 2, 2021.

62 High-throughput experimentation is another technique that allows the execution of large numbers of experiments conducted in parallel with less effort per experiment when compared to traditional experimentation. Specific to chemical research, high-throughput experimentation is used to test reaction conditions to quickly determine the preferred catalyst, reagent, and solves for a given synthesis. See Michael Shevlin, “Practical High-Throughput Experimentation for Chemists,” ACS Medicinal Chemistry Letters, Vol. 8, No. 6, May 17, 2017, for a more in-depth explanation.

Nontargeted Screening

Nontargeted screening methods include bioassay technology,\textsuperscript{64} surface-enhanced Raman spectroscopy,\textsuperscript{65} and traditional analytical approaches combined with machine learning (ML).\textsuperscript{66} These techniques typically demonstrate high-throughput nontargeted screening of opioid subclasses and purity analysis.

For nontargeted screening of complex mixtures, separation and purification of the individual compounds are required, which calls for complex instrumentation sited in laboratories. In addition, most of the nontargeted techniques are coupled with ML, which is limited by the type and quality of data collected and analyzed. To fully leverage the capabilities of ML in nontargeted screening, data of sufficient quality, quantity, and diversity is required.

Two-Dimensional Techniques

Each unique synthetic method and its various derivations produce chemical profiles that are based on impurities related to production, processing, and storage of the final product. The chemical impurity profiling of fentanyl and other synthetic opioids is very challenging: these illicit drugs are typically dosed at relatively low concentrations, are mixed with high levels of adulterants, and contain numerous chemically diverse synthetic impurities. Two-dimensional analytical techniques facilitate the analysis of complex mixtures by employing a sequential separation mechanism, typically based on chromatography.\textsuperscript{67} Currently, two-dimensional techniques are primarily used in the laboratory since it requires large, complex instrumentation and in-depth expertise. The selection of a particular two-dimensional method is dependent on the type of compound, the objective of the investigation, and method optimization often requires significant resources.\textsuperscript{68} Although it is unlikely that two-dimensional techniques will be utilized for field operations, they do provide the sensitivity and selectivity required to analyze new and unknown fentanyl derivatives and analogues.


\textsuperscript{67} Chromatography is a technique that separates molecules based on their dissolution and migration through various separation phases, such as solid or liquid. This technique is relevant for assessing the purity of fentanyl or analogues, and for identifying new compounds or impurities produced by novel synthetic methods. Greater separation of complex molecules leads to less overlap in chemical signatures. The separation power of this technique allows for better separation of compounds of similar structure, chemical features, or molecular weight, increasing sensitivity and decreasing analysis time. With greater sensitivity and less analysis time, these methods can increase the identification of new analogues. Since the separation power is increased, this method can also minimize sample preparation time.

Machine Learning and Artificial Intelligence

Artificial intelligence and ML are not a stand-alone identification technique but can be applied to various detection and identification technologies in a systemic manner to identify fentanyl-related functional groups in compounds based on their chemical properties, which can include chemical spectra.⁶⁹ A growing area of study in academia aims to identify compounds from their chemical properties via data-driven algorithms. This research typically anchors on a predictor data point and widely used classification or clustering ML methods for analysis.⁷⁰ ML has also been shown to expedite the identification of novel pharmaceutical agents and their analogues, as well as the development of improved synthetic routes.⁷¹

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Appendix E

ONLINE SOURCING OF SYNTHETIC OPIOIDS AND RELATED CHEMICALS

OVERVIEW

Online selling of synthetic opioids still occurs on both clear and the darknet websites. The clear net, also known as the surface web or open web, accounts for approximately 5 percent of internet content that is publicly available or indexable by common search engines such as Google.1 This amount of content is relatively small compared with the deep web, which accounts for approximately 90 percent of internet content and is out of reach for a variety of reasons. Darknet content, which is part of the deep web, is explicitly excluded from search engines; it is behind security walls and often used by those seeking to avoid law enforcement or government scrutiny.2

This appendix examines some recent trends and details regarding the availability of illegally manufactured synthetic opioids and related precursor chemicals across several areas of the internet. By explaining the landscape of online retailing, this appendix aims to better inform the policymaking responses to restrict the means by which criminals or others may exploit open platforms to transact in synthetic opioids or related chemicals. It seeks to answer several questions, including the following:

- How are these substances and related chemicals advertised online?
- What roles do both clear and darknet websites play in the availability of synthetic opioids and related materials?
- Does the availability vary across domain or time?
- What are the likely source countries for online vendors that purport to trade in synthetic opioids or related substances?

Variations in what is offered across platforms in 2021 provide consumers with many options for potentially engaging in illegal acquisitions or transactions of fentanyl, other synthetic opioids, and associated precursor chemicals. Analysis of online selling on clear and darknet websites has observed advertising channels and platforms such as social media, business-to-business (B2B) websites,3 and classified ads. These advertising channels were observed communicating information to buyers using terminology such as chemical names or Chemical Abstract

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2 Ibukun Taiwo, “90% of the Internet Is Hidden from Your Browser; and It’s Called the Deep Web,” TechCabal, November 18, 2015.
3 B2B e-commerce is an online business model that allows two businesses to transact, often at the wholesale level. B2B web platforms take an active role in the business transaction by providing credit card services and bidding tools. They are different from business-to-consumer e-commerce platforms that focus on retail transactions. The buyer using a B2B platform to obtain a fentanyl precursor in some cases may appear to be a business, but in others the buyer may just be an individual.
Service (CAS) numbers, in addition to descriptions of purity, weights, shipping, and pricing for fentanyl and precursor chemicals. The advertising channel of social media is used for advertising fentanyl precursors by posting images containing contact information as an additional form of communication. As the size and reach of social media in general is represented in billions of users, the Commission investigated whether the use of social media platforms is starting to become an emerging trend in the sale of synthetic opioids and related precursor chemicals needed to illegally manufacture synthetic opioids.4

METHODOLOGY

This appendix reports on the Commission’s examination of the online presence of synthetic opioid supply chains from chemical manufacturing companies, marketing methods, and the distribution of synthetic opioid–related products that are illegally manufactured, and how it contributes to the U.S. opioid crisis. By collecting publicly available content from clear and darknet sources, the Commission analyzed and documented trends in supply chains between chemical manufacturers and illegal drug sellers and buyers.

For information sources, the Commission focused on four streams of online vending of synthetic opioids or relevant precursors: (1) social media (i.e., platforms generally understood to include such popular websites as Facebook, Twitter, and Pinterest that provide a means for people to interact by creating or sharing/exchanging information, ideas, media, and other types of data); (2) B2B e-commerce platforms (i.e., platforms that take an active role in the business transaction by providing credit card services and bidding tools); (3) classified advertising services (i.e., websites or listings limited to facilitating trade by providing information and a means for communication but leaving the business transaction itself for the buyer and seller to agree on through direct one-on-one communication); and (4) darknet listings for synthetic opioids. Analysis was limited to the English language.

The first three are surface-level or “clear-net” websites accessible to most anyone and that often list precursor chemicals used in the manufacture of synthetic opioids, whereas darknet posts require considerably more effort by the buyer and focus more on the retail or low-level distribution side of synthetic opioid listings. The data collection process uses automated web-scraping tools, followed by aggregation and analysis. The Commission targeted its collection and analysis on several larger or well-known platforms, websites, or services. Assuming the position of a potential buyer of synthetic opioids or related precursor chemicals, the Commission used common search engines and search terms to find suppliers on the clear net. Analysis of the darknet focused on the most popular marketplaces that existed during the months of July to September 2021. Figure E.1 shows the steps taken to collect observations on the clear net.

Figure E.1
Steps Taken to Collect Observations from Clear-Net Vendors That List Synthetic Opioids or Related Chemicals

1. Develop a list of search terms using CAS number/platform combinations.
2. Use the search terms in an internet image search.
3. Export search results.
4. Use OCR processing to extract email addresses.
5. Develop the new list of search terms (email addresses extracted in step 4).
6. Use the search terms in an internet search.
7. Export all search results (website URLs).
8. Label the results by category (social media, classified ads, B2B e-commerce sites).
9. Repeat until all CAS number/platform combinations have been searched.

Search by CAS number and platform
Search for extracted email addresses

NOTE: CAS = Chemical Abstracts Service. OCR = optical character recognition. URL = uniform resource locator (web address).
Limitations

Collecting, aggregating, and analyzing publicly available information on the internet is challenging in multiple ways. The ephemeral nature of information on social media platforms makes it difficult to collect data that is both timely and complete. Furthermore, the Commission is collecting publicly available data on private platforms, so it is legally bound by the terms of service that these technology platforms employ. Additionally, the secured encryption functionality used for communication and personal approaches used for creating anonymity further complicate research in this space. Because of the time limitations of the study, items recognized as ancillary to the production and proliferation of fentanyl have been excluded from the scope of the Commission’s data collection efforts and analyses. These include items such as pill presses, packaging materials, ventilators, and other equipment necessary for the chemical synthesis of fentanyl, most of which can easily be obtained through popular e-commerce platforms such as Amazon or Alibaba.

A major limitation of using data from entities on the darknet is ascertaining the reliability of claims in a highly anonymous setting. Furthermore, most research analysis, including the Commission’s work, does not actively participate in the marketplace but rather passively observes publicly accessible information. In the interest of time, only a representative subset of the total listings on each market was scraped, which may bias the findings. The listings were focused on categories that were relevant to this study. These include subcategories of drug listings that include fentanyl or other opioids. The derived data include listings from low-reputation vendors (i.e., those with few customer reviews). A low reputation may be indicative of a new vendor or a known scammer. Listings that have been miscategorized by the market are not included. The information extracted from each listing is limited to the top-level metadata obtained during indexing. While this does not include the full details of the listing, it provides important information such as the vendor, price, quantity/unit of weight, and a brief description of the item being sold.

Data Collection, Clear Net

To develop an overview of the online presence of synthetic opioids, particularly fentanyl, the Commission collected data from both clear-net and darknet sources between July 15, 2021, and August 31, 2021. The clear-net data were collected in two parts. The first part focused on obtaining a list of entities that promote the sales of fentanyl and precursors using advertisements. This follows previous work by the Center for Advanced Defense Studies (C4ADS), which reports on the prevalence of advertising fentanyl-related precursors. The search keywords were created by pairing CAS numbers with the names of popular social media platforms (e.g., “99918-43-1 + Pinterest”) and entered into the Google search engine. The search results are a set of Google images (Figure E.2) from which information was extracted using optical character recognition (OCR). The extracted information includes the seller’s email address, phone number, social media accounts, usernames, uniform resource locators (URLs), and company affiliation.

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A second part to collecting clear-net data uses the email addresses of the entities advertising fentanyl and precursors, extracted from the previous part, to index Google search results using the emails as keywords. The URLs from the Google search results were categorized as social media, B2B e-commerce, and classified advertisement, shown in Figure E.3. Each unique URL listing that purportedly offers a synthetic opioid or related precursor chemical represents an observation. Given the nature of online sales, listings do not represent transactions.

Previous work has identified two standardized chemical nomenclatures found in advertisements for fentanyl-related products that are likely to be illegally manufactured overseas. These are the CAS registration number and the International Union of Pure and Applied Chemistry. This study focuses on the former CAS numbers, which also provide a standardized nomenclature.

The URLs were then linked to an email address and merged into the previous files used to assist in the development of a community network analysis graph using the RAND Corporation’s in-house natural language processing tool known as RAND-Lex. This community network analysis graph was then used to visualize the illegal seller network helping to identify and expose illegal seller interconnections between companies, advertising mediums, communication channels, and select types of fentanyl-related listings through an examination of similar unique markers, such as the listing’s title, description, or contact information.

As part of the report analysis, the Commission constructed a database of website URLs (as identified by unique contact information) advertising fentanyl and related precursors on the clear net. The website URLs were categorized by website type such as social media, B2B e-commerce, and classified ads. The database contains

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7 CAS, a division of the American Chemical Society (CAS, homepage, undated).

publicly available information collected on listing name, weight, quantity, payment type, and product transportation. Given how online sales operate, analysis can only capture offerings as indicated in listings; this is different from transactions where a sale is made. Additionally, the database contains CAS number, email addresses, telephone number, and company name from listings on these websites as well as country of origin. The database was used to represent the extent of online sourcing in the clear web, informing metrics in this report and serving as a snapshot in time; it is not intended to be an exhaustive review of fentanyl online presence on the clear web.

Data Collection, Darknet Data

In addition to recently scraped data, this study uses recent data made available to the Commission to analyze trends in darknet marketplaces, a literature review of listings in most of 2019 and 2020, and new scraped information from listings in 2021. The data cover the following:

1. vendors (e.g., unique sellers as identified by usernames) and listings (e.g., unique offerings of a drug included in a page on a marketplace) across seven markets (Berlusconi, Dream, FDW, Olympus, Rapture, Tochka, and Wall Street) between October 2017 and April 2019, including additional data purchased from Flare Systems.
2. aggregated measures from the literature covering various months of 2019 and 2020.
3. new listings collected for this study, coming from four markets (Cartel, Monopoly, Vice City, and White House) between July 15, 2021, and August 31, 2021.

These statistics include the number of listings, their geographic origins, product prices and weights, and observed trends, to the extent that each of these are available. The Commission examined the methods of communication and advertising and the connections between postings and online entities. This provides an opportunity to map illicit entities to company affiliations and uncover networks of online entities across various communication channels used to distribute synthetic opioid–related products.

Literature Review of the Darknet

To complement the Commission’s own efforts, which largely cover the years 2017–2019, the Commission undertook a literature review to examine listings that have been scraped and analyzed by other researchers. A small but growing literature that is largely descriptive in nature, most of which covers the year 2020, allowed us to supplement observations from the Commission’s own analyses to help complete the bigger picture of the darknet listings.

9 The term listing name refers to information listed in the form of an online advertisement. An online advertisement is referred to as usage of the internet to deliver promotional marketing messages to buyers or consumers.
10 The term payment type refers to a type of preferred currency or digital currency accepted. Some examples of payment types observed are Western Union and Bitcoin.
11 The term product transportation related to website listing refers to a shipping company. Some examples of product transportation observed are FedEx and DHL.
12 Recent darknet observations involving drugs come from the RAND Corporation’s Dark Web Observatory. The Dark Web Observatory maintains a proprietary database and knowledge repository that RAND Corporation researchers can use to study the dark web’s marketplaces (e.g., darknet marketplaces, including cryptomarkets, and single-vendor sites), discussion forums, and other sites.
13 These observations come from the RAND Corporation’s Dark Web Observatory.
Of the available literature on the sale of opioids and synthetic opioids on the darknet, research teams led by Broadhurst, Ball, and Lamy provide the most robust information on the data collected through their automated web-crawling sessions. Though no single source provides a holistic account of the pertinent pieces of information, Lamy et al., 2021, provides the most information; however, it is limited to one cryptomarket, Empire, and only collects data on nonfentanyl novel synthetic opioids. Over the course of this literature review, the Commission’s goal was to aggregate the data within these publications and convert the data to common standards to get a sense of the scale, scope, and veracity of the opioids and synthetic opioid market on the darknet in a single, holistic analysis. The Commission focused on the following types of data:

- substance name (e.g., Carfentanil)
- substance type (e.g., fentanyl analogue)
- total number of unique listings and market percentage of unique listings (i.e., removal of duplicates in the scraped data)
- estimated potency relative to morphine (calculated using morphine-milligram equivalent, or MME)
- number of unique vendors (as established by username)
- darknet cryptomarket name
- total number of unique listing views (e.g., each time a listing was viewed by a unique prospective buyer)
- total number of sales and the number of sales during the data collection period
- product origin (i.e., vendor’s purported location)
- shipping destinations
- data collection period and number of days scanned.

There are obvious limits and challenges to combining data across different sources given the varied methodological approaches and objectives of authors. Each report and article presents different pieces of the information, in different formats, in different measurements, and on different markets (some aggregate their information across up to six markets). Articles were read in their entirety and relevant information extracted into a data spreadsheet to elicit key themes and overarching findings.


FINDINGS FROM THE CLEAR NET

Key Findings

The Commission’s analysis of clear-net content related to the supply of fentanyl concluded with the following key findings:

- Across clear-net advertising media, the objective of the chemical manufacturers and suppliers appears to be the facilitation of sales through direct deals.\(^\text{17}\)
- Illegal seller entities use three distinct marketing channels—social media, B2B e-commerce platforms, and classified ads—for advertising fentanyl and precursors.
- Networks of vendors illegally offering fentanyl and using images containing embedded fentanyl and precursor advertising information, such as CAS number, email, telephone number, and company name, were identified primarily through the clear net.
- Online advertisements for fentanyl and precursors almost exclusively use multiple CAS numbers accompanied by contact information within a single listing description, which facilitates direct deals.
- The online presence of illegal fentanyl vending in the clear net is almost entirely based in the People’s Republic of China (PRC), with some exceptions for India.\(^\text{18}\)
- Some common types of website categories and labeling for fentanyl advertising include recipes, chips and snacks, health and beauty, and jewelry and watches, possibly meant to conceal the true nature of the listing.
- Fentanyl and related precursors were commonly found in the clear net, which is not the case for darknet listings.

Extent of Fentanyl Advertising

Research previously conducted by C4ADS on fentanyl analogues and precursor chemicals using publicly available information indicated preliminary findings of social media platforms being used as a tool for advertising to a larger audience.\(^\text{19}\)

The Commission used this baseline research to further analyze a collection of 3,600 image advertisements for fentanyl-related synthetic precursors collected from Google image search queries from July 2021 through August 2021. The images contained CAS numbers, email addresses, telephone numbers, and public usernames to social media accounts. The aggregated data yielded contact information on 166 unique illegal sellers, 58 of which include affiliations indicative of a corporate entity as identified by email domain name (e.g., email suffixes that point to registered chemical or pharmaceutical companies located in the PRC).\(^\text{20}\) Additional Google queries using the entities’ email addresses returned a total of 24,386 URL results for fentanyl and precursor advertising.

Each URL was manually sorted into three categories of social media, e-commerce, and classified advertising. To confirm that each URL can be linked to fentanyl and precursor advertising, the Commission reviewed the content of the host website, including terms of service, privacy policy, or information describing the website (e.g., “About

\(^{17}\) This was also supported through interviews with clear-net and darknet subject-matter experts (interview 1, July 20, 2021; interview 24, August 18, 2021; and interview 34, August 24, 2021).

\(^{18}\) This finding is additionally supported through interview 21, August 17, 2021.


\(^{20}\) A total of 58 company affiliations were found. Of these, four email domains are from common email providers such as ProtonMail, Gmail, Outlook, and 163.com (a Chinese email address provider).
Us” or “Contact” page). To obtain a proxy for the geographic location and legal owner of the domain (and possibly the company), the Commission queried each URL against a WHOIS registrar, which provides the country for which the domain is registered.

The Illegal Seller Networks

Analysis of the illegal sellers yielded information on types of technology communication tools used, company affiliations, and types of online mediums leveraged for advertising fentanyl precursors globally. To gain insight into the global distribution of fentanyl advertising through online mediums, the Commission identified the ten countries with the most total unique URLs across all advertising categories of social media, B2B e-commerce, and classified ads. Those countries with the greatest advertising presence of fentanyl and precursors in July through September 2021 are illustrated in Figure E.4.

Among the ten countries represented most in the email domains are the PRC and the United States. According to the domain registrar, this result is consistent with the top countries of origin represented in the Commission’s database of chemical precursor distributors; however, the Commission also saw significant entries from other countries, such as Jamaica and the Bahamas. Most of the entries originating from Jamaica can be attributed to the e-commerce website JamDeal, which is marketed to users in Jamaica but is registered to an individual in Florida. It is likely that these websites do not indicate the physical location for a seller, but the use of these platforms might allow anyone to obscure their location such that a Chinese-based entity can use platforms that are hosted in other countries.

The category of “unknown” in the data represents classified ad websites for which the Commission was unable to identify a country of registrar through a combination of WHOIS domain name lookup and website links such as about us, contact, privacy, or terms of service. This “unknown” category raises initial concern around a sizable and highly anonymized advertising channel for fentanyl and its synthetic precursors that is essentially operating undetected with little obstruction, tracking, or enforcement.

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21 The categorizing of unique URLs with labels of social media, B2B e-commerce, and classified ads were all hand-coded during the URL validation process for confirming fentanyl and precursor advertising.

22 JamDeal is a website specific to the Jamaica market (JamDeal, homepage, undated).
Figure E.4
The Ten Illicit Sellers with the Most Advertising for Fentanyl and Precursors, by Country of Registrar

Source countries

Fentanyl advertising categories

- **United States**: Roughly coequal online presence
- **China**: 47% B2B e-commerce
- **Jamaica**: 45% classified ads
- **Bahamas**: 8% social media
- **India**: 82.7% of the postings were posted to U.S. social media sites but initiated by illegal seller entities from China

**NOTES:** B2B = business to business. Clear net is the portion of content on the internet that is publicly available or indexable by a common search engine, such as Google. Data collected are representative of a snapshot in time, from July 1 to August 31, 2021, and not intended to provide an exhaustive review of fentanyl’s online presence in the clear-net space. The social media sites scrubbed include Facebook, Pinterest, LinkedIn, Tumblr, and Twitter. Fentanyl precursors were found predominantly in the clear-net space, with virtually no listings for precursors in the dark web. In this sampling of clear-net data, the United States and China had roughly coequal online presences: 19.8 and 19.5 percent, respectively. Classified-ad policies, or their enforcement, can be less strict than those for display advertising, providing more anonymity to individuals posting. Image-only advertising is prevalent on Pinterest, by a very large margin.
The Commission found several instances where advertisements were posted by different email accounts on the same domain. Figure E.5 contains two image examples from the Pinterest social media platform listed by users hhuanhao.com and molbase.com. This finding is supported by previous work by C4ADS, which uncovered company documents that suggest various formats for employees to submit their advertisements as well as identical text across advertisements posted by different accounts.²³

**Figure E.5**

**Example Posts by Illegal Sellers on Pinterest**

NOTE: cas or CAS = Chemical Abstracts Service. EMS, DHL, TNT, and FedEx are shipping services.

The Commission’s own analysis uncovered cases where corporate email addresses may have been automatically generated or created sequentially—for example, sales1@aoksbio.com, sales10@aoksbio.com, sales15@aoksbio.com, sales16@aoksbio.com, and sales17@aoksbio.com. These email addresses are consistent with reports of companies employing multiple entities to advertise their products. However, the Commission suggests that this might also point toward corporate advertisers’ need to maintain a growing supply of “throw away” email accounts for further use when banned from violating the terms of service on social media, B2B e-commerce, and classified ad services.

Within website domains, the various personas that represent different organizations do not always advertise the same fentanyl precursors in their listings, which are usually identified by CAS numbers. It appears that in many cases, each persona will be responsible for advertising a specific subset of fentanyl precursor CAS numbers that the Commission had identified. From this observation, the Commission could hypothesize a system where when individual accounts are banned, the illegal seller only needs to create a new persona that advertises the banned account’s set of precursors as opposed to having to rebuild an entire catalog.²⁴ This observation is further reinforced when considering the use of image-only advertisements to elude automated efforts by social media platforms to remove postings that violate their terms of service. Figure E.6 provides insight on the ten illegal sellers with the most fentanyl and precursor advertising on social media in July through August 2021.

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²⁴ Information provided through interview 38, August 31, 2021; and interview 44, September 14, 2021, corroborated similar observations with the Commission’s research team.
Figure E.6
The Ten Illegal Sellers with the Most Fentanyl and Precursor Advertising on Social Media, by Social Media Platform

NOTE: URL = uniform resource locator, the formal term for an address on the internet.
Advertising Using Social Media

To examine the prevalence of fentanyl and precursors advertised on social media, the Commission limited its Google image search results to the social media platforms shown in Figure E.7. After noticing the prevalence of image-based advertising in the Commission’s initial search results, the Commission extended the scope of its search to include image-only media. The majority of search results using image-based advertising were sourced from the image-sharing service Pinterest by a very large margin.

Figure E.7

Number of Advertisements Found on Major Social Media Platforms

The use of image-only media for advertising may be explained by several practical considerations. These are listed as follows:

- **Automation**: Advertisements can be generated more easily by combining stock photography of a manufacturer’s stock and a seller’s contact information.
- **Obfuscation**: Embedding textual information in images may elude some social media platforms’ efforts to employ algorithmic detection methods as part of their content moderation strategy.
- **Portability**: Images are inherently self-encapsulating and can be displayed on virtually any device; furthermore, they reliably preserve the information contained within, regardless of a device’s operating system. This is different from other types of text-based documents with embedded markup, which require separate data structures to handle layout and content.
- **Branding**: Image-based advertisements allow the producer full control over branding and the manner in which the information is presented, while requiring a nontrivial amount of effort to reproduce or modify (e.g., by using company logos or watermarks).

In several instances, advertisements were incorrectly categorized by the author. The Commission believes that intentional misclassification of advertisements for chemical products used to illegally manufacture fentanyl or other synthetic opioids may be an effort to thwart the removal of content by the platform—for instance, by eluding automated detection. This type of mislabeling has been observed across several accounts and platforms including classified ads, B2B, and social media. Figure E.8 illustrates a Pinterest post that advertises the chemical 4-Anilinopiperidine (hydrochloride) (CAS 99918-43-1), which is classified as a fentanyl precursor that is controlled in the United States and Mexico. The following tags are associated with the post: snack recipes, snacks, chips, food, and snack mix recipes.

NOTE: URL = uniform resource locator, the formal term for an address on the internet.
As part of the social media analysis, the Commission used a Brandwatch subscription to construct a series of queries on the two content sources available. The social media content sources were Twitter and Tumblr, and the data were collected from January 2017 to September 30, 2021. Two main data queries were developed as part of the analysis. The first query used all 58 company affiliations identified from the illegal seller network, all of which have been identified as having direct Chinese affiliation. The focus of this query was to try and observe possible trends in company activity for the illegal sale of various drug types—for example, synthetic precursors or new psychoactive substances (NPS). According to the data, the first posts on drug sales from these 58 sellers appeared on tweets and Tumblr posts back in January 2018 for synthetic substances such as cathinone, cannabinoids, benzodiazepine, and NPS precursors BMK/PMK glycidate. The Commission also observed multiple CAS number nomenclature and chemical names being used within a single tweet or post for advertising on social media. NPS precursor advertising begins to trend upward starting in March 2018.

The second query used the same 58 company affiliations as in the first data query but replaced NPS precursors with fentanyl and synthetic precursors. The first posts of fentanyl precursor CAS numbers started appearing by April 2019—before the PRC announced a general class ban on all fentanyl-related substances that took effect in the following month. Figure E.9 illustrates the “Brandwatch” comparison of tweets/posts advertising fentanyl precursors versus NPS precursors from the illegal seller network. The comparison between fentanyl and precursor chemicals consistently indicates a higher volume of precursors being advertised on social media platforms versus finished fentanyl. However, according to the data, fentanyl precursor posts slowly increase throughout the analysis period. One of the main takeaways is the commonality of posters using chemical nomenclature such as CAS number as a form of advertising description for a listing across all types of social media platforms.

25 For more on this platform, see Brandwatch, “The #1 Digital Consumer Intelligence Platform,” webpage, undated.
The analysis of the fentanyl and precursors query showed that 25 percent of the company affiliations were identified as advertising fentanyl precursors on Twitter and Tumblr social media platforms. The advertising tweets and posts were represented by 15 percent of the 166 illegal seller entities previously. Within the same data, eight new illegal seller entities were identified that did not show up during the image advertising analysis. Another observation in the data occurred during January 2021, when the first form of tweets and posts from the illegal seller network started to include hyperlink references to other social media platforms, more specifically Pinterest.

It is still unclear why the temporal peaks on tweets and posts are occurring. One hypothesis might be that the illegal seller entities are operating in this manner to provide a low-grade communication signal or heartbeat just to maintain the minimum relevance and ranking within these social media platforms for potential trusted buyers. Perhaps the underlying assumption might be that if a new or experienced buyer starts to learn what to look for regarding fentanyl and associated precursors, these subtle low-key communication channels become easier to find.

Investigating the descriptions of the tweets and posts further, the Commission built a topic wheel, shown in Figure E.10, using the data depicted in Figure E.9. The topic wheel provides a view of the most frequent topics during the January 2017 to September 2021 time period. Fentanyl precursor CAS numbers of 125541-22-2 (4-anilino-1-Boc-piperidine), 23056-29-3 (4-AP), 79099-07-3 (1-Boc-4-piperidone), and 40064-34-4 (4-piperidinone) have a strong topic presence in advertising and in technology communication applications such as Chinese-owned WeChat and American-owned WhatsApp. The remaining topics in the wheel all represent NPS precursors.
Figure E.10

Topic Wheel from Fentanyl, NPS, and Synthetic Precursor Brandwatch Queries

NOTES: CAS = Chemical Abstracts Service. PMK = piperonyl methyl ketone. BMK = benzy1 methyl ketone. CBD = cannabidiol. GBL = gamma-butyrolactone. Larger topics show up more frequently than others—in this case, the most-common topics listed are for CAS numbers of precursor chemicals. The inner circle of the topic wheel contains the highest or strongest signal of a word or phrase across all of the tweets and Tumblr posts. For example, this wheel shows that CAS 125541-22-2 was the most frequently used term in this data set. The outer ring of the topic wheel under that CAS 125541-22-2 arc represents the next set of most frequently used terms associated with CAS 125541-22-2; in this case, terms of WeChat and CAS 40064-34-4 were the next most frequently associated words.
Advertising Using Business-to-Business E-Commerce

The use of B2B e-commerce platforms to advertise fentanyl and precursors was also derived from the illegal seller network. By previously using the seller email ID, which enabled the hand-coding of URLs into the B2B e-commerce category, the Commission identified more than 10,000 fentanyl and precursor listings in B2B e-commerce websites distributed across 57 countries worldwide. Multiple URLs in the total count can be represented on a single B2B e-commerce website because multiple listings of fentanyl and precursor advertisements are unique within a B2B e-commerce website. The number of actual unique B2B e-commerce website domains represented in the data is 115. Figure E.11 provides a summary of the ten B2B e-commerce websites with the most URLs.

![The Ten B2B E-Commerce Distributors with the Most URLs](image)

NOTE: B2B = business to business. URL = uniform resource locator, the formal term for an address on the internet.

The B2B e-commerce web-scraping effort focused on cataloging the data attributes of fentanyl or related precursors, including overall listings advertised by CAS number, quantities, weight in units, pricing, purity, and supplier or manufacturer. A review of listings suggests that most involved illegally produced powders and not diverted medical-grade fentanyl formulations (e.g., patches, lozenges). To achieve a more accurate view of the overall clear-web presence of fentanyl and precursor advertising, the initial target was to perform web-scraping activities on the 115 unique B2B e-commerce websites. However, because of time limitations, the Commission focused on a smaller sampling of 11 randomly selected B2B e-commerce websites—or 9 percent of the 115 unique B2B e-commerce websites.
ONLINE SOURCING OF SYNTHETIC OPIOIDS AND RELATED CHEMICALS

The 11 website domains selected were chemicalbook.com, diytrade.com, drugdu.com, echemi.com, ecplaza.net, made-in-china.com, okchem.com, rude66.com, topchinasupplier.com, tradewheel.com, and worldinout.com. The country of registrar for these 11 domains is the PRC; all sites are Chinese hosted and managed with the exception of one site, “ecplaza.net,” that is hosted and managed out of South Korea. The web-scraping of these 11 domains identified a total of 25,382 listings across the known CAS numbers for fentanyl precursors; however, a little more than half of those unique listings contained available information on price. Where price was absent, postings often included instructions to the buyer to contact the seller. Table E.1 contains summary statistics.

Table E.1
Number of Listings, by Sampled B2B E-Commerce Distributor

<table>
<thead>
<tr>
<th>Domain</th>
<th>Listings Total</th>
<th>Listings With Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>chemicalbook.com</td>
<td>6,758</td>
<td>353</td>
</tr>
<tr>
<td>diytrade.com</td>
<td>298</td>
<td>239</td>
</tr>
<tr>
<td>drugdu.com</td>
<td>174</td>
<td>66</td>
</tr>
<tr>
<td>echemi.com</td>
<td>2,165</td>
<td>550</td>
</tr>
<tr>
<td>ecplaza.com</td>
<td>230</td>
<td>83</td>
</tr>
<tr>
<td>made-in-china.com</td>
<td>14,550</td>
<td>13,510</td>
</tr>
<tr>
<td>okchem.com</td>
<td>288</td>
<td>104</td>
</tr>
<tr>
<td>rude66.com</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>topchinasupplier.com</td>
<td>507</td>
<td>445</td>
</tr>
<tr>
<td>tradewheel.com</td>
<td>44</td>
<td>23</td>
</tr>
<tr>
<td>worldinout.com</td>
<td>168</td>
<td>82</td>
</tr>
<tr>
<td>Grand total</td>
<td>25,382</td>
<td>15,655</td>
</tr>
</tbody>
</table>

The Commission’s analysis showed that roughly 38 percent of the fentanyl precursor listings did not list a price. Instead, fentanyl listings with no price information used key phrases such as “get latest price” or “contact now,” which, according to the Commission’s observations, appears to be an additional step in the buyer engagement process for completing a transaction. The remaining 62 percent of the listings contained price information on chemicals or synthetic opioids, but average weights were not included, limiting a true understanding of the value of chemicals sold in this space.

Additional analysis on listings containing purity information were derived from four of the 11 B2B e-commerce websites: ChemicalBook, Echemi, Made-in-China, and Okchem. Among the 13,144 listings with purity information, 11,215 (85 percent) indicated at least 99-percent purity (although the Commission cannot assess the validity of these claims on product quality or purity). Only 147 listings indicated purity below 95 percent. As observed, listings with higher purity did not list with higher prices on average than other listings with lower purity. See Table E.2 for additional details.
Regarding weight types in fentanyl precursor listings, chemicalbook, drugru, echemi, ecplaza, made-in-china, okchem, tophinasupplier, tradewheel, and worldinout were also the only seven websites of the 11 B2B e-commerce websites that contained weight information. Of the 25,382 listings containing weight information, 74 percent were in kilograms. The breakdown of weight in units is displayed in Table E.3. Among the other units observed, it is unclear what that weight type or unit of measure actually represents, as some were not clear units of weight. Of the 25,382 listings, only 61 percent of listings contained both weight and price information.
The majority of listings contained seller information, and the Commission identified 2,852 sellers across the 11 B2B e-commerce websites. The Commission did some standardization to seller name, but this number might be slightly inflated because seller names could be formatted slightly differently across listings. The seller with the most listings was “Shijiazhuang Suking Biotechnology Co Ltd,” which accounted for 4 percent of the listings. The top 11 sellers account for 12 percent of the total listings. Figure E.12 highlights the top 11 sellers, all of which represent Chinese affiliation.

**Figure E.12**

**Top 11 Sellers, by Number of URLs**

<table>
<thead>
<tr>
<th>Seller Name</th>
<th>URLs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shijiazhuang Suking Biotechnology</td>
<td>1,118</td>
</tr>
<tr>
<td>Mulei (Wuhan) New Material Technology</td>
<td>793</td>
</tr>
<tr>
<td>Shanghai CRM New Material Technology</td>
<td>785</td>
</tr>
<tr>
<td>Hubei Aoks Bio-Tech</td>
<td>732</td>
</tr>
<tr>
<td>Wuhan Kaimubuke Pharmaceutical Technology</td>
<td>695</td>
</tr>
<tr>
<td>Hanhong Medicine Technology (Hubei)</td>
<td>690</td>
</tr>
<tr>
<td>Wuhan wingroup Pharmaceutical</td>
<td>670</td>
</tr>
<tr>
<td>Wuhan Lwax Pharma Tech</td>
<td>608</td>
</tr>
<tr>
<td>Wuhan Xiju Biotechnology</td>
<td>466</td>
</tr>
<tr>
<td>Guangzhou Sunton Biotechnology</td>
<td>446</td>
</tr>
<tr>
<td>Jiangsu Kaihuida New Material Technology</td>
<td>446</td>
</tr>
</tbody>
</table>

NOTE: URL = uniform resource locator, the formal term for an address on the internet.
Advertising Using Classified Ads

To further understand the prevalence of fentanyl advertising, the Commission examined the use of classified ad services by performing Google queries using the illegal seller email addresses obtained previously. To validate classified ad URLs as such, follow-up queries using keywords describing fentanyl and its chemical precursors were performed. Direct queries for fentanyl precursor CAS numbers instead of names such as 99918-43-1 for N-phenyl-4-piperidinamine, 40064-34-4 for 4-piperidinone, or 79099-07-3 for 1-Boc4-piperidone were less effective at validating the indexed listings; instead, keywords that were often matched to advertisement titles included terms such as “fentanyl,” “bmk,” “pmk,” or other shortened chemical names. A listing can have a single CAS number used for a title description with an image attached in the post, but the image can include any amount of text information the poster wishes to communicate to avoid being picked up by a website search index. Interestingly, simple names or abbreviations had substantially higher hits. The resulting matches contained embedded images displaying seller information, as illustrated in Figure E.13.

Figure E.13
Classified Ad Listing from shoppok.com

NOTE: 4-CDC = 4-chloro-N,N-dimethylcathinone. BK-EBDP = 1-(2H-1,3-benzodioxol-5-yl)-2-(ethylamino)pentan-1-one. 4CLPVP = 4-Chloro-alpha-pvp. 4-CEC = 4-chloroethcathinone. A-PPP = α-pyrrolidino propiophenone. 5C-ABP = 5-chloro AB-PINACA. 5F-MDMB-2201 = methyl 2-(1-(5-fluoropentyl)-1H-indole-3-carboxamido)-3,3-dimethylbutanone. THJ-2201 = 1-(5-fluoropentyl)-1H-indazol-3-yl|naphtthalen-1-yl|methanone. HEX-EN = N-ethylhexedrone. U-49990 = trans-3,4-dichloro-N-[2-(diethylamino)cyclohexyl]-N-methyl-benzamide. U-48800 = trans-2-(4-dichlorophenyl)[N-2-(dimethylaminocyclohexyl)-N-methylacetamide, monohydrochloride. 2-NMC = 1-(4-Chloro-phenyl)2-ethylamino-propan-1-one.
Possible explanations for the use of classified ad services over other platforms is that their policies (or the enforcement of them) may be less strict; classified ad services provide more anonymity to people posting content, and the advertisement itself seems to have little to no expiration date, enabling a long-term advertising presence for a fentanyl listing. The data regarding classified ads is comprised of 145 classified ad unique website URLs identified from the illegal seller network described previously. Of the 145 unique website URLs identified, eight websites (5 percent) were randomly selected for web-scraping fentanyl and synthetic precursor listings. Data analysis of classified ad URLs discovered additional illegal seller contact information and B2B e-commerce company URLs, which provide further insights on fentanyl listings containing pricing, weight, and quantity. Table E.4 lists summary statistics highlighting findings with respect to the number of listing counts and average pricing per listing.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Listings</th>
<th>Total</th>
<th>With Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>arabsclassifieds.com</td>
<td>694</td>
<td>417</td>
<td></td>
</tr>
<tr>
<td>expatriates</td>
<td>1,562</td>
<td>1,128</td>
<td></td>
</tr>
<tr>
<td>lolclassifieds.com</td>
<td>309</td>
<td>228</td>
<td></td>
</tr>
<tr>
<td>mirlir.com</td>
<td>448</td>
<td>330</td>
<td></td>
</tr>
<tr>
<td>searchika.com</td>
<td>378</td>
<td>291</td>
<td></td>
</tr>
<tr>
<td>shoppok.com</td>
<td>533</td>
<td>456</td>
<td></td>
</tr>
<tr>
<td>tradersofafrica.com</td>
<td>209</td>
<td>209</td>
<td></td>
</tr>
<tr>
<td>xtree.com.au</td>
<td>934</td>
<td>870</td>
<td></td>
</tr>
<tr>
<td>Grand total</td>
<td>5,067</td>
<td>3,929</td>
<td></td>
</tr>
</tbody>
</table>

The Commission searched eight classified ad sites for fentanyl precursor CAS numbers, as well as keywords *fentanyl*, *bmk*, and *pmk*. The Commission gathered 14,548 listings using these search terms. To eliminate irrelevant listings, Commission researchers checked for either the search term or keywords associated with CAS numbers in either the title or detail section of the index listing. The Commission also deduplicated the data by URL and ended up with 5,067 listings. Many of the sites had a few outliers with high prices, which inflated the average price, so the Commission also looked at median price.

Classified ads are unique in functionality because they offer an additional data attribute of a date timestamp per listing, which was captured in the web-scraping effort. The observations of these date timestamps for fentanyl and synthetic precursor classified ads yielded insight into the relative age of a listing post, including frequency of listing posts per seller over time. Figure E.14 displays the illegal seller listings for fentanyl and other synthetic opioids over time.
THE DARKNET

The darknet—a small subsection of the deep web—is commonly accessed via “Onion Router Tor,” “Invisible Internet Project (I2P),” and “Freenet,” which operates an overlay network of anonymous servers that mask user IP addresses. Further anonymity is achieved through the use of cryptocurrencies (e.g., Bitcoin, Monero, Litecoin) for electronic payment. Cryptomarkets on the darknet are online marketplaces that function using cryptocurrencies and advanced encryption techniques to offer increased anonymity to vendors and customers trading in illegal goods or services. Though a 2015 report estimated that the Tor darknet consisted of around 30,000 unique hidden

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services, a 2018 study suggested this figure was dramatically inflated, in part because of the volatile life cycle of these markets, and concluded that Tor’s hidden service darknet was roughly half the size previously reported. A 2019 study attempted to classify Tor’s hidden services as suspicious (i.e., criminal), normal (i.e., hosting services), and unknown (i.e., empty or locked). This study concluded that of 10,367 known Tor sites, 20 percent were suspicious, 48 percent were normal, and 32 percent were unknown.

The innovation “Silk Road” model of illicit trading on the darknet consists of four pillars:

1. Tor, I2P, Freenet
2. cryptocurrencies
3. escrow
4. trust established via buyer feedback.

According to a 2017 Europol and the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) report, more than 60 percent of the listings on cryptomarkets are dedicated to pharmaceutical and/or illicitly produced psychoactive substances (i.e., diverted and pharmaceuticals, drug-related chemicals, and illicitly produced drugs). The Dream Market charged a US$300 vendor bond, received 4-percent commission on sales, and required payment in Bitcoin or other cryptocurrencies via an escrow service. This model of illicit trading combines efficiency with anonymity and scale, which presents challenges to law enforcement and intelligence agencies (e.g., cross-jurisdictional investigations and tracing illicit transactions) while providing market actors with the ability to adapt and overcome law enforcement countermeasures (e.g., not listing products named “fentanyl”).

Such challenges have brought about more multinational joint law enforcement cooperation—including between the Joint Criminal Opioid and Darknet Enforcement (JCODE) team—comprised of the Federal Bureau of Investigation (FBI), Drug Enforcement Administration (DEA), U.S. Postal Inspection Service (USPIS), U.S. Customs and Border Protection (CBP), U.S. Immigration and Customs Enforcement (ICE), Department of


Defense (DoD), Financial Crimes Enforcement Network (FinCEN), and Department of Justice (DOJ) in the United States—and the European Union Agency for Law Enforcement Cooperation (Europol), Australian law enforcement agency joint operations with key partners (i.e., the United States, United Kingdom, New Zealand, and Canada), and the Association of Southeast Asian Nations and the United Nations Office on Drugs and Crime (UNODC) partners in Asia.

Findings from the Literature

The following are key takeaways from the synthetic opioid darknet literature review:

- Heroin and oxycodone maintain market dominance on the darknet, even though the prices are higher per gram relative to fentanyl and certain analogues (which could reflect the higher potency of synthetic opioids).
- Formulations of items sold online ranged from powders to pills to patches, complicating some of the comparisons; however, most items listed were for formulations of powder.
- It is impossible to know where products were manufactured, though some vendors do list a country of origin where the shipments may be initiated. Based on self-reports, the PRC plays an important role in fentanyl and analogue markets on the darknet; other countries are as well (e.g., Europe broadly, Australia, and the United States), although those countries tend to distribute among themselves.
- Vendors rarely provide data on the purity of their products, and buyers appear to rely on their knowledge of the named substances, vendor “integrity” (e.g., based on reviews from other consumers), and past personal experience with darknet vendors in this regard.

Bans on fentanyl sold on darknet markets (e.g., Dream) do not appear to completely inhibit the sale of fentanyl, although they might reduce the number of listings (for products explicitly named “fentanyl”); however, vendors may have reacted by selling smaller quantities of stronger uncontrolled alternatives that transact at higher prices per gram. Although bans of fentanyl on cryptomarkets appear to reduce its supply, the number of different substances and the price of nonfentanyl novel synthetic opioids increased, which suggests that bans of fentanyl result in vendors shifting their product lines toward uncontrolled substances. Note the following:

- Fourteen of the 17 nonfentanyl novel synthetic opioids for sale on Empire from June to August 2020 were not available for sale in earlier data collections (nine of the 17 were not previously identified by the National Forensic Laboratory Information System).
- Etazene had 135 retail listings for an average price of $128.40 per gram and 60 wholesale listings for an average price of $41.60 per gram (one unique vendor).
- 2-MAP-237 had 65 retail listings for an average price of $63.20 per gram and 69 wholesale listings for an average price of $43.40 per gram (five unique vendors).
- SPM-003 had 29 retail listings for an average price of $61.10 per gram and 88 wholesale listings for an average price of $13 per gram (one unique vendor).
- For nonfentanyl novel synthetic opioids that were sold on cryptomarkets in 2018 and 2019, the average number of listings and average amount available decreased, and the prices increased significantly in 2020.
- From March 2018 to August 2020, the average number of listings for U-48,800 decreased from 224 to 89 listings of 1,845 grams to 1,939 grams, and the wholesale price per gram increased from $14.20 to $24.50.

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• From March 2018 to August 2020, the average number of listings for U-47,700 decreased from 84 to 53 of 540 grams to 83 grams and the price increased from $100.30 to $481.10 per gram retail and $19.70 to $36.50 per gram wholesale.

• Closure of individual darknet markets appears to shift vendors to other markets. Because many vendors advertise multiple products on multiple markets, closure of one market shifts vendors and consumers to the other markets—it does not eliminate fentanyl sales on the darknet, although it instead may result in a short-term reduction in supply with some effect on prices. However, newer chemicals would often simply be introduced.

• In 2019, the closure of Dream (March), Valhalla (February), and Wall Street (April) resulted in the decline of fentanyl listings (from 792 at the end of April to 531 at the end of July to seven at the end of December).

• After Wall Street’s seizure, new markets emerged—Agartha, Dream Alt, and Samsara. Some of the remaining original markets continued to grow. Berlusconi enjoyed rapid growth in total drug sales after Wall Street’s closure. Nightmare’s closure was accompanied by growth in Apollon (291.6 percent), Berlusconi (435.9 percent), and Samsara (338.8 percent).

• A gradual decrease in fentanyl listings among all opioid listings was observed after the closures of Dream and Wall Street. Tochka’s exit scam further reduced fentanyl availability until there were only a small number of listings on only one market—Empire.

Table E.5 reports details extracted from the literature across several darknet marketplaces.

55 Tochka Market’s exit scam was not unique in the darknet market space. As an escrow market, Tochka Market held users’ (buyers’ and sellers’) funds in escrow accounts, and when the administrator decided that there were enough funds accumulated, they stopped accepting new payments and releasing any of the funds held in escrow—followed by taking the market itself offline. By doing so, the administrator of Tochka Market was able to profit by not just collecting a percentage of a transaction but by taking all of the money that was held in escrow at that time. For more information on the exit scam or sudden closure of Tochka, see Roderic Broadhurst, Matthew Ball, Chuxuan Jiang, Joy Wang, and Harshit Trivedi, Impact of Darknet Market Seizures on Opioid Availability, Canberra: Serious and Organised Crime Research Laboratory, Australian Institute of Criminology, Research Report 18, last update May 24, 2021; and National Drug and Alcohol Research Centre, University of New South Wales, Sydney, “Trends in the Availability and Type of Drugs Sold on the Internet via Cryptomarkets, January 2019–January 2020,” Drug Trends Bulletin, June 11, 2020.
## Table E.5
Details About Darknet Marketplaces Extracted from the Literature

<table>
<thead>
<tr>
<th>Substance</th>
<th>Number of Unique Listings</th>
<th>Number of Unique Vendors</th>
<th>Total Average Weight Available, in Grams</th>
<th>Price, in U.S. Dollars per Gram&lt;sup&gt;a,b&lt;/sup&gt;</th>
<th>Darknet Market</th>
<th>Data Collection Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl</td>
<td>819</td>
<td>74</td>
<td>11</td>
<td>78 (retail); 1,474 (retail); 12 (wholesale); 587 (wholesale)</td>
<td>Dream</td>
<td>March 2018–January 2019</td>
</tr>
<tr>
<td>Pharmaceutical fentanyl</td>
<td>301</td>
<td>36</td>
<td>5</td>
<td>17 (retail); 308 (retail); 30 (wholesale); 110 (wholesale)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonpharmaceutical fentanyl</td>
<td>395</td>
<td>33</td>
<td>25</td>
<td>217 (retail); 4,372 (retail); 4 (wholesale); 1,637 (wholesale)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxycodone pills with fentanyl&lt;sup&gt;c&lt;/sup&gt;</td>
<td>123</td>
<td>5</td>
<td>3</td>
<td>1 (retail); 12 (retail); 1 (wholesale); 13 (wholesale)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,118</td>
<td>102</td>
<td>27,310&lt;sup&gt;d&lt;/sup&gt;</td>
<td>68</td>
<td>Berlusconi, Dream, Empire, Tochka, Valhalla, Wall Street</td>
<td>January 2019–March 2019</td>
</tr>
<tr>
<td></td>
<td>3,151</td>
<td>ND</td>
<td>ND</td>
<td>34</td>
<td>Apollon, Empire, Dream, Nightmare, Tochka, Berlusconi, Valhalla, Wall Street, Agartha, Dream Alt, Samsara, Cryptonia</td>
<td>January 2019–December 2019</td>
</tr>
<tr>
<td></td>
<td>1,626</td>
<td>ND</td>
<td>1,470</td>
<td>ND</td>
<td>Empire</td>
<td>June 2020–August 2020&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Substance</td>
<td>Number of Unique Listings</td>
<td>Number of Unique Vendors</td>
<td>Total Average Weight Available, in Grams</td>
<td>Price, in U.S. Dollars per Gram</td>
<td>Darknet Market</td>
<td>Data Collection Period</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------------------------</td>
<td>--------------------------</td>
<td>----------------------------------------</td>
<td>-------------------------------</td>
<td>----------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Heroin</td>
<td>52,510</td>
<td>532</td>
<td>601 - 2,267</td>
<td>28 (retail); 0.2 (wholesale)</td>
<td>Dream</td>
<td>March 2018–January 2019</td>
</tr>
<tr>
<td></td>
<td>4,839</td>
<td>ND</td>
<td>69,760</td>
<td>85</td>
<td>Berlusconi, Dream, Empire, Tochka, Valhalla, Wall Street</td>
<td>January 2019–March 2019</td>
</tr>
<tr>
<td></td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>Apollon, Empire, Dream, Nightmare, Tochka, Berlusconi, Valhalla, Wall Street, Agartha, Dream Alt, Samsara, Cryptonia</td>
<td>January 2019–December 2019</td>
</tr>
<tr>
<td></td>
<td>14,679</td>
<td>ND</td>
<td>36,900</td>
<td>90 (retail); 37 (wholesale)</td>
<td>Empire</td>
<td>June 2020–August 2020</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>Dream</td>
<td>March 2018–January 2019'</td>
</tr>
<tr>
<td></td>
<td>3,169</td>
<td>ND</td>
<td>14,410</td>
<td>1,430</td>
<td>Berlusconi, Dream, Empire, Tochka, Valhalla, Wall Street</td>
<td>January 2019–March 2019</td>
</tr>
<tr>
<td></td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>Apollon, Empire, Dream, Nightmare, Tochka, Berlusconi, Valhalla, Wall Street, Agartha, Dream Alt, Samsara, Cryptonia</td>
<td>January 2019–December 2019</td>
</tr>
<tr>
<td></td>
<td>6,564</td>
<td>ND</td>
<td>9,053</td>
<td>ND</td>
<td>Empire</td>
<td>June 2020–August 2020</td>
</tr>
<tr>
<td>Substance</td>
<td>Number of Unique Listings</td>
<td>Number of Unique Vendors</td>
<td>Total Average Weight Available, in Grams (^a)</td>
<td>Price, in U.S. Dollars per Gram (^{a,b})</td>
<td>Data Collection Period</td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------</td>
<td>--------------------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------</td>
<td>------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
<td>Minimum</td>
<td>Maximum</td>
<td>Darknet Market</td>
<td></td>
</tr>
<tr>
<td>Fentanyl analogues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carfentanil</td>
<td>45</td>
<td>7</td>
<td>0.05</td>
<td>2,552</td>
<td>Dream March 2018–January 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>183 (retail); 4,222 (retail); 26 (wholesale)</td>
<td>232 (wholesale)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ND</td>
<td>ND</td>
<td>8,050</td>
<td>20</td>
<td>Berlusconi, Dream, Empire, Tochka, Valhalla, Wall Street January 2019–March 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td>606</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>Apollon, Empire, Dream, Nightmare, Tochka, Berlusconi, Valhalla, Wall Street, Agartha, Dream Alt, Samsara, Cryptonia January 2019–December 2019</td>
<td></td>
</tr>
<tr>
<td>Furanylfentanyl</td>
<td>217</td>
<td>5</td>
<td>1</td>
<td>6,716</td>
<td>Dream March 2018–January 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14 (retail); 1,443 (retail); 5 (wholesale)</td>
<td>152 (wholesale)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ND</td>
<td>ND</td>
<td>4,010</td>
<td>41</td>
<td>Berlusconi, Dream, Empire, Tochka, Valhalla, Wall Street January 2019–March 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>Apollon, Empire, Dream, Nightmare, Tochka, Berlusconi, Valhalla, Wall Street, Agartha, Dream Alt, Samsara, Cryptonia January 2019–December 2019</td>
<td></td>
</tr>
<tr>
<td>Substance</td>
<td>Number of Unique Listings</td>
<td>Number of Unique Vendors</td>
<td>Total Average Weight Available, in Grams</td>
<td>Price, in U.S. Dollars per Gram&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>Darknet Market</td>
<td>Data Collection Period</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------------</td>
<td>--------------------------</td>
<td>-----------------------------------------</td>
<td>---------------------------------------------</td>
<td>----------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Fluoroisobutyrofentanyl</td>
<td>101</td>
<td>4</td>
<td>541–3,956</td>
<td>18 (retail); 7 (wholesale)</td>
<td>Dream</td>
<td>March 2018–January 2019</td>
</tr>
<tr>
<td></td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>Berlusconi, Dream, Empire, Tochka, Valhalla, Wall Street</td>
<td>January 2019–March 2019</td>
</tr>
<tr>
<td></td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>Apollon, Empire, Dream, Nightmare, Tochka, Berlusconi, Valhalla, Wall Street, Agartha, Dream Alt, Samsara, Cryptonia</td>
<td>January 2019–December 2019</td>
</tr>
</tbody>
</table>


NOTES: ND = no data.

<sup>a</sup> If either minimum or maximum is not indicated, the average amount available is reported.

<sup>b</sup> Not all data sources provided data on average retail versus wholesale price.

<sup>c</sup> This average weight was calculated using the average total weight of 135 milligrams per pill available on average.

<sup>d</sup> This average weight is likely an underestimate given that 282 listings did not provide a mean weight and only included products labeled as fentanyl (i.e., does not include “China White”).

<sup>e</sup> The authors considered fentanyl analogues with fentanyl.

<sup>f</sup> The authors did not provide data for oxycodone without fentanyl.
Key Findings from Scraping Analysis of Darknet Marketplaces

The Commission could not observe any chemical precursors in the current market ecosystem or historically; it was unable to find any listings, even by searching by CAS number.

The overall number of opioid listings found in the dark web markets covered in this study is small relative to other drug categories. The observed category of “opioids” contains 8,048 unique listings across six marketplaces: Berlusconi, Dream, Olympus, Rapture, Wall Street, and Tochka. These observations consist of historical data collected between October 2017 and April 2019. During this time period, opioids accounted for approximately 2 percent of the total 396,241 unique drug listings. More recently, observations made using data scraped in 2021 show no substantial change from previous measures. This suggests that, since 2017, there has been no change in the availability of opioids on the darknet. See Table E.6.

### Table E.6

**Opioid Listings Found in the Darknet Markets**

<table>
<thead>
<tr>
<th>Category</th>
<th>2017–2019</th>
<th>2021*</th>
</tr>
</thead>
<tbody>
<tr>
<td>All opioids</td>
<td>8,048</td>
<td>2,346</td>
</tr>
<tr>
<td>Synthetic opioids</td>
<td>1,651</td>
<td>359</td>
</tr>
<tr>
<td>Heroin or oxycodone</td>
<td>2,843</td>
<td>1,168</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>346</td>
<td>51</td>
</tr>
</tbody>
</table>

NOTES: The all-opioid category includes synthetic opioids, heroin, oxycodone, and fentanyl.

* Observations in 2021 were collected during July to September.

b Includes such substances as etazene, 2-MAP-237, U-48,800, U-47,700, 2F-Viminol, isotonitazene, spiradoline, brorphine, metonitazene, fluonitazene, methadone, tramadol, tapentadol, buprenorphine, and suboxone.

Despite the decrease in overall observed listings, a few key data points have remained constant. The ratio of listings to vendors has remained stable from the historical (2017–2019) observations to the Commission’s latest 2021 data—6:1 compared to 7:1, respectively. This indicates that, despite evidence of a drastic upheaval in the darknet market ecosystem during this time period (including market closures because of law enforcement seizures, exit scams, and denial-of-service attacks), the willingness of vendors to continue selling opioids has not been significantly affected.

Most darknet marketplaces have explicit bans on fentanyl as a part of their terms of service, and listings advertising fentanyl have remained limited. Analyzing the historical data from 2017–2019, the Commission found that approximately 4 percent of opioid listings explicitly mention fentanyl (or an analogue), and these 346 listings were being advertised by 135 unique vendors. The historical observations indicate that fentanyl was advertised in a variety of forms: powder, liquid, transdermal patch, and tablet. All but one of the 51 listings advertising fentanyl are specifically selling pharmaceutical transdermal patches. Of the 51 listings advertising fentanyl observed during July–August 2021, 49 were observed on White House Market and attributed to a single seller. This indicates that the number of vendors willing to advertise fentanyl (and analogue) has decreased.

The Commission’s observations suggest that the overall decrease in the availability of fentanyl has not driven a shift toward nonfentanyl synthetic opioids. The overall availability of nonfentanyl synthetic opioids has changed since 2017, and far fewer listings are observed. However, the willingness of vendors to advertise it has not changed as indicated by the ratio of listings to vendors—3.5:1 in 2017 to 4.5:1 in 2021.
The most significant part of the opioid market was, and continues to be, heroin and oxycodone. Recent observations indicate that the market value of the opioid category in cryptomarkets is largely skewed toward heroin and oxycodone. Fentanyl and nonfentanyl synthetic opioids make up a significantly smaller part of the market, if listed at all. However, it is impossible, at this time, to analytically confirm if items listed as heroin or oxycodone are indeed such opioids or if dealers are masking fentanyl listings by advertising counterfeit tablets that contain fentanyl as diverted prescription oxycodone.

The use of the term *fentanyl* or *fentanil* in listing titles has decreased significantly, coinciding with the overall decrease in availability of fentanyl products. In addition, the Commission has observed listings for other drugs, such as heroin and oxycodone, with titles that explicitly claim that the product contains “no fentanyl.”

Findings from Prior Observations from the Darknet

This section provides historical context for darknet listings between 2017 and 2021. Analysis is conducted on aggregated data sets, both from the RAND Corporation’s Dark Web Observatory archives spanning 2017–2021, and data collection efforts conducted between July 15 and August 31, 2021, specifically for this study.

The Commission separated all listings categorized as “drugs” into two sets. The first consists of listings that sell fentanyl. The second set consists of listings that sell other drugs and claim, specifically, to be free of fentanyl. The former set was constructed by matching titles and descriptions for the terms *fentanyl* and *fentanil*. The latter was constructed by matching titles or descriptions specifically containing the expression “no fent” or “fent free.” See Figure E.15 for trends in listings over time.

Trends in listings that included fentanyl appeared mostly through 2017 but dropped in following years as marketplace administrators started to ban listings containing fentanyl. It is possible that fentanyl-involved listings were concealed as counterfeit tablets, but the Commission has no way of verifying this. The total number of listings that indicate not being fentanyl did not change much over time, as shown in Figure E.15, suggesting that sellers did not attempt to advertise opioid listings as not containing fentanyl.

It should be noted that it is common practice for vendors to advertise other products within a particular listing. For example, a vendor listing for unrelated “drug paraphernalia” may still advertise fentanyl products sold elsewhere. As a result, this listing would be counted as one that sells fentanyl; however, the purpose of this analysis is to document the trends in terminology and the rise of the term *no fent* or *fent free* during mounting opioid crises worldwide.

36 It is possible that these “no-fent” listings could still contain fentanyl, as a lack of fentanyl listings could be attributed to obfuscation techniques by vendors either purposefully miscategorizing their products or using coded words.
Opioid Listings in 2021 for Darknet Listings

The Commission identified 526 vendors across seven markets that were advertising the data fentanyl or fentanyl in the title or description. An overwhelming majority of these vendors were advertising on the Dream Market. This section focuses on listings that were posted in four marketplaces that were operating at the time of analysis between July 15 and August 31, 2021—Cartel, Monopoly, Vice City, and White House.37 These markets were selected based on the following criteria:

1. availability of synthetic opioids in the market’s listings
2. number of available listings
3. listing on Darknetlive38
4. mentions by Dark.Fail.39

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37 Dream Market, which was the largest darknet marketplace at one time, closed in 2019 and was not included in this analysis.
38 Includes Darknet market news, links, and guide website (Darknetlive, homepage, undated).
39 Dark.Fail is a website for how to use Tor hidden services safely. The website also provides verification of whether a darknet site is online and its history and popularity among other darknet sites.
Cartel was selected because it designated a separate “fentanyl” category. Vice City and White House were selected because of the large numbers of listings they had, with the latter being one of the largest markets operating as of this writing. Monopoly was identified as a target because of its high volume of sales despite its small number of listings and lack of fentanyl-specific listings.

In its observations of these darknet markets, the Commission noted that the number of listings that a cryptomarket presents on its landing page can be inaccurate. The Commission is unsure whether this is intentional on the part of the site administrators. For example, in one of the Commission’s crawling sessions, the landing page for Cartel Market indicates that it had more than 800 “opioid” listings, but in its crawl over all of the available index pages, the Commission found only 176 unique listings across six pages.

**Summary Statistics**

The Commission indexed a total of 2,346 listings for fentanyl and other opioid-related products from four darknet marketplaces. Figure E.16 shows the distribution of listings across the marketplaces that were observed. White House Market had more than 80 percent of the listings. Approximately 30 percent of the vendors ship from the United States. A small subset of 220 listings offer insight into the packaging methods and units of measurement of the items being sold. The total value of all listings was estimated at approximately $1.5 million. The total was calculated by converting all currencies to U.S. dollars and summing the listed prices. Note that the estimate reflects the equivalent of purchasing a single item from each listing regardless of the total inventory.
Figure E.16
Estimated Value of Listings, by Darknet Marketplace, in U.S. Dollars

- **White House Market**
  - All opioids: 1,514,024
  - Heroin and oxycodone: 1,066,210
  - Synthetic opioids: 83,303
  - Fentanyl: 26,235

- **Cartel Market**
  - All opioids: 116,573
  - Heroin and oxycodone: 42,929
  - Synthetic opioids: 17,201
  - Fentanyl: 0

- **Vice City Market**
  - All opioids: 90,116
  - Heroin and oxycodone: 90,116
  - Synthetic opioids: 70,116
  - Fentanyl: 31

- **Monopoly Market**
  - All opioids: 838
  - Heroin and oxycodone: 428
  - Synthetic opioids: 838
  - Fentanyl: 0

**Estimated listing value, in U.S. dollars**
ONLINE SOURCING OF SYNTHETIC OPIOIDS AND RELATED CHEMICALS

Fentanyl in 2021

Within the listings categorized as “opioids,” items that specifically list “fentanyl” in the title comprise a very small percentage of overall listings and are concentrated within the White House Market, but this is still a minute share with less than 3 percent of listings (Table E.7). In contrast, about 1 percent of opioid listings explicitly mentioned that the drug did not contain fentanyl.

Table E.7
Fentanyl Darknet Listings, 2021

<table>
<thead>
<tr>
<th>Market</th>
<th>All Opioid Listings</th>
<th>Listings with “Fentanyl” in the Title</th>
<th>Listings Explicitly Excluding Fentanyl</th>
</tr>
</thead>
<tbody>
<tr>
<td>White House Market</td>
<td>1,882</td>
<td>50</td>
<td>18</td>
</tr>
<tr>
<td>Vice City Market</td>
<td>262</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cartel Market</td>
<td>176</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Monopoly Market</td>
<td>26</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>2,334</td>
<td>51</td>
<td>21</td>
</tr>
</tbody>
</table>

Of the markets the Commission investigated for this study, only two of them, White House Market and Vice City Market, have explicit statements in rules or terms of service banning the sale and advertisement of fentanyl or fentanyl analogues. Only three vendors are advertising fentanyl directly. This number is a sharp decline compared with the number of vendors that had been offering fentanyl in the three years prior. Some of the listings that attempt to indicate that the product is fentanyl-free include some of the following substances: China White; #4 Heroin, Heroin #4—Afghan; and BLVCK TVR, Black Tar Heroin.

FINAL SUMMARY OF ONLINE SUPPLY OF SYNTHETIC OPIOIDS

The availability of synthetic opioids and related precursor chemicals online is an important component to the illegal supply of fentanyl and several other potent synthetic opioids. There is a clear variation in what chemicals or drugs are available on what platforms.

Analysis here has shown that no fentanyl precursors were available on the darknet. Further, the listings of opioids on the darknet favored items that included heroin or diverted prescription opioids, not fentanyl outright. There is not a clear understanding of how much fentanyl there is in the darknet given that most markets have a ban on advertising it, and it is unclear how many products that are specifically labeled as “nonfentanyl” may contain fentanyl concealed as another drug. That said, several uncontrolled or novel synthetic opioids (e.g., etonitazene) were listed on darknet marketplaces. The availability of both precursors and fentanyl products on the clear net would make it an unattractive product to market on the darknet, given the overhead required for a seller to openly distribute on a darknet marketplace.

The clear net plays an important role in the supply of synthetic opioids. Suppliers based in the PRC are likely routing listings through B2B e-commerce websites and classified ads. In the case of some listings emanating from websites registered in the Caribbean, analysis identified by email domain suggests that suppliers are likely based in the PRC. Further, as identified by unique usernames or email addresses, firms use different platforms to advertise precursors or other related products. Listings can be added to many platforms, easily concealed by the use of CAS numbers or other coded words to circumvent website monitoring efforts.
Suppliers often include contact information on product listings, and slightly less than half of listings include details such as price. Product listings are sometimes embedded in photos, especially on some social media platforms, with information about suppliers and the product. Buyers are encouraged to directly contact suppliers, which can complicate law enforcement efforts through the use of encrypted web-based communication tools.

The ability that individuals or criminal organizations have to connect with suppliers, who may be linked to legitimate or licensed chemical manufacturers in Asia, facilitates easy trade in precursor chemicals and finished synthetic opioids.
Appendix F

SYNTHETIC OPIOID TRAFFICKING AND REGULATION ACROSS FIVE COUNTRIES

The Commission analyzed illegal or underregulated production of synthetic opioids or their related precursor chemicals in five countries important or potentially important for supplying the U.S. market. The analysis is intended to provide a picture of illegal synthetic opioids and related regulation in each country as part of a global network of production and supply as an input to other parts of the Commission report. The analysis includes separate sections on Canada, the People’s Republic of China (PRC), India, Mexico, and Myanmar, and each of the accounts follows a different format depending on the most relevant issues and the information available. These were selected given the importance of the current or potential role they play with the illegal supply of synthetic opioids.

The PRC and Mexico accounts are longer and more complex because these countries play the largest role in the illegal supply of synthetic opioids sent to the United States. India is known to have a large pharmaceutical sector but plays a smaller role in the illegal supply of synthetic opioids to the United States. Canada faces similar problems with the illegal importation of synthetic opioids and related chemicals, but now might be experiencing growing illegal domestic manufacture. Myanmar currently does not appear to be a source of illegally manufactured synthetic opioids, but the country’s history with illegal drug production, including illegal production of methamphetamine, could make it a source in the future.

In addition, analysis of each country seeks to respond to the following research questions:

- What are the limitations to how the international drug control system reviews and regulates new and emerging drugs and related precursor chemicals?
- What is the size and capability of the pharmaceutical industry?
- What is the nation’s legal and regulatory capacity, and what are its tools and priorities?
- What steps have been taken to address illegal production of synthetic opioids, and what gaps in reducing production remain?
- What role does the country play in the global supply chain of synthetic opioids that are illegally imported to the United States?

OVERALL CONCLUSIONS

The country accounts find that scheduling of synthetic opioids and their precursor chemicals may shift production patterns as chemical producers or transnational criminal organizations (TCOs) move from one chemical to another. This is evidenced by seizure data, which might not provide a full picture of the illegal trade. Furthermore, corruption or national institutional priorities that favor tariff collection over limiting manufacturing could make implementing new regulations challenging. Finally, the number of potential precursors is vast, and many of them are widely used in legitimate medical settings and pharmaceutical manufacturing. These precursors cannot easily be
banned, and efforts to add to the regulatory burden for widely used chemicals might be resisted by some industry actors and governments.

The PRC’s large pharmaceutical industry makes it a natural home for the exportation of precursor chemicals and some synthetic opioids that find their way into the illegal trade. These chemicals have been shipped by mail, but increasingly reports claim that they are shipped to Mexico through seaports and airports and then used by Mexican TCOs to synthesize fentanyl. The Mexican land border is now the primary route for synthetic opioids that illegally enter the United States, along with many other drugs. Other countries have the potential to develop production capacity, and there is evidence that illegal production of fentanyl occurs in Canada. India’s large pharmaceutical industry makes it a potential home for synthetic opioid and precursor production, especially if increased Chinese regulation shifts criminals elsewhere. Myanmar also has the potential for production in the future.

Future regulatory efforts could focus on reporting and sharing information on the transactions or movements of suspected chemicals, improvements to know-your-customer laws, ways to enhance industry partnerships and oversight to increase deterrence, and better target interdiction. Other challenges related to governance might remain as violent criminal actors, especially in Mexico, continue to challenge the state.

METHODS AND RESEARCH APPROACH

The country accounts provide insights into the type of policy options that might be effective or ineffective in combating illicit trafficking of synthetic opioids while recognizing the distinctive features of each country. The countries analyzed are part of a global supply chain and therefore do not operate in isolation. As a result, to some degree these accounts resemble plausibility probes that build theory about the relationship between regulation and the global supply chain.¹ The countries’ production capacity, regulations, and supply chains are compared at the end of the appendix to help support overall themes in the Commission report.

Defining Regulation and Controls

Drug regulations take many forms, from proscriptive regulation (such as the outright banning of certain chemicals or other items) to reporting requirements and other forms of purposive government intervention in markets.² Drug controls typically refer to measures to require reporting or to limit the use of drugs, precursor chemicals, or machinery. For example, fentanyl is often used in hospital settings, but its use is limited and controlled under the U.S. Controlled Substances Act. Scheduling is a form of regulation in which drugs are placed into categories, or schedules, based on their potential for medical use and drug dependency and abuse. A stricter schedule limits access to a drug. Listing of precursor chemicals accomplishes much of the same end through domestic and international reporting requirements for the movement or trade in chemicals needed in the manufacture of controlled drugs.

This appendix focuses predominantly on regulations and controls at the national government level, although drugs are covered by international treaties because they are part of international trade. For that reason, a brief discussion of gaps in the international drug control regime is offered at the beginning of the analysis. However, national-level regulations and controls appear to be the most important level for restricting the availability of synthetic opioids,
though state or province-level regulations are important in some countries. Regulation consists of legal authority and the expertise, and capacity (e.g., people and equipment) to implement the regulations.³

Document and Literature Review and Interviews

The data for the accounts come from relevant national-level regulatory reports; the UN Office of Drugs and Crime, which provides regular reports on drug supply chains; reports from nongovernmental organizations (NGOs); and national and state or province-level legislation, regulation, policies, and procedures. The U.S. Department of State and U.S. Department of Treasury provided reports and data that were particularly useful in writing the cases. The reliance on State Department documents should be expected given that the State Department’s Bureau of International Narcotics and Law Enforcement Affairs (INL) is the U.S. government agency charged with addressing illicit drug supply challenges and regulations in other countries. The Commission identified other relevant reports by examining secondary literature on synthetic opioid regulation and interdiction data (where available) in each country. In many cases, national-level reporting was triangulated with other international reports and interviews.

The literature review was supplemented with interviews with subject-matter experts and key stakeholders, including U.S. government functionaries and individuals at multilateral organizations directly involved with monitoring or implementing programs related to drug control. The interviews were semistructured, following a unified interview topic guide but allowing for a discussion of unanticipated topics. The research team took contemporaneous notes, which were analyzed using standard qualitative techniques.⁴ Coded excerpts were then made available to other members of the research team for triangulation with information collected via other data collection activities. Where possible, the interview data was illustrative or triangulated with official U.S. government reports or United Nations reports.

Assumptions and Limitations

The analysis relies primarily on national government reports, and the UN Office of Drugs and Crime (UNODC). National government reports might not be accurate since governments could have incentives to diminish the severity of the illegal synthetic opioid issue in their country. Governments likely do not have complete visibility into illegal markets, though in many cases government data are the best or only data available. Where possible,


findings were triangulated with government-reported national data and data from other governments, international organizations, NGOs, and news accounts. Here the Commission reports change in trends over time where possible, because the trend data might be more informative than the absolute numbers if sources provide only a limited picture of the full extent of illegal production and supply.

Some conclusions rely on seizure data, which does not represent the total amount of drugs flowing through a country. Seizure data might also reflect shifts in enforcement priorities and thus could be misinterpreted. The interviews provided valuable context for the reports and data analyzed, but interviews were primarily conducted with U.S. officials, and the research team might have seen a different picture had it also interviewed more foreign officials. The Commission did not conduct analysis of legal documents but extracted original-language analysis by legal experts from the Congressional Research Service.5

The individual cases accounts are followed by a summary and case comparison section. Different cases present potentially unique examples of the illegal manufacture of synthetic opioids or related chemicals, and therefore the comparisons do not lead to generalizable conclusions. Instead, the comparisons are intended to provide a snapshot of production, supply, and regulation in countries relevant to U.S. markets as an input into possible policy responses to stem the flow of illegal synthetic opioids and precursor chemicals.

LIMITATIONS OF SCHEDULING WITHIN THE INTERNATIONAL DRUG CONTROL REGIME

The international drug control regime, embodied by a series of international treaties,6 establishes a minimum standard of regulations or controls over drugs or chemicals needed to manufacture drugs. All countries analyzed in this appendix, including the United States, are parties to all three of the major drug control treaties. The treaties are not self-implementing and rely on countries to pass additional national laws to execute these controls. The regime is supported by the work of international organizations such as the UNODC and the International Narcotics Control Board (INCB).

Nevertheless, the international drug control regime is not well positioned to address the growth in new psychoactive substances, including, but not limited to, synthetic opioids. The reason, as pointed out by multiple experts, is because the current regime was developed in an era dominated by plant-based drugs. It is not well suited to the rapid proliferation of large numbers of new substances, developed using precursors that are either common chemicals with important legitimate use or designer chemicals that can be easily and quickly developed to circumvent existing regulations.7 Therefore, the country accounts make only limited reference to international treaties. International organizations such as UNODC do play an important role in providing information about global illicit networks and trade, and this research makes use of their data and analyses.

With respect to end products, there are two principal limitations to placing novel synthetic opioids under international control. First, international drug conventions do not permit class-based scheduling of

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7 Interview 15, August 12, 2021; interview 17, August 13, 2021; interview 25, August 18, 2021; interview 26, August 19, 2021; interview 44, September 14, 2021.
substances—as has been done by some national authorities including the United States as it pertains to fentanyl-related substances. Instead, individual substances must be submitted for assessment by the World Health Organization (WHO) and a vote by the Commission on Narcotic Drugs (CND) of the Environmental and Social Council of the United Nations. As the considerations of individual substances are a lengthy process, this impedes the ability of the international community to react quickly to the emergence of new synthetic drugs, such as novel fentanyl analogues.\(^8\)

Second, part of the assessment of new drugs involved examining evidence of actual harms caused by the substance. The need for evidence precludes the consideration of substances that can potentially enter illegal drug markets before their actual harms can be demonstrated.\(^9\) It also limits a proactive consideration of substances that have been identified as potential new entrants, at least for scheduling substances at the international level (individual countries can adopt their own domestic scheduling protocols and procedures that are more robust or expansive, such as class-based scheduling).

One theoretical option to address these gaps is to revisit the international conventions and, for instance, include the possibility of class-based scheduling. However, as multiple experts emphasized, reopening the conventions is practically impossible because of the difficult political process that would entail and the myriad of difficult issues that would come up.\(^10\)

The situation is similarly difficult with respect to precursor regulation. As with end products, only individual chemicals (and their salts and isomers) can be listed under the existing convention. This is the reason behind the rise of designer precursors (see Appendix D for more information) explicitly developed to circumvent the use of listed chemicals and stay ahead of international progress in listing individual chemicals.\(^11\) Second, there are limits to how far the control of input chemicals can go since, as demonstrated in Appendix D, the production of synthetic opioids often relies on precursors and pre-precursors with extensive legitimate use.\(^12\)

In response to these limitations, much of the work of international organizations has focused on encouraging more effective drug control and partnerships with national pharmaceutical and chemical industries and supporting the exchange of relevant timely information.\(^13\) With respect to encouraging greater national-level action, both UNODC and INCB have been promoting generic or class-based scheduling at the national level.\(^14\) Countries are also encouraged to examine close derivatives of chemicals they recommend for international control with the hope of expediting the assessment process.\(^15\)

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\(^8\) Interview 25, August 18, 2021; interview 26, August 19, 2021.

\(^9\) Interview 25, August 18, 2021; interview 26, August 19, 2021.

\(^10\) Interview 15, August 12, 2021; interview 17, August 13, 2021; interview 25, August 18, 2021; interview 44, September 14, 2021.

\(^11\) Interview 44, September 14, 2021.

\(^12\) For a discussion of possible normative steps that could be taken at the international level and would be binding on the parties of the 1988 Convention, see Commission on Narcotic Drugs, United Nations, *Conference Room Paper Submitted by the International Narcotics Control Board*, titled: “Options to Address the Proliferation of Non-Scheduled Chemicals, Including Designer Precursors—Contribution to a Wider Policy Dialogue,” 63rd session, Vienna, E/CN.7/2020/CRP.13, February 21, 2020.

\(^13\) Interview 17, August 13, 2021; interview 26, August 19, 2021. See also the constituent components of the UNODC Synthetic Drug Toolkit (United Nations, “United Nations Toolkit on Synthetic Drugs,” undated a).


\(^15\) Interview 44, September 14, 2021.
Reflecting on the proliferation of chemicals of interest, INCB maintains the International Special Surveillance List, a voluntary list of substances that are known to be used in illegal drug manufacturing.\textsuperscript{16} Following the emergence of designer precursors, the list was amended to include extended definitions that cover common derivatives of included chemicals. The list includes a designation of whether a listed chemical has known legitimate uses or not. Because it is a voluntary list, chemicals can be added without going through the lengthy review process and being voted on unanimously at CND. The downside is that there is no requirement for individual countries to use the list.\textsuperscript{17}

Another plank of ongoing efforts is encouraging countries to develop strong public–private partnerships with the chemical and pharmaceutical industries with the objective to increase the industry’s awareness of the issues at hand as well as their competence to help address them.\textsuperscript{18} Components of these efforts include promoting know-your-customer laws, encouraging industry to adopt more stringent self-policing procedures, and notifying governments of new chemicals and suspicious incidents. Another important type of private entity is online portals and business-to-business (B2B) websites, which might need technical assistance in preventing the trade in chemicals used in illegal drug manufacturing.\textsuperscript{19}

Last, greater information exchange is needed on the international emergence of novel substances, flows of chemicals, and incidents of interest. Concerning novel psychoactive end products, countries are encouraged to develop robust early warning systems and detection and identification capabilities and to share information via the UNODC Early Warning Advisory System.\textsuperscript{20} With respect to listed precursors, countries have an obligation to report exportations and importations of chemicals through the Pre-Export Notification System.\textsuperscript{21} However, the usefulness of this tool is blunted by the fact that legitimate chemicals are frequently diverted domestically and then smuggled out since domestic distribution falls outside the scope of international reporting requirements.\textsuperscript{22} Similarly, with respect to designer precursors, because there is no legitimate use, there is no legitimate trade to report and monitor. Information on incidents involving nonscheduled chemicals can be reported internationally via the Precursor Incident Communications System,\textsuperscript{23} although information-sharing, such as on circumstances of the incident or seizure, could be improved.\textsuperscript{24}

Ultimately, the current setup of the international drug control regime means that only limited progress can be expected with respect to extending regulatory control over additional new psychoactive substances and precursor chemicals. This raises the importance of encouraging authorities to take steps at the national level and supporting them with information and tools to do so. International organizations maintain tools to foster greater international action in tackling the synthetic drug challenges, but because participation is voluntary in most cases, their effectiveness will ultimately depend on uptake by national governments.


\textsuperscript{17} International Narcotics Control Board, United Nations, Precursors and Chemicals Frequently Used in the Illicit Manufacture of Narcotic Drugs and Psychotropic Substances, 2018, E/INCB/2018/4, March 5, 2019a, Chapter IV.


\textsuperscript{19} Interview 44, September 14, 2021.


\textsuperscript{22} Interview 17, August 13, 2021; interview 44, September 14, 2021.


\textsuperscript{24} Interview 44, September 14, 2021.
CANADA

Background and Nature of the Problem

Canada has been experiencing a growing shift in illegal drug markets with fentanyl and other synthetic opioids becoming increasingly available in recent years, and over a timeline that closely parallels that of the United States (albeit with the “opposite” geography—starting in the west, whereas it started in the east in the United States). New kinds of synthetic opioids have appeared in illegal drug markets, including highly potent varieties such as carfentanil (which is approximately 100 times more powerful than fentanyl). The PRC is the primary source of synthetic opioids or related precursors shipped to Canada, according to law enforcement sources; however, the supply chain is evolving. Domestic counterfeit pill manufacturing has emerged, and since around 2019, Canada has reported an increase in illegal Canadian fentanyl synthesis. Fentanyl precursors are now seized at ports of entry, suspected of being directed to illegal manufacturers in Canada. Canadian authorities have, by controlling (or in this case listing) synthetic opioid precursors and engaging in domestic interdiction and international cooperation, intended to stem the flow of synthetic opioids and their precursors into the country. Similarly, provincial authorities have expanded regulatory controls over tableting machines in an effort to curb illegal pill press operations.

Supply Chain and Connection to Global Markets

Fentanyl has been detected in the drug supply, to different degrees, in all Canadian jurisdictions. It first appeared in the heroin supply chain and in counterfeit pills made to look like genuine prescription medications; there is also concern of fentanyl appearing in the cocaine supply. Since at least 2018, authorities have noticed the presence of carfentanil, particularly in the western provinces. Another trend in illegal drug markets in recent years has been the combination of synthetic opioids with benzodiazepines, often without the knowledge of drug users.

Fentanyl and other synthetic opioids have traditionally been produced in the PRC and shipped to North America. Mexico does not appear to be a primary source of fentanyl for Canada. Authorities have found more evidence of direct shipments to Canada from the PRC and some domestic production of precursors and even

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clandestine fentanyl synthesis.\textsuperscript{31} Canadian law enforcement has identified and shut down illegal tableting operations in Canada that pressed Chinese-sourced fentanyl into counterfeit pills. Interviewees noted that provincial controls made effective in Alberta in 2016 and British Columbia in 2019, respectively, appear to have reduced the availability of counterfeit tablets in street markets.\textsuperscript{32} Nevertheless, gaps remain in control or restrictions of industrial presses at the federal level.

Since 2019, the illegal importation of fentanyl seized at ports of entry in Canada has declined, though fentanyl precursors continue to be seized, sometimes in large amounts, suggesting a shift toward domestic synthesis.\textsuperscript{33} In April 2021, law enforcement in British Columbia dismantled a clandestine synthesis lab containing 37 kg of chemicals associated with the manufacturing of fentanyl. Law enforcement estimated that the laboratory was able to produce some 26 kg of fentanyl each week.\textsuperscript{34} In July 2021, Canadian Border Services Agency (CBSA) seized approximately 1,500 kg of 4-piperidone in a maritime shipment.\textsuperscript{35} Should it be converted under ideal conditions, that amount alone would be enough to produce doses of fentanyl numbering in the billions.

A lab was detected and dismantled in Alberta in July 2021 estimated to be able to produce 10 kg of fentanyl a week.\textsuperscript{36} Another suspected lab was shuttered in Saskatchewan in late August 2021, though details have not been made public.\textsuperscript{37} Similar to clandestine synthesis labs in Mexico, labs in Canada typically appear to rely on improvised lab and personal protective equipment.

Public Safety Canada found that “organized crime groups (OCGs) are increasingly involved in all aspects of the illicit drug supply chain and are using more and more sophisticated methods to commit drug-related crimes, which complicates detection and disruption efforts by law enforcement.”\textsuperscript{38} The potential for profit in the fentanyl market and relative ease of entry into Canada attracts OCGs, according to Public Safety Canada.\textsuperscript{39}

In short, Canadian criminal organizations appear to be increasingly going beyond illegal pill pressing operations to domestic clandestine synthesis, using imported precursors from Asia. Shipments of finished fentanyl from the PRC appear to have declined since 2019, when Chinese authorities placed more controls on fentanyl and fentanyl-related compounds. That said, since 2019, Canada has seen a sharp rise in the numbers of nonfentanyl synthetic opioids, principally benzimidazole opioids.

\begin{itemize}
  \item \textsuperscript{32} Consolidated Regulations of Alberta, Chapter 193, Regulation 2016, Pharmaceutical Equipment Control Regulation; Consolidated Regulations of British Columbia, Chapter 278, Regulation 2018, Pill Press and Related Equipment Control Regulation, O.C. 793/2018, deposited December 14, 2018, effective January 15, 2019; Legislative Assembly of British Columbia, 2018 Legislative Session, 3rd session, 41st Parliament, Bill 27, Pill Press and Related Equipment Control Act, May 10, 2018, c. 24, ss. 27 (2) and 30.
  \item \textsuperscript{33} CBSA notes that fentanyl seizures at import fell from 14.6 kg in FY 2017 to 7.4 kg in FY 2020 (Government of Canada, “Canada Border Services Agency Seizures,” webpage, modified November 29, 2021b).
  \item \textsuperscript{35} “2 Billion Doses of Fentanyl Prevented from Hitting the Streets, Canada Border Agents Say After Seizure,” CBC News, August 12, 2021.
  \item \textsuperscript{36} Caley Ramsey, “$300M Worth of Drugs Seized as Fentanyl ‘Superlab’ Dismantled in Rural Alberta,” \textit{Global News}, August 31, 2021.
  \item \textsuperscript{37} Saskatoon Police Service, “Three Charged—Fentanyl Trafficking—Clandestine Lab—1000 Block Patrick Cres.,” press release, September 2, 2021.
  \item \textsuperscript{38} Public Safety Canada, “2019 Law Enforcement Roundtable on Drugs,” webpage, modified September 6, 2019.
  \item \textsuperscript{39} Public Safety Canada, “2019 Law Enforcement Roundtable on Drugs,” webpage, modified September 6, 2019.
\end{itemize}
Strong Laws and Regulatory Controls

According to the U.S. State Department, Canada has a large chemical industry and robust regulatory oversight. Despite the fact that Canada has a high regulatory capacity and low corruption, criminal groups have imported synthetic opioids and related precursor chemicals needed to synthesize fentanyl. The importation of tableting machines is controlled at the federal level, but several provinces, including Alberta and British Columbia, have restricted access to the sale and possession of these machines to prevent clandestine pill press operations. One interviewee reported on the success of the pill press regulations in Alberta and British Columbia, saying, “I haven’t seen a pill press seized in three to four years [in those provinces]; not the case in Ontario and Quebec.” Pill press regulations appear to be associated with reduced availability of counterfeit tablets in street markets in Alberta and British Columbia, according to interviewees.

Fentanyl is listed under item 16 of Schedule I of the Controlled Drugs and Substances Act (CDSA). Some fentanyl analogues are listed under subitems 16(1) to 16(13) of Schedule I in the CDSA. Structurally similar substances that have the potential to create effects similar to fentanyl are also controlled under item 16, even though they are not explicitly listed in the law. The Canadian Parliament updated the CDSA in 2017, in an attempt to address the danger of synthetic opioids by giving the government “temporary accelerated scheduling” powers for substances for a period of up to two years or until there is a decision on permanent scheduling. The CDSA also requires registration (including name, address, and contact information) to import designated manufacturing devices such as tableting machines. Other relevant regulations include the Precursor Control Regulations (SOR/2002-359), Narcotics Control Regulations, and Benzodiazepines and Other Targeted Substances Regulations.

The Precursor Control Regulations are especially relevant for synthetic opioids. They authorize Health Canada, Canada’s federal health agency, to communicate information to law enforcement agencies, border control officials, foreign authorities, and the International Narcotics Control Board. Amendments to these regulations made in 2019 gave the government greater authority over precursor chemicals, derivatives, and analogues designed to reduce production and distribution of synthetic opioids and other substances.

When it comes to controlling fentanyl analogues, the CDSA is more expansive than the U.S. law in its definition of fentanyl analogues and derivatives. Item 16 of Schedule I of the CDSA lists “derivatives and analogues” of fentanyl, which are understood to be compounds that are “structurally similar” to fentanyl according to its core

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41 Interview 20, August 16, 2021.
42 Interview 20, August 16, 2021.
43 Statutes of Canada, 1996, Chapter 19, Controlled Drugs and Substances Act, assented to June 20, 1996.
47 Consolidated Regulations of Canada, Precursor Control Regulations, SOR/2002-359.
structure as defined in the law. Further, Canada has listed additional fentanyl precursors, such as 4-piperidone, which is not listed in the United States. Of the 38 precursors listed in the Precursor Control Regulations, seven are used to manufacture fentanyl and have been added to the list since 2016.

Nationwide Policing Efforts and Gaps in Information-Sharing

The Royal Canadian Mounted Police (RCMP) provides policing and interdiction at the national and provincial levels, though Newfoundland, Ontario, and Quebec have their own provincial police. RCMP also provides local policing in some municipalities (primarily smaller ones). The National Chemical Precursor Division program is one such national-level RCMP interdiction effort. In addition, Public Safety Canada is the national agency providing coordination of national security and emergency preparedness activities. It is in many ways equivalent to the U.S. Department of Homeland Security (DHS) in the United States, although it does not provide maritime protection.

A 2018 roundtable hosted by Public Safety Canada identified “significant gaps with respect to information sharing” in monitoring synthetic opioids. The roundtable also found that municipal and provincial authorities did not always have access to federal databases. Additional gaps included the inability to search domestic mail for synthetic opioids and difficulty in tracking small-scale financial transactions related to synthetic opioids. Some efforts have been made to fill these gaps, including the creation of a national database of information related to fentanyl. At points of entry, CBSA enforces the provisions of CDSA. Alongside Canada Post, CBSA screens inbound mail to interdict shipments of contraband.

Canada is viewed as a strong bilateral partner to the United States that shares its concern about illicit synthetic opioids. Efforts are underway in Canada to increase domestic law enforcement and interdiction capacity. Improvements include building RCMP capacity to monitor the darknet marketplace and providing more authority to inspect domestic mail. The darknet is a part of the internet that provides for some level of privacy or even anonymity for users and can be accessed with special software.

Like the United States, Canada has postal inspectors, but they do not have the same law enforcement powers as their American counterparts. For instance, a provision of the Canada Post Corporation Act of 1981 restricts the postal service’s ability to inspect mail in order to protect privacy. This provision limits the ability of postal inspectors to inspect mail for drugs. However, the act allows CBSA officers to seize mail. CBSA officers work

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50 These include Propionyl chloride; 1-Phenethyl-4-piperidone and its salts; 4-piperidone and its salts; Norfentanyl (N-phenyl-N-piperidin-4-ylpropanamide), its salts, derivatives, and analogues; 1-Phenethylpiperidin-4-ylidenephenylamine and its salts; N-Phenyl-4-piperidinamine and its salts; and Benzylfentanyl (N-(1-benzylpiperidin-4-yl)-N-phenylpropionamide), its salts, derivatives, and analogues. See Law Library of Congress, *Regulation of Fentanyl-Related Substances*, report for the U.S. Department of State, file 2021-019538, December 2020a.


56 Interview 6, August 2, 2021; interview 34, August 24, 2021.

57 Revised Statutes of Canada, Canada Post Corporation Act, 1985, Chapter C-10.
alongside Canada Post employees at Canadian international mail sorting facilities to identify suspicious packages and turn them over to police.\textsuperscript{58} Canadian policy experts have proposed reforms to the act to permit postal service inspection, but these reforms have not yet been enacted.\textsuperscript{59}

Canada as a Source of Synthetic Opioids

Canada is not known to be a major source of fentanyl, other synthetic opioids, or precursor chemicals to the United States, a conclusion primarily drawn from seizure data. That said, domestic production does occur illegally, and U.S. Customs and Border Protection has seized small amounts of fentanyl items (mostly counterfeit tablets or diverted medications) at ports of entry, including mail facilities.\textsuperscript{60} Canadian criminal groups have the equipment, facilities, and expertise to increase the supply of illegally manufactured fentanyl.

The domestic Canadian fentanyl market has attracted organized crime groups because of its tremendous profitability and ease of entry into the market.\textsuperscript{61} Canada might also be attractive for new entrants to the illicit synthetic opioids market because of its proximity to the U.S. market. Future interdiction efforts might need to account for any possible increases in synthetic opioid trafficking at the northern border or by mail coming from Canada. That said, the quality and composition of illegally manufactured fentanyl in Canada is not readily known at this time, and illegal operators in that country so far do not appear to be exporting large quantities of bulk fentanyl or counterfeit tablets, unlike Mexico as evidenced by seizures.

THE PEOPLE’S REPUBLIC OF CHINA

The PRC has traditionally been a major source of illegally manufactured fentanyl destined for U.S. drug markets. It is also a major source of legal pharmaceuticals in general in part because of the sheer size of its pharmaceutical industry.\textsuperscript{62} Today, the Chinese chemical and pharmaceutical industries (or rogue individuals connected to them) appear to be a major source of chemical precursors for fentanyl and other synthetic opioids bound for Canada, Mexico, and the United States. In recent years, the Chinese central government has taken steps to curb the illegal or unmonitored production of fentanyl and related substances. Most notably, in 2019, at the request from the United States, the PRC adopted a generic control on all fentanyl-related compounds that were structurally similar to fentanyl.

In addition, Chinese money-laundering operations are a potential ancillary service for transnational criminal organizations, as discussed more in Appendix I. However, the use of money-laundering organizations in the PRC is not specific to the emergence of synthetic opioids in illegal drug markets and instead is related to domestic currency controls.\textsuperscript{63} This analysis focuses on the PRC’s current role in and responses to the illegal or unregulated production of synthetic opioids and their input chemicals.

\textsuperscript{60} Interview 6, August 2, 2021.
\textsuperscript{61} Public Safety Canada, “2019 Law Enforcement Roundtable on Drugs,” webpage, modified September 6, 2019.
\textsuperscript{63} Interview 32, August 24, 2021.
Synthetic Opioid Production and the Chinese Chemical and Pharmaceutical Industries

By some accounts, legitimate Chinese chemical and pharmaceutical businesses (or rogue individuals within licensed firms) are the primary manufacturers of synthetic opioids and their precursors, which, until 2019, included the manufacturing and illegal exportation of finished fentanyl. It is difficult to analytically separate the legitimate chemical and pharmaceutical business from rogue groups of individuals working within the business to manufacture and trade synthetic opioids and precursor chemicals. Some journalists have tried to investigate these firms and have found blurred lines between legal and illegal activity.

Since 2019, producers in that country have opted to manufacture uncontrolled fentanyl precursors, shipping them to Mexico where they are illegally synthesized into fentanyl by TCOs. Because several precursors typically have legitimate uses, many of these chemicals can be legally traded without any specific reporting requirements. As one U.S. governmental interviewee noted, “Chinese companies selling precursors are not criminal organizations. Some are legitimate companies that don’t care who the end user is.”

In an examination of online vendors purporting to supply synthetic opioids or other precursor chemicals, the Center for Advanced Defense Studies (C4ADS) compiled the Synthetic Drug Supplier Database gathering information on 103 entities. (C4ADS is a nonprofit research organization based in the United States.) Of these, 65 percent have filed corporate registries in mainland China or Hong Kong. “Many of these companies have links to larger corporate networks in the PRC. In many of the identified instances, it appeared that companies affiliated with multiple entities used these linkages to obfuscate ownership through a complicated hierarchy of layered corporations.” The analysis done by the Commission reported in Appendix E comes to a similar conclusion noted by C4ADS, which found that

the listed location of companies in the Synthetic Drug Supplier Database does not correlate with the geographic distribution of registered Chinese biological technology, trade or commerce, chemical, and pharmaceutical companies. That is, alleged Chinese producers of illicit synthetic drugs tend not to be located in regions with a known concentration of pharmaceutical and chemical companies.

The Chinese chemical and pharmaceutical sectors are distinctive in several ways. First, these are large industries. Interviewees suggested that in the chemical sector alone, between 150,000 and 400,000 firms are involved in

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64 This contrasts with Mexico, where, according to a State Department interviewee, the TCOs own the process as soon as chemicals reach the shore. “The cartels [TCOs] have gotten really good at owning the chemical business that can import from China, including the factories, producing the drugs, hiring the chemists, and moving to and across the border” (interview 27, August 19, 2021).


66 Interview 31, August 24, 2021.


68 Of course, this ignores possible producers of synthetic opioids or related precursor chemicals that do not use the internet to advertise or connect with potential buyers. However, that share of “offline” suppliers is unknown but likely to be small given that they would have to have already made contacts with buyers. One unique advantage of the growth of internet-based trade is that buyers and sellers can easily transact items without having to engage in lengthy travel.


production or distribution, although more than one interviewee was skeptical of these estimates.\(^{71}\) The State Department estimated that there were 160,000 chemical companies in the PRC.\(^{72}\) On the other hand, another estimate that assessed the industry using ISI Emerging Markets data put the number closer to 24,000, though it was unclear whether their estimate included the chemical transport sector.\(^{73}\)

Similarly, a wide range of estimates exist for the size of the pharmaceutical sector (all firms, not just producers), with numbers ranging from around 2,500 firms to the hundreds of thousands.\(^{74}\) Given the nature of shell offices, subsidiaries, and the ease with which new corporate entities can be created on paper without producing anything, it is possible that higher-end estimates are a gross overestimate of the true nature of firms that actually manufacture or handle chemicals. Mergers and acquisitions have likely reduced the number of firms, but by many accounts it appears that Beijing does not have precise numbers of active licensees. Counts are further complicated by the PRC’s estimated 14,000 pharmaceutical wholesalers, which might or might not be represented in different estimates.\(^{75}\)

Second, these sectors are of high value and contribute financially to the Chinese economy, though it is unclear what segment is involved in the production of precursor chemicals or finished fentanyl. As one interviewee stated, “It’s misleading to mention 140,000 chemical factories because it implies all of the other factories are making fentanyl.” Most likely the number of firms making fentanyl is small given the overall size of the sector and the efforts by central authorities to prioritize the most high-value chemicals, such as biologicals, anticancer drugs, and the like. The central government has prioritized biopharmaceuticals as one of ten key sectors in the “Made in China 2025” initiative.\(^{76}\) Consequently, the primary performance goals are related to the growth of the sector, not its adherence to existing regulations. According to one U.S. official, record-keeping in these industries is poor, and it can be difficult to gain access to both business and public information.\(^{77}\)

Third, there are many private companies in these sectors, some of which could be manufacturing synthetic opioids legally and illegally. That is, Chinese state-owned enterprises do not seem to be involved in the illegal manufacture of synthetic opioids, particularly given this sector’s competitiveness and volatility. This information is consistent with several interviewees’ comments that the PRC is concerned about its international reputation on this subject and does not want to be seen as a global drug pariah.\(^{78}\)

Oversight Environment Prior to 2019

Before 2019, Chinese-sourced synthetic opioids reached the United States primarily through the postal and courier services, including express shipping services (e.g., DHL, FedEx, UPS). Customs and Border Protection seizure data report that high-purity (90 percent or more) fentanyl coming from the PRC arrived almost all by air, whereas

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\(^{71}\) Interview 2, July 27, 2021; interview 15, August 12, 2021.


\(^{77}\) Interview 15, August 12, 2021.

\(^{78}\) Interview 8, August 6, 2021; interview 36, August 25, 2021.
lower-purity and bulkier fentanyl continues to arrive from Mexico by land. Appendix B contains a more detailed analysis of seizure activities.

Chinese efforts to curb drug shipments were hampered by several factors. First, synthetic opioids, especially high-potency and highly compact fentanyls, can be easily concealed in small packages and parcels. An ounce of fentanyl can substitute for a kilogram of heroin in terms of morphine equivalency. Thus air-bound shipping of fentanyl or other synthetic opioids is attractive.79 Second, many synthetic opioid compounds are easily manipulatable. Before the 2019 generic ban on all fentanyl-related substances, producers in the PRC with backgrounds in chemistry could easily tinker with the chemical structure to skirt existing laws or evade detection and interdiction.

More important, inspection and oversight capacity shown in Table F.1 remains limited. Scholars of regulation have found that powerful industries can resist oversight that could curtail their growth.80 Some analysts claim that the Chinese pharmaceutical industry has resisted such efforts.81 The Chinese chemical industry is the world’s largest, commanding $1.5 trillion of sales in 2017 and constituting 40 percent of global industry revenue. Although smaller, the pharmaceutical industry still encompasses $159 billion in market capitalization.82

Chinese law restricts production of controlled substances to nationally designated firms that must adhere to state-set production quotas. For example, legal production of several fentanyl analogues used in medical applications is concentrated in the Humanwell Healthcare (人福医药, Renfu Yiyao), which owns 90 percent of the domestic market.83 This arrangement grants sponsored firms near monopoly status and might decrease the oversight burden. A singular focus on sponsored firms, however, might allow others to escape inspections or investigations.

79 Though finished fentanyl is no longer shipped directly to end buyers in the U.S. in small quantities, other nonfentanyl synthetic opioids are sold online and shipped from the PRC.
Table F.1
Inspection Capacity in the PRC

<table>
<thead>
<tr>
<th>Inspection Type</th>
<th>Number of Inspected Firms or Applicants</th>
<th>Number of Inspectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>GMP certification inspection</td>
<td>221</td>
<td>204</td>
</tr>
<tr>
<td>Preapproval inspection</td>
<td>114</td>
<td>34</td>
</tr>
<tr>
<td>Follow-up inspection</td>
<td>181</td>
<td>16</td>
</tr>
<tr>
<td>Unannounced inspection</td>
<td>59</td>
<td>39</td>
</tr>
<tr>
<td>Overseas inspection</td>
<td>25</td>
<td>7</td>
</tr>
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<td>81</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>


NOTE: GMP = good manufacturing practice.

In either case, the size and nature of the pharmaceutical and chemical industries pose significant challenges for Chinese regulators, whether due to its political prioritization and economic clout (e.g., as a high-value industry) or the sheer number of firms. Available data from Chinese authorities are limited and suggest either poor record-keeping or dramatic year-to-year fluctuations given internal government agency reorganizations. Table F.1 contains the most up-to-date numbers of inspections of pharmaceutical firms or applicants as reported in annual reports from the China Food and Drug Administration (CFDA) and its successor agency the National Medical Products Administration (NMPA). As the data show, good manufacturing practice (GMP) certification inspections peaked in 2017 at 428, of which, only 57 were unannounced. The number of inspections declined substantially in 2018 to 143, perhaps as CFDA was transitioning into NMPA. The numbers of unannounced inspections remained the same, at 57 in 2018. Likewise, the numbers of inspectors in the PRC peaked in 2017 at more than 1,200 but fell by more than 50 percent in 2018 to just below 600.

The PRC appears to have a low number of inspectors available, and they perform a relatively low number of inspections given the size of its industries. By way of comparison, the U.S. Food and Drug Administration (FDA) has a much smaller pool of firms to inspect but performs roughly 3,000 GMP inspections each year. Since 2013, the regulatory body overseeing the pharmaceutical sector has undergone two restructures. In 2013, the former State Food and Drug Administration became the China Food and Drug Administration. In 2018, China FDA was restructured and elevated to the State Council as the NMPA.

The Oversight Environment Since 2019

In 2019, the PRC amended several of its laws that governed oversight of the pharmaceutical sector. Enhanced industry oversight was needed because regulatory design and enforcement were divided among a patchwork of central government agencies. The U.S.–China Economic and Security Review Commission reported that, prior to the legislative change, eight central government bodies were involved in promulgating and enforcing production and export requirements for pharmaceuticals or chemicals. Of these, CFDA specifically developed manufacturing and quality guidelines, certifying good supplying practice (GSP) and GMP. Certification essentially served as an entry license for companies to that sector. However, the distribution of oversight functions among multiple agencies created gaps. The U.S.–China Economic and Security Review Commission noted that licensed chemical companies that manufactured active pharmaceutical ingredients were not under jurisdiction of CFDA, but the Ministry of Chemical Industry, which created a loophole that appears to have been exploited by some manufacturers.

Today, the PRC’s drug control authorities are stipulated primarily by three laws: the Drug Administration Law (DAL), the Regulations on the Administration of Narcotic Drugs and Psychotropic Drugs, and the Measures for the Listing of Non-medicinal Narcotic Drugs and Psychotropic Drugs. The DAL has provided the major authority for regulating pharmaceuticals since its promulgation in 1984, though it has undergone subsequent revisions.

Before 2019, the PRC’s DAL authorities focused on monitoring enterprise-level inspections (i.e., the entire firm and its facilities) instead of product-based inspections (or inspections of the end product). The prior focus on firms was inherently limited given the rapid pace of sector growth. Since the start of market reforms in the late 1970s, the PRC’s pharmaceutical sector grew from meeting internal demand to becoming a global supplier. The regulatory environment could not keep pace, allowing some actors to supply a growing market for synthetic drugs that were either illegal or legal, unregulated, and known to be harmful. The DAL, which took effect in December 2019, incorporated a new Market Authorization Holder (MAH) system for research institutions, manufacturers, wholesalers, and retailers and created a unified, nationwide drug regulatory system that defined fake drugs and standardized online sale. In particular, it authorized the NMPA, the successor to the now defunct CFDA, to roll out the piloted MAH system throughout the country. The DAL also eliminated the GMP and GSP certification and market entry systems, instead charging MAHs with continuously meeting these standards. MAHs must also create a drug traceability system for their products, and the

91 In 2018, when Chinese authorities established NMPA, it officially dissolved or merged CFDA into NMPA and other bodies.
DAL stiffens penalties for violations. That said, the PRC still faces significant oversight gaps; namely, the system still devolves enforcement to provincial governments and suffers from capacity and inspection limitations.

Regulations on the Administration of Narcotic Drugs and Psychotropic Drugs, adopted by the State Council in 2005, states that the government will maintain catalogs for narcotic and psychotropic drugs. Drugs listed in these catalogs are subject to national regulations found in the DAL. According to the regulations, cataloged substances are controlled by the State Council directly. That said, Article 5 states provincial authorities are assigned the responsibility of monitoring production of legal narcotics and psychotropic drugs as well as transportation and retailing. County-level or lower public security officials are charged with investigating and punishing illegal production and trafficking.

Article 14 states that the Drug Regulatory Department of the State Council is responsible for determining the number and layout of production enterprises manufacturing narcotics or psychotropic drugs. This seems to give the state authority over where, when, and who manufactures scheduled drugs and could explain the market concentration observed in the legal production of fentanyl and several legitimate analogues in the PRC. Article 18 states that the Drug Regulatory Department of the State Council is also charged with creating and overseeing the wholesale distribution of scheduled substances and limit sales based on nationally set production quotas.

In practice, this means that while the central government sets drug manufacturing policy, provincial officials are left to monitor and enforce said policies at their discretion. Notably, the 2019 DAL followed the regulation’s monitoring and enforcement system when it established the MAH system. The central government establishes general requirements, but it is provincial officials who decide how those requirements are enforced within their province.

Measures for the Listing of Non-medicinal Narcotic Drugs and Psychotropic Drugs, issued by the Ministry of Public Security, the National Health and Family Planning Commission, the State Food and Drug Administration, and the National Narcotics Control Office in 2015, created national level rules for scheduling new drugs. The Supplementary List of Non-medicinal Narcotic Drugs and Psychotropic Drugs was created to supplement the current narcotic and psychotropic drug catalog. New drugs identified by the National Narcotic Control Council as posing significant risk to the PRC through addictive potential, harm to physical and mental health, illegal manufacturing, trafficking or smuggling activities, abuse or proliferation, and/or circumstances causing domestic or international harm or other social harm are reviewed by the State Council for inclusion to the Supplementary List. Included chemicals are then subject to the control regimes laid out in the DAL and in Regulations on the Administration of Narcotic Drugs and Psychotropic Drugs. Currently 116 individual substances are included in the Supplementary List. The PRC now has extended generic controls over fentanyl-related substances as well as several generic controls over synthetic cannabinoids.

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Nevertheless, in the wake of the 2019 fentanyl scheduling and the DAL’s adoption, U.S. agencies noted significant and positive cooperation with Chinese counterparts. Importantly, interviewees observed quick compliance when it comes to rule changes—measured by drops in synthetic opioid seizures. As one interviewee noted,

> We’ve seen that when the [Chinese government] signals their intent to regulate, [the] industry reacts. They don’t necessarily have to hire hundreds of inspectors to go door to door, though we’d love that. Just a signal can help. . . . It wouldn’t take a lot to get business to change practices.

Similarly, the PRC did add two fentanyl precursors (NPP and 4-ANPP) to the controlled substances list in 2018. Both U.S. and Mexican officials reported declines in seizures of those chemicals afterward, though producers shifted to other substitutes. However, the problem of illegally manufactured synthetic opioids using inputs from the PRC remains. In short, efforts made by Beijing appear to have shifted the activities of these firms. The problem of direct-to-buyer supply of fentanyl from the PRC to the United States has dramatically reduced per the discussions with interviewees and as seen in data furnished by U.S. federal law enforcement. Though advances were made, firms or individuals in the PRC appear to have adapted since the 2019 passage of enhanced controls and oversight.

Chemicals from PRC-based sources are shipped to Mexico for use by TCOs, suggesting that individual or firms in the PRC have adapted to restrictions on chemicals in recent years. While direct shipments to the United States have dried up, PRC-based producers instead have been shipping chemical precursors used in the manufacture of fentanyl to Mexico, where products are then “finished” and subsequently trafficked across the U.S. border. Matthew Donahue, the deputy chief of foreign operations for the U.S. Drug Enforcement Administration (DEA), stated in March 2021 that “Chinese traffickers have virtually ceased making analogs to focus solely on precursors.” In diverting the drug trade away from direct PRC-to-U.S. shipments, the 2019 Chinese controls over all fentanyl-related substances altered the behavior of producers. Illegal producers of drugs in Mexico, and to some degree in Canada, can import precursors from the PRC, finishing the products in country and, in the case of Mexico, trafficking fentanyl into the United States.

Precursors used in the manufacture of many synthetic opioids can be easily replaced. Seizures of NPP and 4-ANPP have dropped off substantially since these chemicals were listed under the PRC’s drug control laws, but novel precursors have taken their place. Several interviewees noted the increasing complexity and perhaps futility of controlling precursors, especially some with wide use in many legal industrial and chemical applications. Future efforts to improve industry oversight of who companies export to, through “know your customer” rules or other means of record-keeping and reporting, have the potential to improve investigations and reduce the flow of chemicals out of the PRC.

Chinese Perspectives on Limitations to Regulatory Authority

Chinese regulators and researchers recognize limitations to regulatory authority in the nature of the science involved, administrative fragmentation, and low capacity. First, the science of precursor development makes targeted enforcement and inspection difficult. Both law enforcement, forensic science, and medical journals described a “shotgun” approach to fentanyl and precursor detection that included wastewater testing, spectroscopic

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98 Interview 27, August 19, 2021.

spot inspection, and even hair sampling (in the case of drug users) to assess the movement and use of synthetic opioids. These Chinese researchers and officials had similar concerns (or complaints) about the perceived ineffectiveness of staying ahead of criminal networks and their ability to produce and transport synthetic opioids.\(^{100}\)

Both Chinese and U.S. law enforcement share common understandings about opioids’ pharmacological characteristics and the problems these generate for reducing the supply of and interdicting the transit of illicit drugs. In addition, Xue Yang and Bao Han, researchers at the People’s Public Security University of China, explicitly acknowledge that the PRC is a key source of synthetic opioids and their precursors:

> Although the current abuse of fentanyl substances in our country is not very serious, a considerable part of fentanyl substances are produced in our country in the world. Although our country has demonstrated its antidrug stance by managing fentanyl substances in a whole category, there are still many factories that secretly and illegally produce and sell fentanyl substances, driven by high profits.\(^{101}\)

Furthermore, Zhang Li and Zhang Ta of the People’s Public Security University identified the problems of dual use and areas of lighter enforcement:

> The regional differences in drug control will lead to such a situation: drug criminals focus on the loopholes in the scope of drug control in some countries and regions, looking for a safe haven for manufacturing and trafficking NPS [new psychoactive substances]. . . .

> Therefore, NPS is always guided by evading legal control, showing a trend of flowing from regulated areas to non-regulated areas, thus driving the continuous expansion of NPS consumer market.\(^{102}\)

Second, beyond dual use and scientific challenges, administrative fragmentation limits the ability of Chinese authorities to adopt more cohesive and consistent counterterroric policies related to the illegal manufacture and exportation of synthetic opioids or their precursors. Although the DAL aims to streamline drug production regulations and standards, it could have inadvertently created greater bureaucratic and procedural bloat. Drug production monitoring and DAL enforcement authority are spread across central, provincial, and local agencies. Articles 8 and 9 declare that each government administrative level, from the county through to the provinces, is responsible for drug administration in its region. In addition, Article 6 and Chapter III explicitly task MAHs (that is, individual drug license holders such as manufacturers and research institutions) with legal responsibility for their products throughout the development–production–distribution cycle, including various record-keeping and quality assurance tasks.

\(^{100}\) For example, from PRC law enforcement, see Yang Xue [杨雪] and Bao Han [包涵], “Study on the Difficulties and Countermeasures of Prevention and Control of Fentanyl Substance Abuse [芬太尼类物质滥用防控难点与对策研究],” *Journal of Hubei University of Police [湖北警官学院学报]*, Vol. 3, No. 204, June 2021. Also see Xiangyu Guo, [郭项雨], Ma Lin [马麟], Shang Yuhan [尚宇瀚], Bai Hua [白桦], and Ma Qiang [马强], “Research Progress on Detection Technology of New Psychoactive Substances of Fentanyl [芬太尼新精神活性物质检测技术研究进展],” *Journal of Instrumental Analysis [分析测试学报]*, Vol. 39, No. 12, December 2020.

\(^{101}\) Yang Xue [杨雪] and Bao Han [包涵], “Study on the Difficulties and Countermeasures of Prevention and Control of Fentanyl Substance Abuse [芬太尼类物质滥用防控难点与对策研究],” *Journal of Hubei University of Police [湖北警官学院学报]*, Vol. 3, No. 204, June 2021, p. 77.

\(^{102}\) Zhang Li and Zhang Ta [张黎, 张拓], “Research on the Harm and Prevention and Control of the Abuse of New Psychoactive Substances,” *Journal of People’s Public Security University of China (Social Sciences Edition)* [中国人民公安大学学报 (社会科学版)], No. 4, 2013.
Similarly, Articles 61 and 62 require online retailers to request and confirm the credentials and qualifications of MAHs and drug distributors operating on their platforms. Central government organs sit atop these levels. Figure F.1 presents the organization of central government chemical regulators in the PRC, with MAHs in particular responsive to and responsible for a large number of central, provincial, and local authorities, regulations, and laws.

For example, in response to DAL requirements, the Wuhan municipal government (in the capital city of Hubei Province) established a food and drug safety coordination office; a drug and cosmetic safety supervision and administrative office; and a two-to-three-person department supervising drug circulation and use. Each city district has its own drug supervision office as well. Moreover, the municipal government cited the DAL’s concept of “social co-governance” to distribute responsibility further to drug industry associations and news media. They also mentioned many local regulations and rules that must still be rewritten to align with the DAL.

NMPA is supposed to support these efforts through a team of professional and specialized drug inspectors. But province-level authorities are responsible for “relatively small quantity drug producers, wholesalers, and sales chain headquarters that require highly specialized inspectors,” while municipal ones contend with “larger quantity drug retailers that require relatively unspecialized inspectors.” Added to this, “the provincial drug regulatory departments are responsible for the supervision profession, and the municipal and district drug regulatory departments are responsible for the supervision efficiency.” It is unclear, however, how size and specialization needs are determined.

Third, enforcement capacity challenges limit the PRC’s ability to implement controls. Yang and Bao note that drug enforcement resources are insufficient at even the central government level:

> The current drug testing work in our country is mainly carried out by the drug testing center of the public security department, and the staff of state agencies is often limited. In addition, the salary and treatment may not be as good as that of private companies. Those with professional knowledge may be poached by private companies and paid high salaries with broad room for advancement, resulting in a large workload of drug testing and fewer professionals.

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105 Yang Xue [杨雪] and Bao Han [包涵], “Study on the Difficulties and Countermeasures of Prevention and Control of Fentanyl Substance Abuse [芬太尼类物质滥用防控难点与对策研究],” *Journal of Hubei University of Police* [湖北警官学院学报], Vol. 3, No. 204, June 2021.
**Figure F.1**
Organizational Structure of Existing Regulatory Structure Governing Controlled Drugs in the PRC as of 2021

The MAH system also suffers from this lack of specialized skills and uneven implementation. Importantly, the DAL charges MAHs themselves with meeting the legal requirements for clear record-keeping, credential verification, and quality assurance throughout a drug’s development–production–distribution cycle, alongside support from the NMPA and other central government agencies. However, a team of researchers at Guangzhou’s Guangdong Drug Administration office surveyed 30 MAH license applicants about violations. Of these, 63 percent of the problems related to the DAL verification system, including failure to review credentials, not having a process to review credentials, and failure to address identified problems.

Fourth, there are constraints imposed by the PRC’s legal system. Yang and Bao note that several central government bodies—including the Supreme Procuratorate and the Ministry of Public Security—have yet to issue promised prosecution standards and sentencing guidelines for opioid-related crimes, slowing enforcement. Further, despite designating fentanyl and its derivatives as controlled substances, the Chinese regulatory system has difficulty identifying and scheduling new psychoactives, such as the benzimidazole series of opioids, which could escape existing controls. Zhang and Zhang emphasize that these “windows” are the critical point to combat TCOs by controlling new substances or families proactively.

Only by advancing the early warning work to NPS prevention and control, can the drug harm be controlled more effectively. . . . If we do not carry out prevention and control of new psychoactive substances and control them when they develop into a serious abuse, we will miss the best time to prevent and curb the abuse of synthetic drugs.

Research has also identified problems with policing and investigation. Lu Changming and Duan Xiongbo of the China Customs Management Academy highlighted several evidence procedure and collection issues, including gathering insufficient physical evidence, failing to leverage accomplices to generate a larger case, and relying on admission and confession in lieu of physical evidence. Gai Kejing of Qingdao University joined these researchers in highlighting the importance of a strong and well-coordinated response to synthetic opioid trafficking.

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in examining the difficulty investigators have in establishing “knowing” intent and conspiracy under Chinese legal practice.111

Finally, Chinese data could be inaccurate or incomplete. In aggregate, according to China Judgments Online (an official repository of judicial decisions), fentanyl-related cases have actually declined since a peak in 2018 when just over 150 court cases were concluded.112 Nearly half of the cases occurred in four provinces or autonomous regions (Guangdong, Fujian, Guangxi, and Gansu). Since then, the numbers of cases dropped to just under 100 in 2020. There is some evidence, however, that the Chinese government has suppressed public databases, therefore public databases about fentanyl cases could reflect missing information rather than true declines.113

U.S.–PRC Cooperation to Reduce Flows

Many interviewees noted significant and positive cooperation with Chinese counterparts, particularly following the 2019 scheduling of fentanyl. According to a State Department official, “It seems to me . . . like we’re on the same page. Our law enforcement agencies work well with their Ministry of Public Security. Our diplomatic corps works well with their Ministry of Foreign Affairs.”114 As another official stated, “There was, for example, a sense that our posture toward Chinese government was fundamentally cooperative. This is a shared problem and they want to limit drug flows and not have drug problem domestically and so do we.”115

As an example of Chinese efforts, high-level discussions eventually led to the 2019 scheduling of fentanyl-related substances. But worsening U.S.–PRC relations inhibited deeper cooperation from that point on. According to U.S. government officials, the Chinese leadership expected that their help on this issue would be reciprocated by more conciliatory U.S. policy on trade and other matters. According to this official, when the trade war continued, and as officials in the Trump administration began directly criticizing the Chinese Communist Party, Beijing concluded that further cooperation on the matter was not worth the effort, particularly as it was a unidirectional problem only affecting the United States.116 While this is the perspective of one official on how Chinese officials interpreted the situation, this view does present potential constraints for future U.S. policymakers who might seek direct criticism of the party.

U.S. officials continue to seek the PRC’s cooperation to address challenges, including the importation of unscheduled precursors from the PRC to Mexico.117 But future cooperation on opioids will be more difficult for two reasons. The Chinese government might be reluctant to be perceived as having a second failure in working with the United States on illegal supply of synthetic opioids while receiving no reciprocal policy concessions. Particularly, as the PRC does not have a significant domestic problem with synthetic opioids incentivizing it to take further action, the PRC is unlikely to make further unilateral concessions on drug enforcement (as it did in 2019); instead, it might leverage its cooperation to relieve U.S. pressure or achieve gains in other issue areas.118

111 Keliang Gei [盖克靓], “Knowing Cognizance of the Crime of Smuggling Drugs [走私毒品罪明知的认定——以有偿带货人携带不知藏有毒品行李通关案为例],” publisher and date unknown.
112 China Judgments Online [中国裁判文书网], homepage, undated.
115 Interview 29, August 23, 2021.
116 Interview 41, September 7, 2021.
117 Interview 17, August 13, 2021.
Given the complex range of interests that characterize the U.S.–PRC relationship, and the notable risk that restricting production in the PRC will have only modest and temporary effects on supply in the United States, U.S. policymakers and diplomats will need to assess how to balance the goal of supply reduction with other U.S. priorities.  

**MEXICO**

Mexico is a substantial source of illegally manufactured synthetic opioids that are trafficked into the United States. Almost all of these synthetic opioids are fentanyl, although some minor fentanyl analogues have been reported. Further, there are indications that Mexico’s fentanyl production capacity is increasing and that TCOs are seeking to diversify sourcing the primary inputs. While stricter regulation of fentanyl in the PRC in 2019 led to a decline in direct shipments of finished fentanyl by mail from the PRC to the United States, this decline is correlated with an increase in seizures of fentanyl synthesized in Mexico from precursors obtained from the PRC and smuggled across the southwest border. Mexican authorities report increases in domestic fentanyl seizures. At present many precursor chemicals used in the illegal manufacture of fentanyl in Mexico are imported from the PRC. Finished fentanyl products, including powders and pressed counterfeit tablets made in Mexico, are then trafficked into the United States. In 2021, the DEA noted that Mexican cartels “will remain the primary source of supply and [finished] fentanyl smuggled into the United States, using precursors primarily sourced from China.” In recent years, Mexico has also reported a small but growing domestic fentanyl use problem.

**The Illegal Supply Chain**

Since the PRC listed all fentanyl-related substances as controlled substances in 2019, Mexico appears to have become the dominant source of illegally manufactured fentanyl sent to the United States. Mexican authorities have reported a near fivefold increase in the raw (or unadjusted for purity) amount of fentanyl seized in that country since 2019 as well as increases in the frequency of clandestine synthesis labs and counterfeit pill processing operations. See Appendix B for additional details on fentanyl seizures.

According to information from the U.S. DEA, Mexican Attorney General (Fiscalía General de la República, or FGR), and Mexican Secretariat of the Treasury and Public Credit (Secretaría de Hacienda y Crédito Público, or SHCP), trafficking of precursor chemicals and fentanyl production began to increase in Mexico starting around 2017, when Chinese chemical producers and Mexican TCOs established connections, allowing for trade in

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119 Interview 3, July 29, 2021.
120 Interview 31, August 24, 2021.
122 Interview 27, August 19, 2021. Only a handful of precursor chemicals used to manufacture fentanyl are controlled in the PRC. Exports of uncontrolled precursors may not be illegal even if they are destined for countries where they are controlled (improper importation of controlled chemicals may be illegal, however), and it is unclear to what extent authorities in the PRC take steps to regularly monitor possible exports of chemicals that are suspected to be used in illegal manufacture of fentanyl outside of the PRC.
precursor chemicals.\textsuperscript{127} An investigation by Spanish-language journalists produced a list of 64 active Chinese companies manufacturing precursor chemicals that the news organization claimed were linked to Mexican TCOs but this was not verified by the Commission.\textsuperscript{128} The journalist did not release the source of the list beyond claiming it was confidential, likely because he would put the source at risk of violence if he publicized where the list came from.

Other sources report that the Sinaloa and Jalisco cartels have further strengthened ties to Chinese and Indian producers over the past years to import large quantities of precursor chemicals to transform into fentanyl for smuggling to the United States.\textsuperscript{129} The mention of India as a supplier is notable because the country is more often referred to as only a potential supplier; however, no elaboration about India’s role is provided. Seizures of precursors in Mexico originating from India (including a seizure of ANPP and NPP in 2020) have been noted by authorities,\textsuperscript{130} though the country appears to remain a much smaller source for Mexico-based TCOs. News sources are, on the one hand, less useful than official government statistics because they rely more on single cases, anecdotes, and confidential sources. On the other hand, these sources could provide important information that governments do not have access to, or are unable to release publicly, particularly when many organizations are in danger from powerful TCOs.

Three seaports appear to serve as key entry points into Mexico for chemical precursors according to amounts seized: Manzanillo, Lázaro Cárdenas, and Veracruz.\textsuperscript{131} However, Mexican Secretary of the Navy José Rafael Ojeda Durán declared in 2021 that smuggling had also shifted to other ports further north such as Guaymas and Ensenada.\textsuperscript{132}

Two major cartels, Sinaloa and Jalisco Nueva Generación (CJNG), control much of the illegal drug trade in the north, including fentanyl. Independent producers appear to operate in the south. According to a U.S. government official, “CJNG, because they don’t control major [poppy] growing areas, have been able to leverage synthetic opioids to rapidly expand leverage in Mexico.”\textsuperscript{133} While the two larger cartels exert considerable influence over the processing and transport of fentanyl and its precursors, other splinter groups are also involved.\textsuperscript{134} Meanwhile, most of the illegal production and interdiction operations have been in Sinaloa-controlled territories.\textsuperscript{135} According to one

\textsuperscript{127} Alberto Nájar, “Fentanilo: cómo operan los carteles de México y China para vender esta potente droga en Estados Unidos,” BBC News, February 4, 2020. However, it is more likely that trafficking started earlier but went unreported by authorities.

\textsuperscript{128} Laureano Pérez Izquierdo, “Las 64 empresas chinas que venden químicos y máquinas a los carteles de México para desatar una epidemia de fentanilo descontrolada,” Infobae, March 7, 2021.

\textsuperscript{129} CJNG controls ports of Lazaro Cardenas, Manzanillo, Coatzacoalcos and Veracruz, as well as checkpoints of Tuxpan, Veracruz, and Cancun, while the Sinaloa cartel controls Ensenada, Baja California ports, and checkpoints of Mazatlan, Sinaloa, and La Paz (Tonatiuh Fierro, "Fentanilo, la otra pandemia: un emergente desafío bilateral para México y China," Otros Diálogos de el Colegio de México, Vol. 14, January 2021).


\textsuperscript{133} Interview 4, August 2, 2021.


U.S. government official, the cartels appear generally to use the same or similar routes that they have used in the past to transport other drugs.\textsuperscript{136} Although the two largest TCOs appear to control most of the fentanyl supply, smaller groups have also shown signs of interest and activity. In Juarez, local sellers and small-scale smugglers were arrested with fentanyl packages.\textsuperscript{137} Interviewees emphasized that the fentanyl trade offers Mexican TCOs an especially lucrative and streamlined business model, at least in the short term. Though Mexican traffickers are increasingly entering the fentanyl trade, chemical precursors from the PRC remain important links in the supply chain.\textsuperscript{138} In response to new regulations over fentanyl-related substances, NPP and 4-ANPP, Chinese producers have developed at least four precursor substitutes or “indirect precursors or pre-precursors” and have begun shipping these to Mexico by air and maritime commercial channels where they are transformed into finished fentanyl.\textsuperscript{139}

Limited Enforcement Capacity

Unlike the PRC and India, Mexico’s pharmaceutical sector is not as large and is not suspected to be involved directly in the illegal manufacturing or diversion of fentanyl that is trafficked into the United States. Instead, illegal manufacture involves clandestine operations employing illegally imported precursors or finished fentanyl. Therefore, much of the Mexican domestic drug regulation is aimed at regulating Mexico’s domestic use and preventing illegal use by Mexican citizens. Regulation of narcotics, like synthetic opioids, is found in the General Health Law (Ley General de Salud), which establishes the list of controlled substances, accepted uses, importation and exportation requirements, and penalty guidance for relevant criminal activity.\textsuperscript{140} This law grants primary authority to develop and implement policy related to listed substances to the Department of Health and the General Health Council (GHC). The implementation of the law is led by the GHC (Consejo de Salubridad or CSG in Spanish), presided by the Secretary of Health, and reporting directly to the President of Mexico.\textsuperscript{141} Other institutions that make up the GHC are secretaries of foreign relations, treasury, economy, communications and transportation, and the attorney general’s office.

Another important legislative tool is the Federal Law for the Control of Chemical Precursors, Essential Chemical Products and Machines to Manufacture Capsules, Tablets and/or Pills, which is one of the primary regulatory control measures in Mexico aimed at both controlling precursor chemicals as well as equipment used in the processing or manufacturing of finished drugs.\textsuperscript{142} Written in 1997, this law establishes reporting requirements for entities involved in the production, purchase, transport, and use of listed chemicals and equipment/machinery and provides penalties for noncompliance. This law mandates that entities involved in the handling of controlled substances must prepare an annual report of relevant transactions to the Department of Health. Similarly, entities involved in the transport of listed substances are required to report annually to the Department of Commerce on

the quantities of chemicals transported and the recipients. In both cases, the Commission was unable to determine how consistently these reports are completed or the extent to which the reported information is used.\(^{143}\)

In 2017, NPP and 4-ANPP, known fentanyl precursors, were elevated to international control and authorities included them in the federal law. This was the first time fentanyl precursors were controlled in Mexico. In May 2021, Mexican authorities scheduled four new chemicals, including 4-AP\(^{144}\) (a known masked substitute precursor that the PRC has not yet controlled\(^{145}\)). Masked precursors are chemically altered to escape detection; see Appendix D for more information.

Monitoring precursors scheduled in 2017 and 2021 is carried out by Mexico’s GHC; the Department of Commerce is charged with enforcement by imposing fines for noncompliance and referring instances of illegal use of machines to federal prosecutors.\(^{146}\) Those found to have contributed to the production or preparation of narcotics per this legislation are subject to five to 15 years imprisonment and a fine.\(^{147}\)

In an effort to improve regulatory oversight of new chemicals, as well as give law enforcement and regulators the capacity to seize controlled precursors, GHC passed an agreement in May 2021 to implement a surveillance list for “substances susceptible to dual use,” with monitoring entrusted to GHC, Secretaries of Foreign Relations, Public Credit, and Hacienda; Economy, Health, Communications and Transport; the attorney general; and SEMAR (Mexican Naval Secretariat). These authorities designate the “Technical Group of Synthetic Drug Control” (GTCDS), which receives specific data on cases (e.g., name and amount of substance to be exported or imported, name and address of exporter or importer) and shares that and other information with GHC, which makes the final determination of addition or suppression of a controlled substance.\(^{148}\) Factors that the council considers for the scheduling of a substance are the volume necessary for illegal drug production, the gravity of public health caused by its use, the importance of legal use, and the cost of scheduling.\(^{149}\)

Though Mexico has regulations and laws to control precursors and machinery used in the tableting of drugs, the enforcement of these laws is another matter. Issues of corruption present one hurdle.\(^{150}\) Securing sufficient staffing and resources for regulatory agencies is another.\(^{151}\) One U.S. government official also noted that, in contrast to the U.S. system, Mexico’s customs authorities focus more on tariff collection than on law enforcement.\(^{152}\) Since 2020,


\(^{144}\) Cámara de Diputados, Congreso de la Unión, “Ley federal para el control de precursores químicos, productos químicos esenciales y máquinas para elaborar cápsulas, tabletas y/o comprimidos,” December 26, 1997 (adding the following chemicals: N-Fenil-4-piperidinamina [4-AP], Diclorhidrato de N-Fenil-4-piperidinamina, Anhidrido propiónico, Cloruro de propionilo); interview 5, August 2, 2021; interview 9, August 10, 2021.


\(^{150}\) One interviewee noted that Customs in Mexico prioritizes collection of tariffs and not interdiction of controlled chemicals (interview 9, August 10, 2021).

\(^{151}\) Interview 9, August 10, 2021.

\(^{152}\) Interview 9, August 10, 2021.
the administration of Mexican president Andrés Manuel López Obrador (known by his initials AMLO) has reorganized government agencies. The administration gradually shifted oversight of the country’s 49 ports and border checkpoints from customs authorities to the military (Agencia Nacional de Aduanas de Mexico, under direction of national security agencies Mexican Secretariat of National Defense [SEDENA] and SEMAR) in order to curb contraband, tax evasion, drug trafficking, and opportunities for corruption.\textsuperscript{153} The president’s decision came after a purportedly successful reduction of gasoline contraband at checkpoints controlled by the military and in an effort to “clean all customs checkpoints.”\textsuperscript{154}

While officially the GHC does not include military secretaries, since the military began to oversee ports and checkpoints in mid-July 2020,\textsuperscript{155} the secretary of the Marines, Rafael Ojeda, alluded to additional controls over precursor chemicals needed to produce fentanyl or methamphetamines. However, it is unclear whether the May 2021 agreement described previously, which includes SEMAR as a member of GTCDS, is the reform he was alluding to.\textsuperscript{156} Ojeda mentioned that the “enemy appeared to be in the Judicial branch” since Mexican federal judges were blocking seizures and arrests. The Mexican Supreme Court (SCJN) pushed back on Ojeda’s remarks, claiming that judges were independent and entrusted with defending human rights and the Constitution. The issue of corruption was also mentioned by an interviewee who suggested that seaports, which are officially under the authority of SEMAR, are an area of opportunity for interdiction efforts, but that cartels anecdotally have carte blanche to operate.\textsuperscript{157}

With regards to pill presses and tableting equipment, “companies that produce, sell, acquire, import, export, or stock pill presses are required to submit annual reports to the government and to maintain relevant records for a period of three years.”\textsuperscript{158} Laws contain record-keeping and reporting requirements to allow tracking of tableting equipment.\textsuperscript{159} A report by journalist Anabel Hernandez mentioned that although laws exist and documentation is required, Mexico does not monitor or control tableting equipment’s final destination.\textsuperscript{160} Moreover, criminal groups routinely mislabel chemicals and pill press machines when shipping them to avoid inspection. Compounding the challenges, oversight at maritime ports is reportedly not effective, at least in part because organized crime groups have maintained longtime control of the ports through corruption and intimidation.\textsuperscript{161}


\textsuperscript{155} “AMLO entrega a las Fuerzas Armadas el control de puertos y aduanas,” Animal Político, July 17, 2020.


\textsuperscript{157} Interview 18, August 13, 2021.


\textsuperscript{160} Anabel Hernández, “Informe de EE.UU.: Crece el poder de narcos durante el gobierno de AMLO,” Deutsche Welle, March 22, 2021.

Figure F.2 shows the relationship of Mexican government agencies responsible for regulating or interdicting synthetic opioids, both in shipments from other countries, and within the country. The structure is fragmented, particularly between military (shown on the right side of Figure F.2) and civilian agencies (shown on the left), though not necessarily more so than other countries’ regulatory systems. The national security agencies SEMAR and SEDENA have separate lines of authority from the civilian GHC. This organization chart was assembled from a variety of disparate sources indicated in the source note. The system of synthetic opioid policy and regulation reflects increasing focus on domestic fentanyl consumption and a shift of operational control from the national police to the military (SEDENA), which is due to be completed in 2023.

There is concern, however, that increased jurisdiction and responsibilities of Mexican armed forces, especially in areas of government previously led by civilians, could lead to erosion of judicial and democratic institutions necessary to effectively combat trafficking and TCOs in the long term. One U.S. government official said that the Mexican military’s emphasis on seizing and destroying contraband and production facilities, rather than on arresting and prosecuting those involved in trafficking, contributed to a “whack a mole” dynamic in which disrupted operations could be restarted elsewhere. Critics argue that more focus and resources on the military, by both the United States and Mexico, will lead to continued encroachment on outdated and neglected Mexican civil institutions.

The National Guard, which was meant to have a “civilian character” according to the constitutional amendment that authorized it and centralize police functions throughout the country, is 70 percent staffed by former military members and has been trained by the armed forces. As of the end of 2020, around 100,000 National Guard members had been deployed throughout the country, nearly three times as many as the extinct federal police. Moreover, control over daily operations, which was formerly under SSPC (Secretaria de Seguridad y Proteccion Ciudadana), shifted to SEDENA in October 2020.

Interdiction Efforts and Joint Collaboration

Mexico interdicts illegally traded synthetic opioids at its borders through various means, including use of Fourier-transform infrared spectroscopy (FTIR) machines and other nonintrusive technologies, as well as canine units. However, detection technologies are not always effective due to required ongoing maintenance and the need for updated referent libraries to detect emergent chemicals. Mislabeling of shipping containers that contain fentanyl precursors or the shipment of masked or intermediate precursors from the PRC might also help circumvent detection efforts.

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162 Interview 18, August 13, 2021.
165 Interview 9, August 10, 2021; interview 18, August 13, 2021.
Figure F.2
Mexican Government Agencies Relevant to Interdiction and Regulation of Synthetic Opioids

NOTE: GTCDs = Grupo Técnico de Control de Drogas Sintéticas, or Technical Group for the Control of Synthetic Drugs. CSG = Consejo de Salubridad General, or General Health Council. CONADIC = Comisión Nacional contra las Adicciones, or National Commission Against Addictions. SRE = Secretaría de Relaciones Exteriores, or Secretary of Foreign Affairs. SHCP = Secretaría de Hacienda y Crédito Público, or Secretary of Finance and Public Credit. UIF = Unidad de Inteligencia Financiera, or Financial Intelligence Unit. ANAM = Agencia Nacional de Aduanas de México, or National Customs Agency of Mexico. SCT = Secretaría de Comunicaciones y Transportes, or Secretary of Communications and Transport. FGR = Fiscalía General de la República, or attorney general. AIC = Agencia de Investigación Criminal, or Criminal Investigation Agency. FEMDO = Fiscalía Especializada en materia de Delincuencia Organizada, or attorney specializing in matters of organized crime. CENAPI = Centro Nacional de Planeación, Análisis e Información, or National Center for Crime Control Planning, Analysis, and Information. SEMAR = Secretaría de Marina, or Secretary of the Navy. SEDENA = Secretaría de la Defensa Nacional, or Secretary of National Defense. SSPC = Secretaría de Seguridad y Protección Ciudadana, or Secretary of Security and Citizen Protection.
Unlike his predecessors, AMLO’s antidrug strategy on paper focuses on finding alternative livelihoods for people employed in the drug trade, social development, violence reduction, and health-based approaches to treat addiction (demand reduction), often avoiding direct confrontation with TCOs. As a sign of rejection of previous approaches, in July 2021 Secretary of Foreign Relations, Marcelo Ebrard, expressed that “the Merida Initiative (the central security cooperation agreement between U.S. and Mexico since 2007) is dead.” No effort was made to renegotiate it under the Trump administration given the Mexican president’s disagreement in security strategy. However, during 2021, a new plan was announced with an emphasis on reducing homicide, capturing heads of cartels, reducing weapons traffic on the border, and increasing efforts to seize materials used in fentanyl production. In addition, the United States and Mexico, along with Canada, continue to use the North American Drug Dialogue as a forum for discussing counternarcotics cooperation. According to one U.S. official, the North American Drug Dialogue represents an opportunity for Mexico to talk with the United States as an equal partner and to counteract the perception that the bilateral relationship is mainly about the United States providing assistance to Mexico.

The Mexican government does appear to have increased attention on fentanyl smuggling, reporting monthly seizure amounts of fentanyl starting in 2019, albeit with limited U.S. direct involvement. An effort to counter corruption and improve interdiction occurred when the military was assigned responsibility for customs inspection at ports to “renew and clean [the] system of ports and entryways of the country, [and to] promote security and avoid the introduction of drugs.” Joint efforts with Unidad de Inteligencia Financiera (Mexico’s financial intelligence unit, FIU) and Servicio de Administración Tributaria to minimize corruption also began. Although U.S. government agencies do share information with their counterparts in Mexico, the practice is limited by U.S. concerns about leaks, corruption, and potential negative impacts on ongoing law enforcement investigations.

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171 Interview 31, August 24, 2021.
176 Interview 18, August 13, 2021; interview 30, August 23, 2021; interview 32, August 24, 2021.
Seizure data from Mexico are harder to obtain given the various types of agencies that are involved with drug law enforcement. Systematically reported data on fentanyl seizures by SEMAR began in 2019. As reported previously, seizures have dramatically increased in recent years, from 222 kg in 2019 to 1,301 kg in 2020 and 1,157 kg from January to August 2021 (see Figure F.3). According to government reports, recorded seizures took place from 2013 to 2018 but at lower levels, with a high of 724 kg in 2017, which was a substantial increase over preceding years in which annual seizures were under 100 kg (and zero or close to it in some cases). However, it is possible that seizure data is incomplete, particularly from before 2019 when systematic data became available.

**Figure F.3**

**Annual Fentanyl Reported Seizures by SEMAR, 2015–2021, in Kilograms**

Monthly seizure data from Mexico was available only for 2020 and 2021, limiting a proper long-term analysis. That said, May and August 2020 accounted for 46 percent of the annual seizures, and March to May 2021 have accounted for nearly 70 percent of seizure so far (see Figure F.4). The number of pills seized also has been on the rise, though data were only available through 2018. In 2013 and 2014, pill seizures were not reported; in 2015, 19,068 pills were reportedly seized. With the exception of 2016 (four pills seized), the number jumped to 331,767 pills seized in 2018. These data are presented in Figure F.5 as inputs for analysis in other parts of the Commission report.

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177 One U.S. government official assessed their most significant data need as reliable “whole of government seizure data” from Mexico (interview 18, August 13, 2021).
Figure F.4
Monthly Fentanyl Reported Seizures by SEMAR, January 2020–August 2021, in Kilograms


Figure F.5
Fentanyl Reported Seized by SEMAR, PGR, PF, and SEDENA Pre-2018, in Pills and Kilograms

Conclusion—Increasing Production and TCO Involvement

The continued growth in availability of illegally manufactured fentanyl from Mexico is of primary concern. It appears that TCOs are increasing illegal production of fentanyl using imported precursors. A noted decline in the amount of heroin produced in Mexico might indicate an important shift in the illegal supply of opioids. Poppy cultivation and heroin production in Mexico has been declining for three consecutive years. All the while, fentanyl seizures in Mexico have risen from nearly 0 kilogram in 2016 to over 1 metric ton in 2020. The illegal supply of fentanyl is different from other major drug sources because it primarily involves criminal actors and not underregulated chemical or pharmaceutical producers in Mexico. Issues of corruption and violence also compound the problem facing Mexico.

INDIA

India is a producer of controlled substances with a history of regulatory problems and drug diversion, or the illegal distribution of drugs that are legal for specific medical uses. Further, current Indian economic policy favors export-driven growth. Recent amendments to Indian law have relaxed restrictions on fentanyl, designating it as an “essential” medication, allowing for greater access in pain relief and palliative care. It is unclear to what extent diverted pharmaceutical fentanyl produced in India is illegally imported to the United States, but India is a major source of diverted tramadol that is misused in Africa and the Middle East. In short, India might not be a major source of illegally manufactured fentanyl or analogues in the United States, but it is not far behind its eastern neighbor as a major producer of drugs and controlled chemicals that make their way into illegal drug supplies. Industry watchers see India and others as a growing source of diverted pharmaceutical drugs, precursor chemicals, and illegally produced controlled drugs. Should the PRC strengthen its oversight to the point where drug traffickers cannot source precursors, then criminals might turn to India as an alternative. The Indian pharmaceutical sector is well positioned to fill this role given its size and the minimal regulatory oversight it faces due to a lack of resources and staff to conduct inspections. In recognition of this risk, the United States has begun to engage with India on the topic of counternarcotics. A bilateral counternarcotics working group met for the first time in 2021.

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181 For more on the PRC, see the corresponding section earlier in this appendix.

182 Interview 27, August 19, 2021.


184 Interview 27, August 19, 2021.

185 Interview 4, August 2, 2021.

186 Interview 15, August 12, 2021; interview 27, August 19, 2021.
India’s Pharmaceutical Sector and the Regulatory Structure

By volume, India is the third largest exporter of pharmaceuticals in the world. Its pharmaceutical sector, valued at $33 billion in 2017, was projected (pre–COVID-19) to exceed $50 billion in 2020.\(^\text{187}\) India hosts a large number of pharmaceutical firms, with a network of about 3,000 drug companies and roughly 11,000 manufacturing sites.\(^\text{188}\) This size is on par with the PRC’s pharmaceutical industry, which totals some 5,000 firms.\(^\text{189}\) Much of the sector provides generic drugs to global markets, accounting for 20 percent of the global volume of generic exports and making the country the largest provider of generic medicines.\(^\text{190}\)

The pharmaceutical sector has been growing rapidly because of increased investments in research, development, and acquisitions in addition to support from the central government. New Delhi’s policy aims to promote the industry as an important global producer. The Department of Pharmaceuticals (housed in the Ministry of Chemicals and Fertilizers) supports growth through Pharma Vision 2020, which seeks to “make the Indian pharmaceutical industry . . . one of the world’s leading destinations for drug manufacturing.”\(^\text{191}\) This business-friendly policy is not unlike that of the PRC, which aims, through subsidies and tax rebates, to promote high-value industries that contribute to the export-driven economy.\(^\text{192}\)

Like the PRC, the sheer number of manufacturers and companies complicates regulation and oversight, allowing any number of firms or individuals with the knowledge of organic chemistry and access to precursors the means with which to manufacture drugs outside of the watchful eye of regulators. To this last point, India has had its own problems ensuring that businesses adhere to rules\(^\text{193}\) and is plagued by high levels of regulatory corruption.\(^\text{194}\)

The U.S. FDA inspects drug manufacturing facilities around the world to ensure the safety of the U.S. drug supply. The FDA tests for drug quality using standards submitted in marketing applications, standards set by the United States Pharmacopeia, or FDA’s own methods. FDA has reported that, of all countries participating in their inspections, Indian firms report the highest rates of required actions to address violations. From 2012 to May 2020, one in seven inspections resulted in a regulatory or administrative action; this is in contrast to fewer than one in ten for the PRC.\(^\text{195}\)

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\(^\text{188}\) India Brand Equity Foundation, “Indian Pharmaceuticals Industry Analysis,” July 2021.


\(^\text{190}\) India Brand Equity Foundation, “Indian Pharmaceuticals Industry Analysis,” July 2021.


\(^\text{195}\) Judith A. McMeekin, associate commissioner for regulatory affairs, Office of Regulatory Affairs, Food and Drug Administration; Mark Abdoo, associate commissioner for global policy and strategy, Food and Drug Administration; and Douglas Throckmorton, deputy director for regulatory programs, Center for Drug Evaluation and Research, Food and Drug Administration, “COVID-19 and
Additionally, many competing players are overseeing India’s pharmaceutical sector with different policy remits and objectives. The Department of Pharmaceuticals oversees industry development and does not oversee health regulations. Instead, its goal is to develop the sector and regulate price and access to pharmaceuticals. The department offers assistance, including financial aid, to firms to help with capital-intensive improvements to bring them up to good manufacturing standards and best practices.

The Central Drugs Standard Control Organization (CDSCO, housed in the Ministry of Health and Family Welfare) is the Indian regulatory body for pharmaceuticals and medical devices and serves in a manner similar to the U.S. FDA or the European Medicines Agency. To add even greater complexity, Indian State Drug Control authorities, rather than the central government, often enforce regulations designed by CDSCO pursuant to the manufacture, sale, and distribution of drugs.

Apart from oversight of the pharmaceutical sector, the central government regulates activities involved in controlled substances through the Narcotics Control Bureau (NCB), which sits in the Ministry of Home Affairs. Since its foundation in March 1986, NCB has served as a primary law enforcement agency coordinating the enforcement of India’s drug laws at the national and state levels. In 2013, New Delhi passed the 2013 Narcotic Drugs and Psychotropic Substances (Regulation of Controlled Substances) Order proscribing the production, stockpiling, usage, trafficking, and possession of schedule A substances unless NCB has authorized the entity to do so for “educational, scientific, or analytical purposes.”

In addition to NCB, the similarly named Central Narcotics Bureau, housed in the Ministry of Finance, is tasked with implementing the Narcotic Drugs and Psychotropic Substances (NDPS) Act that bans the production, possession, sale, transport, storage, usage, import, and export of drugs. The Central Narcotics Bureau is tasked with “preventing and combating the abuse of narcotic drugs and psychotropic substances and their illicit trafficking.” Further, it is responsible for authorizing licenses for the manufacture of synthetic narcotic drugs and oversees legal opium cultivation in India.

Fentanyl is not listed on India’s list of controlled substances. Instead, fentanyl is listed as a manufactured drug, which is legally restricted through the 1985 NDPS Act. However, in 2014, India amended the NDPS Act to categorize fentanyl as an essential narcotic drug to allow its use in medicine and science. While fentanyl is not on India’s controlled substances list, two of its precursors are. In August 2020, New Delhi added both 4-ANPP and

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NPP, both fentanyl precursors, as schedule A substances to the list associated with the 2013 Narcotic Drugs and Psychotropic Substances (Regulation of Controlled Substances) Order.204

India as a Source of Illegally Manufactured Synthetic Opioids

Though India maintains control over chemicals and fentanyl, enforcement is limited. According to one U.S. government official, India has “great laws and structure but too few resources” to implement its regulatory system.205 Inadequate oversight of the Indian pharmaceutical industry results in diversion of pharmaceutical and precursor chemicals. India manufactures and exports a substantial amount of tramadol that is diverted and consumed in many developing markets in the near Middle East and Africa.206 In the last decade, Indian regulators relaxed export requirements for pharmaceuticals, including tramadol, which corresponded to a tenfold rise in tramadol seizures in parts of sub-Saharan Africa from 2013 to 2017.207 Not until mid-2018 was tramadol exportation brought under legal control through an emergency act.208

It is unclear to what extent India supplies global markets with illegally exported fentanyl, but in 2018 Indian authorities disrupted two trafficking operations of illegally manufactured fentanyl.209 Others have documented the online sales of fentanyl from India,210 and the United Nations International Narcotics Control Board (INCB) has reported instances in which unmonitored fentanyl precursors, such as 4-AP, were shipped to Mexico.211 What is of equal concern is the fact that India is behind on controlling precursor chemicals listed in international conventions. As of 2020, India regulates 19 of the 30 listed chemicals, having added the two main fentanyl precursors to the list in 2019.212 The extent to which Indian pharmaceutical companies support or use other international systems, including INCB’s International Special Surveillance List of watched but not controlled precursors is unclear.

205 Interview 27, August 19, 2021.
208 Department of Revenue, Ministry of Finance, Government of India, amendment to the Narcotic Drugs and Psychotropic Substances Act adding tramadol to the list of psychotropic substances, April 26, 2018.
MYANMAR

Presently, little evidence suggests that there is significant illegal production of synthetic opioids in Myanmar. However, Myanmar is included in this appendix because of its current role as a major source of other illegally supplied drugs, including methamphetamine and heroin. Further, its proximity to chemical sources in the PRC, a weak central government, and long-standing civil conflict create a suitable environment for the illegal manufacture of fentanyl. In early 2020, some reports suggested that fentanyl production and trafficking in Myanmar was ongoing because of a series of raids and seizures by Myanmar’s security forces of what was believed to be fentanyl or methylfentanyl. Through interviews with government sources, it appears that purported presumptive seizures of fentanyl were inaccurate; instead, it appears that these were seizures of methamphetamine precursors. There is some indication, however, that production of synthetic opioids might occur—a sizable shipment of propionyl chloride, a chemical that can be used to make fentanyl or methamphetamine, was destined for Myanmar when it was seized by Laotian authorities. At least prior to the 2021 coup, the U.S. government provided counternarcotics assistance to Myanmar, including detection equipment and support for training and capacity building.

History of Illegal Drug Production

Legal chemical and pharmaceutical production in Myanmar is small in comparison to neighboring India and the PRC. Most drugs produced in the country are illegally manufactured and mostly in the form of opiates and methamphetamine. There is ample reason to be concerned about the future of drug production and trafficking in Myanmar by examining the country’s past. Myanmar has long been a haven for illegal drug production and trafficking in South and Southeast Asia. This drug economy has been an effective source of revenue for various armed actors stretching back to the early years of the ongoing civil war that began in 1948. For much of Myanmar’s history, the primary drugs produced and trafficked were opium and heroin, supplying regional heroin markets in Asia and Oceania but also western Canada as recently as the early part of this century.

213 Further, officials at the U.S. State Department indicate little appears to have changed in synthetic opioid production in Myanmar to the present (interview 37, August 26, 2021).
214 Interview 37, August 26, 2021.
216 Interview 37, August 26, 2021.
218 Interview 37, August 26, 2021.
Recent studies suggest that the opiate trade has experienced some decline since 2014.\textsuperscript{221} Since the mid-1990s, Myanmar drug production has shifted from opiates toward methamphetamine—namely, crystal meth and yaba (a caffeine and methamphetamine hybrid that comes in tablet form) that has largely overtaken, but not replaced the opiate economy.\textsuperscript{222} Myanmar’s methamphetamine is largely consumed within Asia and Oceania but has made its way further afield.\textsuperscript{223}

As Myanmar’s methamphetamine production picked up, opiate production has continued but declined. This decline is likely due to a limit on profitability owing to the availability of a cheaper Afghan supply and possibly due to producers deciding to instead produce methamphetamine, which can be done in any location and can occur indoors (making identifying production locations more difficult for those seeking to disrupt the trade and allowing production to occur year-round).\textsuperscript{224} Methamphetamine and heroin production sometimes occurs in shared facilities. But this diversification is not uniform—some former heroin producers fully transferred to methamphetamine as it is easier to produce, distribute, and profit from than heroin.\textsuperscript{225}

**Synthetic Precedence and Minimal Regulatory Oversight**

As drug production in Myanmar shifts from plant-based to synthetic, so too might the skills and methods of illegal drug producers. Chemists or cooks could adapt to demand outside Myanmar by opting to manufacture other synthetic drugs, which can be done in the same location using much of the same equipment and sometimes some of the same precursor inputs. Concerningly, there are limited reports that Myanmar is experiencing a rise in the production of other synthetic drugs such as ketamine.\textsuperscript{226}

Myanmar's large-scale production of narcotics goes on despite its laws and regulatory framework. In 1992, Myanmar passed its National Drug Law “to register drugs, control their safety and quality, and regulate their manufacture, import, export, storage, distribution, and sale.” This was followed with the 1993 passage of the Narcotic Drugs and Psychotropic Substances Law that “implement[ed] the provisions of the United Nations conventions against narcotic drugs and psychotropic substances” while instituting controls on “the production, possession, trafficking, and use of illicit narcotic drugs and psychotropic substances.”\textsuperscript{227} This legislation gave authority to the Ministry of Health\textsuperscript{228} to designate substances as narcotic drugs and designated those “substances

\begin{footnotesize}
\begin{itemize}
\item\textsuperscript{223} International Crisis Group, *Fire and Ice: Conflict and Drugs in Myanmar’s Shan State*, Brussels, Report 299, January 8, 2019.
\item Throughout this section, the entity that has been called the “Ministry of Health” as well as the “Ministry of Health and Sports” will be referred to as the “Ministry of Health.” The Ministry of Health was renamed the Ministry of Health and Sports in 2016.
\end{itemize}
\end{footnotesize}
and drugs derived or extracted from poppy, coca, cannabis or other plants designated by” the Ministry of Health as narcotic drugs.229

The 1993 law codified punishments for those who “possess, transport, distribute or sell, without permission, chemicals, implements or materials” used for producing designated narcotic drugs with five to ten years imprisonment and a possible fine.230 It also provides legal repercussions for those who “produce, distribute, sell, import or export” a designated narcotic drug with 15 years to life imprisonment or to a death sentence.231

In July 2004, Myanmar’s Ministry of Home Affairs published its Rules Relating to the Supervision of Controlled Precursor Chemicals. This set controlled precursors as those that are controlled through narcotic drug designations from the Ministry of Health.232

These regulations are applied unevenly. Production of illicit narcotics continues in the country. It seems that enforcement tends to target either the state’s opponents or smaller organizations and individuals that pose little threat to the state.233 Concerningly, Myanmar allows portions of its military, its allies, and groups it has ceasefire agreements with to produce and traffic narcotic drugs in exchange for fighting on its behalf or refraining from fighting the government.234 Further, Myanmar’s state banks allow for any amount of money to be deposited without explanation as long as the depositor pays a tax of 25 percent of the whole deposit (it had previously been as high as 40 percent). In this way, Myanmar provides its drug traffickers with a means to launder their money. The government also supplies a similar means of legitimizing funds by paying surcharges on property and the permits required to establish a front organization.235

Additionally, little appears to be stopping the inflow of chemical precursors into Myanmar. Most precursors appear to be sourced from the PRC, where they are purchased through legitimate markets or illegally directly from

Following the 2021 coup d’état, the Ministry of Health and Sports was broken into the Ministry of Health and the Ministry of Sports and Youth Affairs. It appears that the authorities described here have remained with the Ministry of Health since it was broken into two organizations. For more, see President Office, Republic of the Union of Myanmar, “Two Ministries Renamed,” May 25, 2016; and State Administration Council, Republic of the Union of Myanmar, “Reconstitution of Union Ministries,” Order 151/2021, August 1, 2021.


precursor producers. Further, the porous Myanmar–PRC border is likely to facilitate illegal or unregistered shipments of chemicals used in the manufacture of synthetic drugs. Other precursors seem to enter the Shan State via Thailand and Laos. It also appears that some precursors produced in India are reaching Myanmar.

CROSS-COUNTRY COMPARISON

The cross-country comparisons summarize the major differences in regulations across the countries analyzed and place them in the context of a global supply chain. The general comparison, summarized in Table F.2, is followed by a comparison of tableting machine and precursor regulations across countries.

Table F.2
Country Accounts Comparison

<table>
<thead>
<tr>
<th>Characteristic Measured</th>
<th>Canada</th>
<th>The PRC</th>
<th>India</th>
<th>Mexico</th>
<th>Myanmar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree with which illegally manufactured synthetic opioids are supplied to the United States</td>
<td>Minor, though could grow</td>
<td>Minor, though was a leading source until 2019</td>
<td>Presently none to minor, though could become a major source</td>
<td>Substantial</td>
<td>Presently none</td>
</tr>
<tr>
<td>Domestic public health problem associated with unauthorized use of synthetic opioids</td>
<td>Major health problem</td>
<td>No problem reported</td>
<td>Diverted prescription analgesics, including tramadol, a noted problem</td>
<td>Incipient public health concern, though prevalence rates not reported</td>
<td>No problem reported</td>
</tr>
<tr>
<td>Source of potential or actual illegal production</td>
<td>Clandestine labs</td>
<td>Private firms</td>
<td>Private firms</td>
<td>Clandestine labs</td>
<td>Clandestine labs</td>
</tr>
<tr>
<td>Nature of (illegally) manufactured synthetic opioids</td>
<td>Powder and counterfeit tablets</td>
<td>Highly pure powders</td>
<td>Unknown, potentially pure powders and diverted pharmaceuticals</td>
<td>Powders and counterfeit tablets</td>
<td>Powder and counterfeit tablets</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Characteristic Measured</th>
<th>Canada</th>
<th>The PRC</th>
<th>India</th>
<th>Mexico</th>
<th>Myanmar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of fentanyl precursor chemicals</td>
<td>Imported, likely from the PRC</td>
<td>Major source country for precursors</td>
<td>Minor source country for precursors</td>
<td>Imported from the PRC and India, potentially other imports from U.S. or Europe</td>
<td>Unclear if illegal production occurs</td>
</tr>
<tr>
<td>Role of pharmaceutical/chemical industry in illegal synthetic opioid production</td>
<td>Not likely directly involved</td>
<td>Large, lightly regulated sector with thousands of firms, some of which are directly involved</td>
<td>Large, lightly regulated sector with thousands of firms</td>
<td>Not likely directly involved</td>
<td>Not likely directly involved</td>
</tr>
<tr>
<td>Degree of regulatory oversight on pharmaceutical/chemical sectors</td>
<td>High</td>
<td>Extremely low relative to size</td>
<td>Extremely low relative to size</td>
<td>Medium but affected by corruption</td>
<td>Unclear</td>
</tr>
<tr>
<td>Statutory/regulatory definition of fentanyl</td>
<td>Expansive, fentanyl defined by chemical structure</td>
<td>Expansive, fentanyl defined by chemical structure</td>
<td>Narrow, only fentanyl defined</td>
<td>Narrow, only fentanyl defined</td>
<td>Narrow, only fentanyl defined</td>
</tr>
<tr>
<td>Degree of controls over fentanyl precursor chemicals</td>
<td>High (includes most common chemicals)</td>
<td>Low (only two chemicals)</td>
<td>Low (only two chemicals)</td>
<td>Medium (includes several chemicals, but enforcement is limited)</td>
<td>Low (only two chemicals)</td>
</tr>
<tr>
<td>Degree of controls over equipment used in illegal manufacturing of tablets</td>
<td>Medium, modest federal law with some more robust provincial regulations</td>
<td>None</td>
<td>None</td>
<td>Medium; federal law, but lacking enforcement</td>
<td>None</td>
</tr>
<tr>
<td>2020 Corruption Perceptions Index Ranking (1–179 ranking, least corrupt to most)</td>
<td>11</td>
<td>78</td>
<td>86</td>
<td>124</td>
<td>137</td>
</tr>
</tbody>
</table>

NOTES: The categories low, medium, and high are general degrees of difference based on an examination of the comprehensiveness of the law and enforcement regime when it applies to controlling synthetic opioids, precursor chemicals, or other related equipment necessary for illegal drug production.

The major route for illegal drug shipments into the United States, according to the country-specific investigations and research team analysis of seizure data and other reports, appears to be the land border with Mexico—the Canadian border appears to be used less often. There is also evidence that mail shipments from the PRC continue to reach the United States, though the problem has declined substantially, and in recent years attention has shifted to cross-border shipments. As of 2021, India and Myanmar are not large sources of illicit drugs in the United States, but India’s pharmaceutical industry and Myanmar’s levels of illegal drug production have the potential to become a larger part of the supply chain in the future. Countries differ in their expertise and capacity to produce synthetic opioids. The PRC and India have large pharmaceutical manufacturing industries, but as knowledge and technology spreads, other countries could become producers. For example, Mexico and Canada show potential for developing production capacity for illicit synthetic opioids.

In Canada, Mexico, and Myanmar, the source of synthetic drugs is almost entirely illegal production by nonstate actors. In the PRC and India, however, the picture of nonstate actors’ relationship to the pharmaceutical industry is less clear. There is less public reporting by government and news media about criminal activity and the drug trade in these countries.

REGULATORY CAPACITY COMPARISON

Regulatory capacity and the number and reach of laws and regulations varies across countries, as shown in Table F.2. The country accounts presented regulatory structures in great detail, but this table provides a high-level summary. Canada has high regulatory capacity, including controls over precursors. Mexico has a moderate amount of regulatory capacity, and there is some evidence of corruption affecting its ability to implement regulations. The PRC and India have some domestic regulatory capacity, but it is relatively small compared with the large size of their industries. Canada and the PRC have expansive statutory regulation of fentanyl, defined by its chemical structure. India, Mexico, and Myanmar, however, have only more narrowly targeted fentanyl regulations.

Beyond regulating chemicals, countries can regulate the machines to produce synthetic opioids. Of the five counties analyzed, only Canada and Mexico have national laws regulating tableting machines, which might suggest limitations of the effectiveness of controls over such equipment. The conclusions in Table F.2 about lack of enforcement driven by corruption were drawn from document reviews and interviews and the Transparency International Corruption Perceptions Index of 2020. Canada’s apparent lack of corruption appears associated with its relatively strong regulatory capacity.

The degree to which there is a widely recognized domestic fentanyl use problem might affect the likelihood of domestic regulation in all countries analyzed in the future. Canada has a widely recognized use problem and the most extensive regulations of the five countries analyzed. India has an emerging domestic use problem of diverted prescription analgesics including tramadol and opioid use more broadly, but not yet synthetic opioids such as fentanyl. The PRC has a declining heroin use population and no signs of a notable synthetic opioid problem, though data from the PRC are spotty. In Mexico, fentanyl use is an incipient public health concern, but there are not yet data about the extent of the problem.


Tableting Machine Regulations

Limiting access to the machines that press synthetic opioids into counterfeit pills is one way that governments attempt to limit the supply of illicit drugs and reduce harm. Counterfeit tablets appear to be one cause of overdose deaths. Unsuspecting users may not be aware that a tablet contains a high concentration of powerful synthetic opioids mixed with other drugs.

An international consensus provided for regulation and controls of tableting machines as part of the 1988 United Nations Convention Against Illicit Traffic in Narcotic Drugs and Psychotropic Substances, under articles that mention controls on materials and equipment used in the manufacture of drugs. Some interviewees noted that this is an underutilized tool that could be expanded given the growth in illegal manufacturing of counterfeit tablets containing synthetic opioids. Nonetheless, the evidentiary base over control of these machines and equipment to restrict the illegal manufacture of counterfeit tablets is limited. Machines could be replaced or other similar equipment (e.g., candy presses or other stamping machines) could potentially be used if tableting machines are prohibited.

As shown in Table F.3, Canada, Mexico, and the United States regulate machines to a greater degree than other countries, though the effectiveness of such efforts has not been systematically analyzed. The United States is included as a reference in this table as it maintains its own federal regulations on the importation or possession of these machines. Canada maintains a dual system of laws, with the federal law imposing restrictions on importation. Only two provinces, Alberta and British Columbia, further regulate the transfer, sale, or possession of these equipment. Some interviewees in Canada noted the relative success of provincial controls in reducing the prevalence of counterfeit tablets. Mexico maintains a national regulation over tableting equipment, but traffickers continue to circumvent the law as counterfeit pill pressing operations continue to be detected and seized. Table F.3 contains additional details.

The PRC, India, and Myanmar do not report specific restrictions on tableting equipment or other machinery. Other drug control laws might allow for the seizure of these equipment when they are found to be used as part of the illegal drug supply, but the Commission was unable to find specific laws or regulations that control their manufacture, sale, transfer, or exportation. Further, the Commission’s analysis found many instances of sales listing these devices, some of which were of industrial grade, on online business-to-business websites.

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243 Interview 44, September 14, 2021.

244 Interview 20, August 16, 2021.
### Table F.3
Comparison of Tableting Regulations

<table>
<thead>
<tr>
<th>Country</th>
<th>Tableting Equipment Legislation</th>
<th>Monitoring Tableting Equipment</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>Specific rules and regulations</td>
<td>Appears they are probably enforced, but the &quot;regulatory changes are relatively recent, [and] there is not much information about their effectiveness and enforcement.&quot;</td>
<td>Federal registration requirement for imports. Provinces of British Columbia and Alberta have specific rules, which appear to be relatively new and exceed federal rules in registering transfer or possession of machines. Had national legislation in 2017 on importing of devices into Canada. Regulates tablet, gel, and pill presses, molds, dies, and punches, as well as pharmaceutical mixers and/or blenders.</td>
</tr>
<tr>
<td>India</td>
<td>No specific legislation</td>
<td>Not clear</td>
<td>Does not appear that there are laws regulating or scheduling ownership of tablet machines or pill presses. There are laws relating to how to manufacture tablets and capsules for oral consumption.</td>
</tr>
<tr>
<td>Mexico</td>
<td>Specific rules and regulations</td>
<td>Not clear if these rules are applied frequently, outside of using other laws to seize equipment used in illicit narcotics manufacturing.</td>
<td>Rules focusing on “controlling the production, preparation, sale, purchase, transport, storage, and distribution” of tablet machines with set rules on commercial use and penalties for violating rules. Companies producing tablet presses are required to keep records on these presses for three years.</td>
</tr>
<tr>
<td>Myanmar</td>
<td>No specific legislation</td>
<td>Government seizes tableting machines during drug raids.</td>
<td>While producing illegal narcotics is against the law, it does not appear machinery to produce pills is regulated. Appears government/authorities are able to regulate “drug-making materials” but that this law has not been applied to tablet machines.</td>
</tr>
<tr>
<td>PRC</td>
<td>No specific legislation</td>
<td>Chinese authorities appear to investigate unauthorized possession of tableting equipment.</td>
<td>Could be included in legal requirements to register &quot;leases or transfers of certain equipment used to make drugs&quot; through drug control laws. But no specific legislation exists.</td>
</tr>
</tbody>
</table>

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*Table F.3 continued...*
<table>
<thead>
<tr>
<th>Country</th>
<th>Tableting Equipment Legislation</th>
<th>Monitoring Tableting Equipment</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>Specific rules and regulations&lt;sup&gt;g&lt;/sup&gt;</td>
<td>Appears to monitor sale and purchasing of such equipment</td>
<td>Those who purchase or sell “pill presses or encapsulating machines” are legally required to “report these transactions to [the] DEA.”&lt;sup&gt;h&lt;/sup&gt; For those imported to the United States, those not imported with proper designation to the U.S. authorities are “subject to interception, seizure, and destruction by U.S. Customs and Border Protection.”&lt;sup&gt;i&lt;/sup&gt; They might also be seized by the DEA.</td>
</tr>
</tbody>
</table>

NOTES:


Precursor Regulations

Beyond regulating fentanyl and its analogues, and the machinery to produce tablets, the precursor chemicals that can be used to make synthetic opioids can also be subject to regulation. However, the sheer number of precursors and potential precursors makes regulation challenging, given that precursors have legitimate uses in the manufacture of many other compounds.

State parties to the international conventions are required to control the fentanyl precursors that are listed per the conventions. Presently, this includes NPP and 4-ANPP, which were elevated to international control in 2017. With the exception of Myanmar’s fentanyl scheduling, which could not be verified, all countries analyzed here have elevated these two fentanyl precursors to national control, which restricts access to these chemicals and places additional reporting requirements on their movements or trade. That said, several other precursor chemicals that can be used in the manufacture of fentanyl are not uniformly under national control, including 4-AP, 4-Piperidone, and norfentanyl.

Presently, 4-AP and norfentanyl are listed in United States drug laws. Several other countries, such as Mexico and Canada, include additional fentanyl precursors, going beyond the requirements listed in the conventions. The PRC and India have so far only complied with the listing of precursors included in the two tables of the 1988 Convention Against Illicit Traffic in Narcotic Drugs and Psychotropic Substances—though India has an additional list that includes some precursors as manufactured drugs, which can be legally produced so long as the government has provided a license to the producer. Table F.4 details the overall scope of precursor chemical controls for the countries analyzed.
### Table F.4
Comparison of Fentanyl Precursor Regulations

<table>
<thead>
<tr>
<th>Country</th>
<th>4-ANPP</th>
<th>4-AP</th>
<th>4-Piperidinone</th>
<th>Benzylfentanyl</th>
<th>Norfentanyl</th>
<th>NPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>Controlled Drugs and Substances Act (1996)(^a)</td>
<td></td>
<td>Precursor Control Regulations (2003)(^b)</td>
<td>Precursor Control Regulations (2003, added 2019)(^b)</td>
<td>Precursor Control Regulations (2003, added 2019)(^b,c)</td>
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<tr>
<td>India</td>
<td>Narcotic Drugs and Psychotropic Substances (Regulation of Controlled Substances) Order, 2013 (added in 2020)(^a)</td>
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<tr>
<td>Mexico</td>
<td>The Federal Law for the Control of Chemical Precursors, Essential Chemical Products, and Machines for Development of Capsules, Tablets, and/or Pills (1997, added 2017)(^f,g)</td>
<td>The Federal Law for the Control of Chemical Precursors, Essential Chemical Products, and Machines for Development of Capsules, Tablets, and/or Pills (1997, added 2021)(^f,h)</td>
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<tr>
<td>PRC</td>
<td>Regulation on Administration of Precursor Chemicals (2005, added in 2018)(^d)</td>
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<tr>
<td></td>
<td>Narcotic Drugs and Psychotropic Substances (Regulation of Controlled Substances) Order, 2013 (added in 2020)(^a)</td>
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<tr>
<td>Country</td>
<td>4-ANPP</td>
<td>4-AP</td>
<td>4-Piperidinone</td>
<td>Benzylfentanyl</td>
<td>Norfentanyl</td>
<td>NPP</td>
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<tr>
<td>Inter-national</td>
<td>United Nations Convention</td>
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<td></td>
<td>Against Illicit Traffic In</td>
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<td>Narcotic Drugs and</td>
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<td></td>
<td>Psychotropic Substances,</td>
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<td></td>
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<tr>
<td></td>
<td>1988 (added in 2017)</td>
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</tbody>
</table>

**NOTES:**

- **a** Statutes of Canada, 1996, Chapter 19, Controlled Drugs and Substances Act, assented to June 20, 1996.
- **b** Consolidated Regulations of Canada, Precursor Control Regulations, SOR/2002-359.
- **c** Governor in Council, Canada, “Regulations Amending the Narcotic Control Regulations and the Precursor Control Regulations (Fentanyl and Amphetamines): SOR/2019-120,”
- **e** Department of Revenue, Ministry of Finance, Government of India, “The Narcotic Drugs and Psychotropic Substances (Regulation of Controlled Substances) Order, 2013,”
  *March 26, 2013; Department of Revenue, Ministry of Finance, Government of India, “Narcotic Drugs and Psychotropic Substances (Regulation of Controlled Substances) Amendment Order, 2020,” August 26, 2020.*
- **f** Federal law for the control of chemical precursors, essential chemical products, and machines for development of capsules, tablets, and/or pills (Cámara de Diputados, Congreso de la Unión, “Ley federal para el control de precursores químicos, productos químicos esenciales y máquinas para elaborar cápsulas, tabletas y/o comprimidos,”
  *December 26, 1997.*
- **g** Accord by which the substances N-phenethyl-4-piperidone (NPP) and 4-anilino-N-phenethylpiperidine (ANPP) are added to the list of classification referred to in Section I, Article 4, of the federal law for the control of chemical precursors, essential chemical products, and machines for development of capsules, tablets, and/or pills (Secretaría de Gobernación, “Acuerdo por el que se adicionan las substancias N-fenetil-4-piperidona (NPP) y 4-anilino-N-fenetilpiperidina (ANPP), al listado de la clasificación a que se refiere la fracción I, del artículo 4, de la Ley Federal para el Control de Precursores Químicos, Productos Químicos Esenciales y Máquinas para Elaborar Cápsulas, Tabletas y/o Comprimidos; y se consideran estupefacientes comprendidos en el artículo 234, de la Ley General de Salud,”
  *Diario Oficial de la Federación, July 18, 2017.*
- **h** Accord by which the substances N-Phenyl-4-piperidinamine (4-AP), N-Phenyl-4-piperidinamine dihydrochloride (4-AP), Propionic anhydride and Propionyl chloride are added to the list of the classification referred to in Section I, Article 4, of the federal law for the control of chemical precursors, essential chemical products, and machines for development of capsules, tablets, and/or pills; they are considered narcotics included in Article 234 of the General Health Law (Secretaría de Gobernación, “Acuerdo por el que se adicionan las substancias N-Fenil-4-piperidina (4-AP), Diclorhidrato de N-Fenil-4-piperidina (4-AP), Anhídrido propiónico y Cloruro de propionilo), al listado de la clasificación a que se refiere la fracción I, del artículo 4, de la Ley Federal para el Control de Precursores Químicos, Productos Químicos Esenciales y Máquinas para Elaborar Cápsulas, Tabletas y/o Comprimidos; y se consideran estupefacientes comprendidos en el artículo 234, de la Ley General de Salud,”
  *Diario Oficial de la Federación, May 13, 2021.*
- **i** Controlled Substances Act (Public Law 91-513, Comprehensive Drug Abuse Prevention and Control Act of 1970, October 27, 1970, Title II, Control and Enforcement).
<table>
<thead>
<tr>
<th>Country</th>
<th>4-ANPP</th>
<th>4-AP</th>
<th>4-Piperidinone</th>
<th>Benzylfentanyl</th>
<th>Norfentanyl</th>
<th>NPP</th>
</tr>
</thead>
</table>


o. International Narcotics Control Board, United Nations, “Notification from the President of the International Narcotics Control Board to the Chair of the Commission on Narcotic Drugs in Its Sixtieth Session Concerning the Scheduling of 4-Anilino-N-Phenethylpiperidine (ANPP) and N-Phenethyl-4-Piperidone (NPP) Under the United Nations Convention Against Illicit Traffic in Narcotic Drugs and Psychotropic Substances of 1988,” Vienna, INCB 114 (1-1) CND, February 1, 2017.
Regulations and Illegal Markets in Comparative Perspective

This appendix provides a picture of illegal synthetic opioids across five countries—their regulatory design, levels of governance, and the extent to which each is a source of synthetic opioids illegally imported to the United States. The picture is necessarily incomplete, because governments and NGOs might not have the full picture of illegal activity, or they could have incentives to underreport. Some general observations can be drawn from the country accounts, despite the limited picture of the illegal synthetic opioid trade.

Scheduling of synthetic opioids and their precursors is associated with reduced seizures in some countries. However, seizure data do not provide a full picture of the illegal trade. Furthermore, corruption or national institutional priorities could limit robust oversight or the implementation and execution of new rules or regulations. In other instances, producers simply move to uncontrolled chemicals to avoid running afoul of the law or to avoid detection and interdiction. An examination of regulatory efforts and authorities offers some understanding of the national environments for countries examined.

Given the size of the PRC’s pharmaceutical industry and reports that precursors manufactured there make their way to Mexico for the illegal production of synthetic opioids, further industry oversight and compliance in the PRC is needed to ensure a more durable resolution. Efforts to control chemicals appear to shape producer behaviors but have so far not effectuated a permanent solution to the problem of production of chemicals and inputs needed in the illegal manufacture of synthetic opioids. The PRC account found, however, that Chinese state-owned enterprises do not seem to be involved in illegal manufacture of synthetic opioids, and that the PRC is concerned with its international reputation. The Chinese government has also taken some additional steps to improve regulatory oversight and extend controls over fentanyl-related substances.

Future oversight efforts may involve export controls through “know your customer” rules or other means of record-keeping and reporting. Many interviewees noted significant and positive steps made by the Chinese government, exemplified by the 2019 decision to schedule fentanyl-related substances. However, further cooperation with the United States may be challenging if the PRC does not perceive itself to have a domestic synthetic opioid abuse problem or if the PRC does not perceive cooperation to result in gains in other policy areas.

The appendix provides a picture of the current illegal trade, but there is the potential for new manufacturers of synthetic opioids or precursors to emerge. Because of the regular production of synthetic drugs in Myanmar, authorities are concerned that it might be only a matter of time before traffickers there, some of whom have links through existing heroin smuggling routes, begin to manufacture fentanyl. Furthermore, it is possible that a significant and effective crackdown by Beijing could relocate illegal drug production to Myanmar or India. Past relocation of production of methamphetamine from Thailand in the 1990s and from the PRC in the 2010s to Myanmar serve as past examples of production movements into the country and could be a model for future shifts in production for criminal and armed actors in the region. India’s large pharmaceutical and chemical sectors may also present opportunities for TCOs or firms willing to ignore rules over the production and handling of inputs needed to manufacture fentanyl. Authorities in Mexico and India have reported several events of unlawful exportation of fentanyl or controlled precursor chemicals.

Developments in Canada offer an important insight for the United States. Since 2019, there has been a noted rise in the detection of clandestine fentanyl labs in that country. Criminals there have started importing precursor chemicals, which coincides with the PRC’s listing of all fentanyl-related compounds. Illegal domestic manufacturing along similar lines could attract criminals in the United States.
Appendix G

VULNERABILITIES IN THE DETECTION OF ILLEGALLY IMPORTED SYNTHETIC OPIOIDS AT THE BORDER OR MAIL AND EXPRESS CONSIGNMENT FACILITIES

This appendix provides a description of primary pathways and nodes in the illegal distribution of synthetic opioids in the United States through legitimate shipping networks and highlights key challenges and limitations that will be confronted when taking steps to reduce access into the United States through these networks. Illegally imported synthetic opioids are discussed in Appendix B. Briefly, these substances generally arrive into the United States through three pathways: (1) the international mail system (e.g., Express Mail Service [EMS] or letter post); (2) express consignment carriers (ECCs) such as FedEx, UPS, and DHL; or (3) cross-border smuggling operations. That said, the flows through each of these vectors has changed, and cross-border smuggling appears to be the main source of illegally produced synthetic opioids since 2019.

METHODS

Analysis in this section is based on a review of public documents and stakeholder interviews. Literature searched includes the Congressional Research Service, the Government Accountability Office (GAO), and the Office of Inspector General (OIG) reports, as well as congressional testimony and public documents from the U.S. Department of Homeland Security (DHS), U.S. Customs and Border Protection (CBP), the U.S. Postal Service (USPS), and other stakeholders that include reference to opioids, fentanyl, the Synthetics Trafficking and Overdose Prevention Act (STOP Act), Advance Electronic Data (AED), the shipment of illicit substances in the mail or ECC networks, the detection of opioids, and limitations to the interdiction of opioids. Databases used include Google, Google Scholar, Oversight.gov (a database of OIG reports for all government agencies),

1 Mail distribution from the People’s Republic of China (PRC) has also been identified as a leading source of synthetic opioids in other countries, such as England (Owen Bowden-Jones, chair, Advisory Council on the Misuse of Drugs, Home Office, United Kingdom; and Simon Thomas, chair, New Psychoactive Substance Committee, Advisory Council on the Misuse of Drugs, Home Office, United Kingdom, “Re: ACMD Report—Misuse of Fentanyl and Fentanyl Analogues,” letter to Priti Patel, home secretary, London, UK, January 3, 2020) and the European Union (EU) as a whole, as well as Canada, although domestic production is now the main source of fentanyl in British Columbia and possibly other provinces. See European Monitoring Centre for Drugs and Drug Addiction and Europol, EU Drug Markets Report 2019, Luxembourg: Publications Office of the European Union, 2019; see also Claire Brownell, “For Fentanyl Importers, Canada Post Is the Shipping Method of Choice,” Maclean’s, March 7, 2019.

2 When referring to any item handled by USPS—including letters and packages—the Commission uses the term mail. When referring specifically to items handled by express consignment carriers (ECCs), the Commission uses the term express cargo.
VULNERABILITIES IN THE DETECTION OF ILLEGALLY IMPORTED SYNTHETIC OPIOIDS

Govinfo.gov (government and congressional documents), GAO.gov, the Homeland Security Digital Library, and the Defense Technical Information Center. Key search topics initially included the following:

- reports or documentation of USPS and private courier screening and detection capabilities
- USPS, UPS, FedEx, DHL, and DHS reports on drug detection and/or seizure processes
- CBP reports of detection and interdiction capacity and practices
- reports on the use of AED on internationally shipped packages
- U.S. Department of Justice (DOJ), congressional, and federal agency reports and testimonies on opioid detection and interdiction success and limitations.

Additional literature topics were identified based on the results of the initial search, including documents related to the STOP Act and related content in the Federal Register. All documents used in the analysis described in this section are publicly available. Therefore, this section does not include restricted details that could enhance analysis, such as which specific countries are providing the least AED, which specific countries are currently sending opioids through the mail and ECC systems, what the sensitivity limits of automated detection devices are, what specific information and algorithms are used by the Automated Targeting System (ATS), and information about the business practices of ECCs.

Interviews were conducted with representatives from the U.S. Postal Inspection Service (USPIS), CBP, and High Intensity Drug Trafficking Areas (HIDTAs) as key stakeholders at different stages of the detection process in order to fill gaps in information available in public documents. The Commission was not able to obtain interviews with personnel from Canada Post, the Canada Border Service Agency, or ECCs, each of which supply limited public documentation for review.

FINDINGS

Figure G.1 presents a summary of key steps in the potential pathways synthetic opioids can take during this distribution. The figure distinguishes international versus domestic transportation stages of illegally manufactured synthetic opioids. Broadly, illegal drugs can be sent from an originating (or intermediary “transshipment”) country (step 1) through the international mail system or by an ECC (inbound express cargo volume is roughly 20 percent of the volume of international mail). 3 Foreign posts have limited capacity and knowledge to detect illegal drugs in their mail systems, resulting in the need for inspection at subsequent steps within the United States. Prior to the mail or express cargo’s arrival in the United States, CBP evaluates the items for risk of containing opioids or other illicit or dangerous goods using AED and other information about the items (as discussed below). Items are flagged while in transit for inspection on arrival in the United States. ECCs currently provide AED for all express cargo, while international mail currently has AED only for roughly half of the mail (step 2). 4

When the mail or express cargo arrives at one of the five international service centers (ISCs) operated by USPS or one of the 25 ECC international hubs (express consignment carrier facilities, or ECCFs), items that CBP has flagged for a customs hold are located and sent to CBP for physical inspection (step 3). Screening capacity at the largest ISC is


0.01 percent of items,\(^5\) while screening capacity at one ECCF was reported to be 0.3 percent.\(^6\) Cleared express cargo may then continue on through the domestic ECC logistics network, and new items containing illegally imported synthetic opioids may also enter the domestic ECC networks at this point (step 4). Mail continues from the ISC into the domestic mail stream, and new shipments of drugs may also enter the domestic mail at this point (step 5). Some express cargo containing illegally imported synthetic opioids may eventually enter the domestic mail system when USPS performs last-mile delivery on behalf of the ECC.\(^7\)

Figure G.1

Steps in the Detection Process for Synthetic Opioids

Alternatively, drugs are smuggled across the border\(^8\) and then sometimes enter the domestic mail or ECC systems (step 6). Screening capacity at the southwest border is reported to be 2 percent of the 73 million private vehicles, and 16 percent of the 6.4 million commercial trucks,\(^9\) with unknown capacity for the 49 million pedestrians entering annually.


\(^6\) Interview 19, August 16, 2021.

\(^7\) In some situations, ECCs contract with USPS to make last-mile delivery of packages to locations that are beyond their own networks, where it is more cost-effective to use the USPS delivery network.

\(^8\) Primarily the southwest border or, to a much lesser extent, the Canadian border.

Detection techniques used in these steps generally include predictive analytic models based on data about the package, automated scanning of unopened packages to identify their contents, use of drug-sniffing canines, and direct examination of the contents of packages once opened using electronic hand scanners or testing strips.

However, challenges to detection remain because of

- the immense number of international and domestic packages
- current limitations of automated scanning technology
- Fourth Amendment protections against warrantless searches applicable to items sent within the United States.

In the near term, further development of predictive modeling using AED and other information may offer the most immediate and broadly usable approach to detection than other technological solutions. Although scanning technology holds the potential to improve the ability to detect illicit substances coming in through international pathways, Fourth Amendment protections greatly limit the applicability of such technology for domestic use.

Detection of synthetic opioids smuggled across the border remains a key challenge. A significant portion of contraband synthetic opioids identified within the domestic mail system is believed to have been smuggled over the southwest border, then entered into the postal network close to the border.\(^\text{10}\)

In the remainder of this appendix, the Commission discusses the vulnerabilities identified for each of the key steps in Figure G.1. The discussion of each step begins with a listing of the primary vulnerabilities, their causes, and their impact.

### VULNERABILITIES IN DETECTION OF SYNTHETIC OPIOIDS BY FOREIGN SENDERS (STEP 1)

<table>
<thead>
<tr>
<th>Primary Vulnerabilities</th>
<th>Causes of Vulnerabilities</th>
<th>Impact of Vulnerabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illegally manufactured synthetic opioids are not identified or stopped before entering the global mail network or ECC networks in foreign countries.</td>
<td>There is a lack of detection capacity relative to the large volume of items and limited training in foreign countries.</td>
<td>Domestic law enforcement must detect contraband opioids in international mail and express cargo on arrival in the United States.</td>
</tr>
</tbody>
</table>

The first line of defense for preventing synthetic opioids and their precursor chemicals from entering the United States lies with the capabilities and efforts of the originating (or intermediary) countries to detect contraband before it is shipped. However, illegally produced synthetic opioids are often not identified or prevented from entering the global mail and express cargo networks in foreign countries, largely because of a lack of knowledge and capacity, representing a gap in detection. Sometimes detection difficulties have to do with the nature of fentanyl analogues or other novel synthetic opioids that are not controlled and thus are not strictly prohibited in national or international law. As a consequence, illicit substances must be detected and interdicted on arrival in the United States.

\(^\text{10}\) Interview 6, August 2, 2021.
The United States maintains the largest postal system in the world and is the only country with a postal service that contains its own law enforcement service. Both traits contribute to the United States’ significant leadership role on issues related to global postal security, including training and capacity building. The United States continues to work in conjunction with other countries to enhance their efforts and capabilities in this regard. Despite efforts to increase awareness of the significant flow of synthetic opioids through the global mail system and to build global postal security capacity, the need for continued training, provision of support materials, information-sharing, and technical assistance is ongoing.

The United Nations Office on Drugs and Crime (UNODC) has called for rapid information-sharing among international stakeholders about the emergence of new substances, as well as provision of technical assistance with setting up national systems in countries where there is a lack of capacity to identify new synthetic opioids. Rapid information-sharing about new analogues can enhance the control efforts of novel synthetic opioids or related chemicals, granting law enforcement the power to interdict items. UNODC also notes that a complementary aspect of international information-sharing is the cross-border sharing of investment in analytical techniques, such as nuclear magnetic resonance spectroscopy, and the updating of existing laboratory and field-based forensic analytical technologies to enhance the ability of foreign countries to identify the presence of new synthetic opioids.

The Role of the Universal Postal Union and U.S. Postal Service in Capacity Building

Much of the capacity-building effort abroad is led by the USPIS and takes place through the Universal Postal Union (UPU), a specialized agency of the United Nations that governs the international movement of mail among its 192 member countries under the Universal Postal Convention. USPIS works closely with the U.S. Department of State, which has statutory responsibility for the formulation, coordination, and oversight of foreign policy related to international postal services. UPU also provides technical assistance and training designed to increase cooperation against trafficking and improve the detection and seizure of illicit substances.

USPIS is an active member of UPU; much of the U.S. effort is focused on advancing AED requirements (discussed later in this section), and USPS is now making investments of roughly $18 million over five years for postal security and the provision of AED. USPIS also works to expand the security and screening capacity of foreign posts. With regard to capacity building related to synthetic opioids specifically, UPU views knowledge development and awareness of the issue of illicit substances in the mail as the primary goal, rather than providing technological solutions. Importantly, the need for training and review of adherence to new UPU security standards, particularly

11 While some countries have postal inspectors within their postal services, those inspectors must coordinate with separate law enforcement. For example, Canadian police must ask a Canada Post postal inspector to review packages on a case-by-case basis; if the package is determined to be “nonmailable,” then the inspectors can open it and turn it over to the police (Claire Brownell, “For Fentanyl Importers, Canada Post Is the Shipping Method of Choice,” Maclean’s, March 7, 2019).


13 Pursuant to U.S. Code, Title 39, Postal Service; Part I, General; Chapter 4, General Authority; Section 407, International Postal Arrangements, the Secretary of State is responsible for the formulation, coordination, and oversight of foreign policy related to the international postal service and has the power to conclude postal treaties, conventions, and amendments related to the same. In addition, in carrying out the aforementioned responsibilities, the Secretary of State shall coordinate with other agencies as appropriate and include appropriate liaisons with the USPS. See 39 U.S.C. § 407(b).


related to the transportation of illegal drugs, has surpassed the availability of security experts, and work must be
done to build capacity, especially in developing regions.\textsuperscript{16}

ECC efforts to screen inbound international express cargo are focused on detecting explosives, not illegal
substances.\textsuperscript{17} However, ECCs do work with CBP to identify and screen packages for narcotics and contraband once they have arrived in the United States (step 3).

**VULNERABILITIES IN CBP ABILITY TO ASSESS RISK FOR ALL INCOMING INTERNATIONAL MAIL (STEP 2)**

**Primary Vulnerabilities**
CBP cannot assess risk for all incoming international mail prior to domestic arrival.

**Causes of Vulnerabilities**
The STOP Act mandates 100-percent AED, yet AED is not provided for 45 percent of incoming international mail because of the lack of foreign post capacity; labor-intensive screening of large volumes of mail is impractical.

**Impact of Vulnerabilities**
Large quantities of international mail are not screened on arrival at ISCs.

**Importance of Advance Electronic Data**
AED typically includes information that is collected on customs declaration forms (such as sender/recipient, contents description, weight, value)\textsuperscript{18} as well as information on movement of the package through the shipping network (such as package location, timing of arrival, and flight number). AED is provided by the original shipping entity, either the ECC or the foreign post. This information is used by CBP at its National Targeting Center to target shipments posing a high risk of containing contraband for inspection on arrival in the United States through the use of its ATS, which employs predictive modeling and algorithms derived from previous experience and other intelligence on smuggling organizations and new trends in smuggling.\textsuperscript{19} The ATS draws on many law enforcement, intelligence, and other enforcement databases, including the Terrorist Screening Database, the Department of Justice’s National Crime Information Center, the Social Security Administration Death Master File, and the National Insurance Crime Bureau’s private database of stolen vehicles. ECCs have also created their own proprietary systems that allow customers to track and identify suspicious packages\textsuperscript{20} that they can refer to CBP for inspection if deemed suspicious.

As discussed in the next section, it is not feasible for CBP to check every shipment for contraband once it arrives in the United States; analysis of AED is the primary method CBP uses to help narrow down what containers and packages to inspect. Because AED can be analyzed prior to the arrival of a package, it enables CBP to place hold


\textsuperscript{17} Interview 2, July 27, 2021.


\textsuperscript{19} John Davis, “Fighting the Opioid Scourge: CBP Disrupts Flow of Illegal Opioids at Our Borders,” webpage, undated.

\textsuperscript{20} Interview 19, August 16, 2021.
requests in advance. Items flagged for a “customs hold” by CBP are then located by USPS or the ECC on arrival at IPCs, downstream hubs, or local delivery units and presented to CBP for inspection.

Through the Trade Act of 2002, Congress required ECCs to collect specific AED on all packages shipped through their networks for security purposes following the September 11, 2001, terrorist attacks. As a result, all express cargo packages have AED. ECCs are able to collect AED on all their packages because they control the item from initial receipt, even in foreign countries. In contrast, USPS has not previously been required to collect and transmit AED to CBP, primarily because USPS is wholly dependent on the foreign post to collect and transmit the AED to USPS; USPS is not involved in the initial entry of the item into the international mail system.

USPS and CBP have been conducting pilot programs since 2014 at various inbound international mail processing facilities to develop increasingly automated and sophisticated targeting systems using AED. The pilots began at the USPS ISC at John F. Kennedy (JFK) International Airport in New York City and have since expanded to include all five of USPS’s major ISCs, as well as an international mail and bulk mail facility in Jersey City, New Jersey, and the Honolulu International Airport.

Use of AED targeting has been shown to be effective. According to CBP, AED targeting increased the overall contraband seizure rate per inspection from 9.29 percent under conventional targeting to 16.26 percent in an operational pilot conducted at their processing facility at JFK. Increased automated targeting of inbound international mail and express cargo can be an essential tool to cope with increasing package volumes, rather than simply increasing manual inspections. This requires increases in AED inclusion on international mail.

The STOP Act of 2018 mandated that USPS provide AED to CBP for 100 percent of inbound international items for this purpose. However, as described in a subsequent section on Vulnerabilities in U.S. Postal Service Network’s Screening of Domestic Mail (Step 5), the ability of CBP or USPS to conduct an inspection of packages is greatly diminished once those packages leave the international processing centers, and the lack of AED hinders CBP’s ability to effectively target illegal opioids or other dangerous goods before they enter the United States.

Availability of AED for International Mail Is Limited

Although AED information is generally required by UPU and CBP on existing customs forms for international mail, many foreign posts are still using paper forms that are affixed to the package rather than digital forms. Consequently, CBP is able to evaluate all express cargo inbound through ECCs and request items for inspection but can only evaluate the percentage of inbound international mail with AED. This limitation on screening inbound items is compounded, as ECC package volume is estimated to be about 20 percent of the size of

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22 Inbound International Mail generally includes EMS (Express Mail Service, an express postal service offered by UPU members), letter post, and parcel post. Until January 1, 2020, letter post included small packets containing goods weighing up to 2.2 kg (“ePackets”); now letter post includes “documents only” and “small packets” up to 5 kg (Postal Regulatory Commission, Annual Compliance Determination Report: Fiscal Year 2020, March 29, 2021).
23 ISCs are located at New York’s JFK, O’Hare International Airport (ORD) in Chicago, Los Angeles International Airport (LAX), San Francisco International Airport (SFO), and Miami International Airport (MIA).
international mail volume, meaning large volumes of incoming international mail cannot be assessed using the National Targeting Center’s algorithms. Lack of AED on international mail packages, but not ECC express cargo, may be one reason why international shippers of illicit fentanyl prefer to use mail over ECCs.

Packages from the People’s Republic of China (PRC) represent the largest volume of inbound international packages that the United States receives. As described in Appendix B, the PRC was the leading source of fentanyl and fentanyl analogues trafficked in the United States, at least through 2019. Thus, concerted efforts by the United States were made to increase the PRC’s provision of AED on packages through bilateral agreement from a level of between 20 to 30 percent in 2018. The PRC currently provides nearly 100-percent AED on international mail and now has the highest rate of AED provision of any country. As with many countries, lack of infrastructure and capacity were originally key barriers to the provision of AED.

Currently, more than 50 countries provide some form of AED to USPS, and there has been a substantial increase in AED provision in recent years. AED provision rose from 26 percent in October 2017 and peaked immediately before the COVID-19 pandemic at 67 percent—well short of the STOP Act’s 100-percent requirement. In September 2021, UPU stated that AED was being provided for 56 percent of all items containing goods.

As noted, a key challenge to the ability of USPS to provide AED to CBP is that the sending post is responsible for the quality and quantity of AED. UPU has been laying the groundwork for increased AED capacity and provision from its member countries since 2016 with the encouragement of the United States. In April 2019, UPU promulgated new regulations to require all foreign posts to provide AED for parcels and small packets containing goods starting January 1, 2021. Postal items that were missing AED required per UPU regulations would be considered “noncompliant” and could be deemed not admissible into countries that required AED. In addition to the United States, other countries including the European Union, Australia, the PRC, Russia, Thailand, and Brazil have begun to or will require AED in the near future. In response to the large volumes of mail that still lack AED, USPS and CBP have temporarily relaxed the inadmissibility rules as detailed in a subsequent section.

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27 Interview 6, August 2, 2021.
29 Interview 6, August 2, 2021.
30 CBP and USPS interviews reported compliance of 97 and 98 percent (interview 2, July 27, 2021; interview 6, August 2, 2021).
33 Noor Adan, Universal Postal Union, “UN Toolkit on Synthetic Drugs,” web seminar, September 15, 2021.
Despite UPU regulations and associated capacity building, and the threat of impending mail disruptions that are likely for countries that do not adhere to them soon, there remains a significant lack of capability for many countries to collect and transmit AED, particularly in the developing world.\(^{35}\)

Capacity-building initiatives for developing countries led by UPU also include technical assistance in establishing their AED capabilities, such as the SECUREX project, launched in 2017, which helps countries collect and transmit AED.\(^{36}\) However, “progress to date [2020] indicates getting to 100-percent compliance will take many years.”\(^{37}\) USPS participates in these UPU programs and has agreed to pay $17.4 million over five years to help pay for these and other security projects.\(^{38}\)

Even among countries with existing AED capability, there remain challenges to overcome. A USPS OIG assessment of the quality of AED provided to USPS between October 2017 and January 2019 indicated a substantial degree of unreliable data. Thirty-four percent of packages had at least one problem with AED where data was incomplete or inaccurate; 37 percent of a subsample of AED from 2018 only matched at the ZIP Code level and did not match the ZIP+4 or full address (street name and number).\(^{39}\)

In addition to the technical challenges faced by many countries, foreign posts must also resolve operational issues, such as developing a process for creating AED on untracked packages, instituting manual entry of AED at postal retail counters, handling packages mailed at curbside collection boxes, and low customer awareness of AED requirements.

For all these reasons, AED compliance will remain a difficult challenge for many foreign posts. UPU reported that by the end of 2020, AED was not being provided by roughly one-third of high-income countries,\(^{40}\) while about half of low-income through upper-middle-income countries were not providing AED, highlighting the capacity gap by gross national income.\(^{41}\)

Further, the use of freight forwarding or other countries’ mail systems to move illegally produced synthetic opioids may remain one gap in the AED system. Although packages and parcels departing the PRC contain AED, as required for entry into the United States per the STOP Act, it is possible that traffickers or vendors reroute items through third-party countries using freight-forwarding services to get around this requirement.

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\(^{36}\) Universal Postal Union and World Customs Organization, WCO–UPU Postal Customs Guide, June 2018.


\(^{40}\) Based on gross national income per capita: low-income ($1,045 or less); lower-middle income ($1,046 to $4,095); upper-middle income ($4,096 to $12,695); high-income ($12,696 or more) (World Bank, “How Does the World Bank Classify Countries?” webpage, undated).

\(^{41}\) UPU also reported an “other countries” category that included AED on 89 percent of items, although the number and names of countries included in this category are not identified. See U.S. Customs and Border Protection, U.S. Department of Homeland Security, “Mandatory Advance Electronic Information for International Mail Shipments,” Federal Register, Vol. 86, No. 48, March 15, 2021b.
The STOP Act Addresses Compliance with AED Responsibilities

Despite USPS not directly controlling the AED it receives, the STOP Act holds USPS accountable for full compliance and calls for penalties if it violates regulations. The STOP Act required that DHS set regulations for USPS’s AED responsibilities by October 2019 and that USPS and CBP were to stop accepting international mail that did not meet AED requirements after December 31, 2020, except where remedial action (such as destruction, seizure, or correction of the failure to provide the required AED) was deemed warranted by USPS.

DHS did not promulgate the regulations by October 2019, but an interim final rule by CBP published in the Federal Register became effective on March 15, 2021.\(^42\) The interim final rule formalizes the original guidelines of the STOP Act and requires that USPS transmit comparable AED for international mail shipments that are currently required to ECCs, subject to the parameters set forth in Section 343(a)(3) of the Trade Act of 2002 through a new AED regulation, 19 C.F.R. § 145.74, or refuse shipments.\(^43\) Accepting packages without the required AED after December 31, 2020, will result in USPS being liable for $5,000 per violation; however, as provided by 19 U.S.C. § 1436(e)(2),\(^44\) the penalty will be reduced or dismissed as long as USPS is making significant progress toward compliance and a good-faith effort to comply with the rule to the extent of its current ability. CBP has indicated it will show restraint in enforcing the data submission requirements for 12 months from implementation of the rule.\(^45\) It is estimated that about 4 million pieces of mail would be refused per month if USPS turns away international mail lacking the required AED,\(^46\) and the bearer of the cost of returning the items is not clear.

STOP Act (Interim Final Rule) Limitations

Seeking increases in AED provision on international mail is one key aspect to facilitating CBP’s targeting of contraband among hundreds of millions of international packages. However, there are important vulnerabilities and loopholes in the interim final rule in addition to the considerable uncertainty about the ability of foreign posts to meet this requirement. In addition to concerns about how noncompliant packages will be handled, the interim final rule contains language that weakens its usefulness in combating illegal shipments of synthetic opioids through international mail. One potentially problematic aspect of the interim final rule is that it specifies that the new regulations about AED apply to classes of mail as defined by UPU (e.g., letter class mail, goods, parcel post), which differ from the classes used and defined by USPS (e.g., first class, priority mail, express mail) and which USPS does not have direct control over. UPU classes could potentially change or expand in the future, which would necessitate revision of regulations resulting from the interim final rule as written.

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\(^{43}\) Public Law 107-210, Trade Act of 2002, August 6, 2002; U.S. Code, Title 19, Customs Duties; Chapter 4, Tariff Act of 1930; Part I, Definitions and National Customs Automation Program; Subpart B, National Customs Automation Program; Section 1415, Mandatory Advance Electronic Information for Cargo and Other Improved Customs Reporting Procedures; Code of Federal Regulations, Title 19, Customs Duties; Chapter I, U.S. Customs and Border Protection, Department of Homeland Security; Department of the Treasury; Part 145, Mail Importations; Subpart G, Mandatory Advance Electronic Data for Mail Shipments; Section 145.74, Mandatory Advance Electronic Data (AED).

\(^{44}\) U.S. Code, Title 19, Customs Duties; Chapter 4, Tariff Act of 1930; Part II, Report, Entry, and Unlading of Vessels and Vehicles; Section 1436, Penalties for Violations of Arrival, Reporting, Entry, and Clearance Requirements.


VULNERABILITIES IN THE DETECTION OF ILLEGALLY IMPORTED SYNTHETIC OPIOIDS

An additional limitation of the current interim final rule is that it excludes “letter class mail—documents” and parcel post. The relatively slow delivery speed of parcel post may make it an unattractive option to illicit shippers, but small yet high-value shipments of synthetic opioids could be disguised as “document only” mail.

The interim final rule also contains an exclusion from AED requirements for countries that do not have the capacity to collect and transmit AED that have been assessed as representing a “low risk” for illicit shipments and account for “low volumes” of items. This exclusion could be exploited by shippers through “transshipment” of illicit items using freight-forwarding firms to send packages to the United States.

CBP estimates that annualized costs to implement the interim final rule 2019 through 2028, for both CBP and USPS, are approximately $6.1 million to each entity (plus unquantified training costs). Costs to CBP primarily reflect analysis of AED, placing holds, and upgrading software, while USPS costs primarily reflect labor related to processing CBP holds and upgrading and maintaining software. CBP also estimates that the annualized additional cost to foreign posts of implementing the interim final rule 2019–2028 (compared with developing AED capacity to meet mandatory AED requirements imposed by other countries such as planned for the European Union in the absence of the STOP Act), is $9.7 million to $11.3 million, at a discount rate of 7 percent or 3 percent (respectively); these costs result primarily from the labor required to manually enter AED.

VULNERABILITIES IN DETECTION OF SYNTHETIC OPIOIDS UPON ARRIVAL AT INTERNATIONAL SERVICE CENTERS AND EXPRESS CONSIGNMENT CARRIER FACILITIES (STEP 3)

<table>
<thead>
<tr>
<th>Primary Vulnerabilities</th>
<th>Only a tiny fraction of all mail and express cargo is inspected for contraband at ISCs and ECCFs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Causes of Vulnerabilities</td>
<td>Sheer volume of international mail and express cargo precludes manual search; automated screening technology is not currently fast enough or sensitive enough.</td>
</tr>
<tr>
<td>Impact of Vulnerabilities</td>
<td>Unknown quantities of foreign-origin opioids enter the country through legitimate shipping pathways.</td>
</tr>
</tbody>
</table>

As detailed in Appendixes B and C, the quantity of fentanyl and most other synthetic opioids being seized at international mail and express cargo facilities has declined substantially over the past several years, yet it still represented close to 200 lbs in FY 2020. Inbound international mail primarily enters the United States through

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47 Interview 6, August 2, 2021.
49 CBP argues that foreign posts would develop capacity in the absence of the STOP Act, but on a longer timeline; these estimated costs reflect the specific costs associated with developing capacity on a timeline to meet the interim final rule requirements.
one of five ISCs. CBP and USPS inspect mail originating from over 180 countries at these facilities. In 2017, USPS received 498 million international packages and 578 million in 2019. JFK receives about 60 percent of the USPS international volume, while ORD receives about 20 percent.

Inbound international express cargo is inspected by CBP at 25 established ECCFs located throughout the United States, including several colocated at ISCs and other major hubs located in Louisville, Kentucky; Memphis, Tennessee; and Cincinnati, Ohio. Items that have been flagged for inspection by CBP through the use of AED, or are identified by the ECC using their own analysis of AED and other information, are then presented to CBP. The total international volume handled by ECCs is only roughly 20 percent of the size of inbound international mail handled by USPS. In 2017, approximately 110 million inbound international express cargo packages were handled by ECCs.

CBP Inspection of Suspicious Packages and Detection Capabilities

CBP has the authority to conduct inspection of mail and express cargo at the border without a warrant, according to Title 19 of the Code of Federal Regulations and other federal statutes and regulations. This effectively means that incoming international mail and express cargo can be searched without probable cause or a warrant at ISCs and IMFs. This authority allows CBP to use a much broader range of screening approaches on incoming international mail and express cargo than is permitted for screening of domestic mail by USPIS, highlighting the importance and opportunity of this stage of detection to the interdiction of foreign-origin fentanyl.

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52 ISC is the USPS term for these processing facilities. CBP refers to international inspection facilities as international mail facilities (IMFs), which are effectively located at or near the ISCs, as well as four smaller USPS facilities that receive international mail in Honolulu, Hawaii; Newark, New Jersey; San Juan, Puerto Rico; and St. Thomas, U.S. Virgin Islands.


57 Interview 19, August 16, 2021.


59 See, for example, Code of Federal Regulations, Title 19, Customs Duties; Chapter I, U.S. Customs and Border Protection, Department of Homeland Security; Department of the Treasury; Part 145, Mail Importations; Subpart A, General Provisions; Section 145.2, Mail Subject to Customs Examination, ¶ (b), generally.

60 Unless exempt by diplomatic status.

61 This step does not consider international maritime freight cargo. Although there is a high likelihood of widespread maritime smuggling, the data do not yet identify significant amounts moving through maritime routes directly into the United States. Less than 1 percent of fentanyl seizures between 2016 and 2017 by CBP involved a method other than mail or land trafficking, and before 2019, there was only one seizure at a maritime port (June 2018, Port of Philadelphia) (Steven Dudley, Deborah Bonello, Jaime López-Aranda, Mario Moreno, Tristan Clavel, Bjorn Kjelstad, and Juan José Restrepo, “Mexico’s Role in the Deadly Rise of Fentanyl,” Washington, D.C.: Wilson Center, February 2019).
When CBP interdicts suspicious packages at an IMF or ECCF, officers then use nonintrusive inspection (NII) techniques (including X-ray and gamma-ray imaging) that do not involve opening the package, narcotics detection canines, and intrusive inspection techniques such as chemical testing that involve opening the package to detect and presumptively identify illicit drugs. If the presumptive test suggests the package contains illicit materials, it is seized and detained for further analysis. If the substance is confirmed to be controlled, CBP’s National Targeting Center adds information from the seizure into its database to improve future targeting efforts.62

In order to facilitate more efficient high-volume NII, X-ray screening technology is currently being enhanced with algorithms to automatically detect illicit substances and other threats within items; operators are then alerted that additional inspection is required.63 A major innovation in this regard is the Opioid Detection Challenge grand-prize winning technology developed by Integrated Defense and Security Solutions (IDSS), which combines a 3-D X-ray computed tomography scanner with automated detection algorithms to detect abnormalities in the scanned item’s features and physical properties.64

Several of IDSS’s machines are now in use at JFK’s IMF and an ECCF in Memphis, Tennessee, to serve as a pilot to evaluate their functionality in mail and express cargo environments. While the accuracy of IDSS’s machines is reportedly greater than 95 percent,65 the speed and sensitivity of the scanners are currently too low to provide a broad solution to the challenges of screening millions of items each day. Each IDSS machine can scan only up to 1,000 items an hour, and the machines must be capable of detecting the presence of very small weights of highly pure fentanyl that are possible within mail and express cargo packages. A range of related scanning technologies are also in development, but in the DHS’s Science and Technology Directorate’s view, they are still several years away from operational assessment and validation.66

Narcotic detection canines represent a key NII asset for CBP. All CBP Office of Field Operation (OFO)67 canines and canine handlers have completed a comprehensive fentanyl odor-recognition test to validate the canine’s ability to detect fentanyl and its analogues since 2018.68 In December 2020, OFO had 453 canine teams,69 of which IMFs had access to 58 canine teams shared with other areas of the ports of entry, and with ten teams assigned to

67 OFO is the law enforcement component within CBP responsible for carrying out CBP’s border security mission at all ports of entry (POEs). OFO operates in 328 POEs and 19 ECCFs, among other facilities.
ECCFs. At that time, although Congress mandated that 15 canine teams be assigned specifically to IMFs, eight were still awaiting training because of COVID-19–related delays.

Once NII determines that a package should be opened, an intrusive inspection to presumptively identify the substance is conducted by CBP. The high purity of fentanyl in the international mail and express cargo systems allows CBP officers to use a variety of devices and handheld narcotics analyzers (e.g., Fourier-transform infrared spectroscopy, Raman spectroscopy) to obtain a presumptive (or inconclusive) result, which can be confirmed by law enforcement laboratories. The 2018 INTERDICT Act required CBP to increase the number of chemical screening devices available to interdict fentanyl and other synthetic opioids as well as other illicit drugs. Common presumptive testing methods include (1) handheld electronic devices, (2) color-changing test kits, and (3) fentanyl test strips.

Ideally, an intrusive inspection equipment is easy to use and provides a yes-no-maybe match for a compound of interest. One challenge faced by the intrusive scanners is that they rely on reference library data that must constantly be kept up to date given the continued development of new analogues. Similar limitations in detecting new fentanyl analogues apply to testing strips. While a presumptive test can be used to establish probable cause for arrest or seizure, confirmatory testing is required for federal prosecution.

Lateral flow immunoassays test kits are also used by CBP OFO. These kits consist of papers strips with antibodies. Commercial off-the-shelf test kits are available for fentanyl, fentanyl analogues, and other types of drugs.

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73 As of October 2020, there were 334 handheld electronic devices deployed to POEs, and at least one in each field office. Fifty-six were deployed to U.S. Border Patrol stations and checkpoints, including one in all sectors and major checkpoints along the Southern border (U.S. Government Accountability Office, Border Security: CBP Has Taken Actions to Help Ensure Timely and Accurate Field Testing of Suspected Illicit Drugs, Washington, D.C., GAO-21-286, April 26, 2021).

74 As of October 2020, test kits were available at all POE and Border Patrol stations and checkpoints. These kits develop color in the presence of certain drugs. Different kits are intended for different types of drugs (e.g., cocaine versus heroin). CBP policy identifies the specific product names of color-changing test kits that CBP officers and agents can use, based on CBP’s assessment that they are the most reliable (U.S. Government Accountability Office, Border Security: CBP Has Taken Actions to Help Ensure Timely and Accurate Field Testing of Suspected Illicit Drugs, Washington, D.C., GAO-21-286, April 26, 2021).

75 More than 1,400 fentanyl test strips were deployed to POE and all major Border Patrol checkpoints. These test strips are used when fentanyl is suspected (U.S. Government Accountability Office, Border Security: CBP Has Taken Actions to Help Ensure Timely and Accurate Field Testing of Suspected Illicit Drugs, Washington, D.C., GAO-21-286, April 26, 2021).


CBP allocates presumptive testing equipment to the field based on factors such as threat level, amount of drug seizures, and geographic considerations. International mail facilities are generally first priority for the deployment of equipment, with POEs along the southwest border the second priority.79

Because of the enormous number of international packages being processed at IMFs and ECCFs daily, it is impossible to manually inspect or automatically scan even a fraction of items. For instance, at one major ECCF global air hub, which processes 500,000 parcels a day, only a fraction of items are physically inspected. Of more than 910 cargo planes per week at the hub, CBP is able to scan and inspect the items from only three planes.80 The challenge to manual searches posed by large volumes of packages can be partly addressed through the use of predictive algorithms and other modeling based on AED to narrow down the search.

However, even the use of analytic algorithms can only target a tiny percentage of all incoming parcels for inspection, limited by what USPS can reasonably provide to CBP on a daily basis, and cannot ensure significant deterrence of contraband through the mail. For example, in 2018, CBP only targeted 0.01 percent of all incoming mail for inspection at JFK’s IMF using its predictive algorithm,81 and overall CBP inspected only about 100 items per day out of the 1.3 million inbound international packages that USPS handled daily.82 While AED is available at lower rates for mail than for express cargo, the relative volume of mail to express cargo suggests that the total percentage of all inbound items that are selected for inspection as a result of identification by CBP’s algorithm, automatic scans, or hand or canine searches is very small, particularly in light of time and staffing constraints.

Additional Detection Challenges for International Mail and Express Cargo

The primary limitations that have been described at this point in the detection pathway pertain to the identification of suspicious packages given the sheer volume of mail and express cargo, which can be partially mitigated through the use of predictive algorithms to narrow the search, automated scanners that can screen packages for illicit substances at high speeds, and intrusive inspection devices with current reference libraries. However, several minor limitations offer room for improvement as well.

First, not all inbound items CBP requests for presentment are eventually provided to CBP, as locating the targeted items once they arrive at ISCs can be challenging.83 During 2020, 6 percent of customs holds were not presented to CBP by USPS,84 although this represents a significant improvement from 2016 when 33 percent of hold requests were not presented.85 A recent USPIS OIG audit of one major ISC identified a series of operational issues that

80 Interview 19, August 16, 2021.
83 If USPS does not capture the hold at the ISC, it also has procedures and equipment to capture the item further into the delivery network and present them to CBP for review (Office of Inspector General, U.S. Postal Service, Advance Electronic Data Holds and Reliability, Audit Report MS-AR-19-002, July 12, 2019).
delayed the processing of international packages such that the oldest arriving and/or most time-sensitive packages were not prioritized for presentation to CBP, and some containers of customs-hold items were still awaiting presentation after 25 days. 86 CBP is reportedly working with ISC staff on managing international mail and is developing an International Mail Dashboard to assist in the tracking of CBP targeting activity in each ISC. 87 It is not clear that improved AED provision through the STOP Act will affect presentment rates, although increased volumes of customs-hold requests will require increased staffing resources.

Compared with ECCFs, ISC equipment is old and inefficient and hinders CBP inspection of international mail. 88 CBP has recently stated that replacement conveyor belt systems that provide improved sorting and movement as well as barcode scanning and 3-D X-ray technology are needed in the ISCs. 89

Given the large volumes of mail and express cargo received at ISCs and ECCFs, items need to be screened at high speed to minimize significant disruptions to processing and delivery times. Mass use of automated screening technology is not currently feasible in these high-volume settings for this reason, as well as limitations on sensitivity. Thus, the refinement of targeting analyses using AED offers more potential for improved detection and interdiction in the near term by reducing the number of items requiring physical search from among the millions of items inbound every day, while continued development of automated screening holds promise for detection activities at ISCs and ECCFs in the future.

VULNERABILITIES IN SCREENING OF EXPRESS CONSIGNMENT CARRIER NETWORKS (STEP 4)

Primary Vulnerabilities  Domestic express cargo is largely not screened by ECCs; knowledge of other inspection activities is limited; CBP has limited ability to inspect domestic express cargo.

Causes of Vulnerabilities  Law enforcement lacks authority to conduct domestic express cargo screening; ECCs protect business practice information; ECCs may not exercise their authority to conduct thorough inspection of domestic express cargo.

Impact of Vulnerabilities  Unknown quantities of synthetic opioids travel through domestic ECC networks with limited detection and interdiction efforts.

Once express cargo has been cleared for release from the inbound international hubs by CBP, it continues on through the domestic ECC networks. Packages containing synthetic opioids may also enter the ECC network domestically. Screening efforts are substantially reduced for domestic networks compared with inbound international arrivals, and there may be untapped potential to expand screening of domestic express cargo. A current concern is that fentanyl that has been smuggled over the southwest border is sent by domestic ECC from

VULNERABILITIES IN THE DETECTION OF ILLEGALLY IMPORTED SYNTHETIC OPIOIDS

border states where it passes through major ECC hubs and distributed elsewhere.\textsuperscript{90} However, the major ECCs do not conduct investigative scans of domestic items,\textsuperscript{91} meaning that once inbound international cargo leaves the initial processing point, or when items originate domestically, detection must rely on other methods. Levels of cooperation between specific ECCs and law enforcement vary, but the presence of AED for all express cargo does facilitate additional targeting of selected items by ECCs.\textsuperscript{92}

Detailed information on the profiling and targeting techniques used by ECCs is not publicly available, but algorithms using AED and other information (the package origin, packaging materials, and the number of times a parcel’s tracking information is checked are prime factors), similar to the approach used by CBP for inbound international items, may be used. While AED is not required for domestic mail, some is collected for domestic express cargo, which provides a deeper level of useful screening information for ECCs compared with the mail. For example, a likely illegal distributor of synthetic opioids based in Pennsylvania was identified using AED from 120 packages sent from the same address; other likely distributors also ordered items from the same Pennsylvania address.\textsuperscript{93} ECCs can use their own parcel interdiction teams and pair with law enforcement at local levels, but screening at small local sorting facilities is labor-intensive and focused on the local area, compared with the national or regional focus of the large hubs.\textsuperscript{94} It is not known precisely how ECC algorithms for detecting suspicious packages vary from those used by other ECCs, CBP, or USPIS, nor are the accuracies of relative contraband identification rates across entities known.

In some situations, ECCs contract with USPS to make last-mile delivery of packages to locations that are beyond their own networks, where it is more cost-effective to use the USPS delivery network. The three largest last-mile customers are Amazon.com, UPS, and FedEx, whose combined last-mile parcels accounted for 32 percent of USPS parcel volume in 2019.\textsuperscript{95} An earlier study suggested that USPS screening for suspicious packages in general was more thorough than the screening performed by ECCs,\textsuperscript{96} but USPIS indicated that last-mile deliveries are not a significant portion of their seizures.\textsuperscript{97}

ECC “Terms and Conditions” explicitly state that they maintain the right to open and inspect any package and its contents.\textsuperscript{98} It is not known whether or how often this right is exercised. Scanner detection technology in development and already installed at ISCs could be used for screening domestic express cargo at major hubs, although the Commission was unable to confirm whether this practice is currently in use. Further, law

\textsuperscript{90} Vic Brown, Appalachia High Intensity Drug Trafficking Area, “Appalachia HIDTA Parcel Interdiction,” presentation, audience and date unknown.

\textsuperscript{91} Interview 19, August 16, 2021.

\textsuperscript{92} Interview 19, August 16, 2021.


\textsuperscript{94} Vic Brown, Appalachia High Intensity Drug Trafficking Area, “Appalachia HIDTA Parcel Interdiction,” presentation, audience and date unknown.


\textsuperscript{97} Interview 6, August 2, 2021.

\textsuperscript{98} UPS “reserves the right to open and inspect any package tendered to it for transportation” (United Parcel Service, “Terms and Conditions of Ground Service,” undated). “Without notice, FedEx Ground may, at our sole discretion, open and inspect any package and its contents tendered to it for transport” (FedEx, “FedEx Ground Terms and Conditions,” effective February 28, 2005).
enforcement may only enter ECC facilities for the purpose of inspecting parcels by the invitation of the ECC, and legislation would be required to grant CBP or domestic law enforcement the ability to enter ECC facilities for the purposes of parcel inspection in a manner similar to CBP’s access to international express cargo. Additionally, ECCs do not share information on problem shippers with CBP, USPS, or other ECCs, although both FedEx and UPS maintain lists of people and entities that are not allowed to ship packages through their networks.99

VULNERABILITIES IN U.S. POSTAL SERVICE NETWORK’S SCREENING OF DOMESTIC MAIL (STEP 5)

Primary Vulnerabilities  USPS screening of domestic mail is generally limited to information about the package, and inspection methods generally cannot include automated content scans.

Causes of Vulnerabilities  The Fourth Amendment prohibits unreasonable searches and seizures; the large volume of items makes systematic inspection impossible.

Impact of Vulnerabilities  Unknown quantities of synthetic opioids are distributed through USPS.

Once inbound international mail is cleared to leave the ISC, the items become the jurisdiction of USPIS rather than CBP. As detailed below, because of Fourth Amendment protections, USPIS has substantially less power to screen domestic mail than CBP has at ports of entry, which poses a substantial gap in detection and interdiction capability in theory but not in practice.

USPS is the only postal system with a dedicated law enforcement arm. More than 1,200 postal inspectors are stationed throughout the United States and abroad.100 Postal inspectors enforce over 200 federal statutes related to crimes that involve the USPS system. The Contraband Interdiction and Investigations program currently leads USPIS efforts to eliminate illegal drugs and other contraband in the mail. Between 300 and 500 inspectors work on narcotics issues daily.101 While large cities such as New York City, Los Angeles, and Washington, D.C., have full-time drug teams, the majority of teams cover a wide range of issues.

In fiscal year 2018, postal inspectors made 2,562 arrests that involved use of the U.S. mail in drug trafficking and seized more than 150,000 lbs of illegal narcotics and nearly $25 million in illegal proceeds.102 Synthetic opioids represent a significant part of these seizures. The decline in international mail seizures has been countered by substantial increases in seizures of synthetic opioids in domestic mail—primarily Priority Mail or Express Mail, which are designed for overnight or two-day shipping.103 In fiscal years 2017 through 2020, USPIS seized 1,054 lbs of synthetic opioids in 1,323 seizure events.104 In fiscal year 2020 alone, more than 425 mail seizures occurred, with

101 Interview 6, August 2, 2021.
103 Interview 6, August 2, 2021.
more than 480 lbs of synthetic opioids—reflecting more than double the weight seized in FY 2019. The number and weight of seizures continues to increase; between October 2020 and September 2021, USPIS conducted 780 seizures totaling 948 lbs of synthetic opioids. Depending on the seizures, weights can range from a few grams to multiple pounds in a parcel. The rough average of seizure events in the domestic mail system appears to be substantially larger than those arriving at IMFs.

Many of these seizures in the domestic mail system originate in jurisdictions near the southwest border, and as noted elsewhere, the southwest border seizures are low purity finished product, either compressed powder form or in tablets. As discussed below, USPIS believes that Mexican transnational criminal organizations (TCOs) are smuggling synthetic opioids across the border, warehousing them in close proximity to the southwest border. They then either continue overland distribution or sell the drugs to midlevel traffickers who mail them out. USPIS interdiction efforts are thus primarily focused on the southwest border, where USPIS has 17 field offices, each with its own counternarcotics team. Major metropolitan areas have larger teams, although there are also rural teams.

Fourth Amendment Protections Against Search and Seizure

A key consideration in the detection of illicit substances in the domestic mail is that letters and parcels are protected against search and seizure under the Fourth Amendment to the Constitution and, as such, cannot be opened without a search warrant. If there is probable cause to believe the contents of a letter or parcel violate federal law, postal inspectors can obtain a federal search warrant to open the mail piece. Under what is known as the “border search exception,” searches performed at international borders or their functional equivalent generally do not require a warrant, probable cause, or reasonable suspicion. This exception represents a critical distinction between CBP’s ability to conduct inspections of international mail and USPIS’s ability to inspect domestic mail, highlighting the importance of strengthening the international mail screening process.

Fourth Amendment case law, according to analysis in law reviews, indicates that the use of a molecular scanner or other sense-enhancing technology that provides information that could not otherwise have been obtained without physical intrusion constitutes a “search” under the meaning of the Fourth Amendment, and that technologies such as molecular scanning and thermal imagine arguably violate the Fourth Amendment. The amendment effectively limits USPS to screening domestic mail only by visual inspection or analysis of information about the package. However, the practical impact of this limitation at the current time is less severe, given that scanning technology that could identify contents of items is too slow and inaccurate to feasibly be used extensively in a USPS mail processing environment with large volumes of items being processed at high

105 Interview 6, August 2, 2021.
108 Interview 6, August 2, 2021.
109 Interview 6, August 2, 2021.
110 Interview 34, August 24, 2021.
111 Mail may also be opened if consent is received from the mailer or recipient, or if life and safety are at stake following exposure to potential hazards from an accidental opening of the item.
speeds.\textsuperscript{113} If automatic scanning technology eventually becomes capable of scanning at the high speeds that would be needed in a mail environment, the potential limitations on searches posed by the Fourth Amendment may then become more relevant.

To reduce the barriers to inspecting domestic mail and facilitate investigations, in 2018 USPS OIG recommended\textsuperscript{114} legislative changes be made that would authorize USPIS to open and inspect packages suspected of containing illicit drugs by clarifying that Fourth Amendment protections apply only to letter mail and that packages are subject to inspection without a warrant based on probable cause.\textsuperscript{115} As of early 2021, USPS management continued to disagree with OIG, given that USPIS can work with local U.S. Attorney’s Offices to obtain search warrants where probable cause exists.\textsuperscript{116} While USPS indicated that in practice the Fourth Amendment does not pose a significant barrier to detection or interdiction, and that the current parcel warrant system is adequate, it noted that a significantly greater limitation on the ability to investigate domestic mail was the lack of administrative subpoena authority for drug investigations (e.g., to obtain computer IP addresses linked to suspicious packages from internet providers).\textsuperscript{117} Currently USPIS only has administrative subpoena authority under the Deceptive Mail Prevention and Enforcement Act, designed to address lottery and sweepstake fraud in the mail.\textsuperscript{118}

Domestic Mail Screening Methods

The sheer volume of mail USPS handles makes it impossible to manually review every piece of mail. In 2020, USPS handled 7.3 billion domestic packages among its total 129.2 billion pieces of mail.\textsuperscript{119} This package volume is a 40-percent increase since 2016,\textsuperscript{120} which has placed unanticipated strains on USPS processing infrastructure such as sorting machines and delivery vehicle storage capacity. Necessarily, USPIS relies instead on intelligence and analytics to target suspicious packages. Once items are identified through analytics, they are located within the mail system and subjected to canine inspection in order to provide sufficient cause to request a federal “parcel warrant” to open the package.

Canine support is provided through CBP or other state or local law enforcement, since USPIS does not maintain canine teams of its own.\textsuperscript{121} While canine support is invaluable, use of canines to screen the mail more broadly for illicit substances at processing facilities without establishing probable cause may represent a violation of the Fourth Amendment, consistent with some rulings against the use of canines in CBP checkpoints a significant distance away.

\textsuperscript{113} Interview 6, August 2, 2021; interview 63, September 15, 2021.


\textsuperscript{115} Letter mail is a type of first-class mail, weighing no more than 3.5 ounces.


\textsuperscript{117} Interview 63, September 15, 2021.

\textsuperscript{118} Public Law 106-168, an act to amend U.S. Code, Title 39, Chapter 30, to provide for the nonmailability of certain deceptive matter relating to sweepstakes, skill contests, facsimile checks, administrative procedures, orders, and civil penalties relating to such matter, and for other purposes, December 12, 1999.


\textsuperscript{120} U.S. Postal Service, “A Decade of Facts and Figures,” webpage, undated a.

\textsuperscript{121} Interview 34, August 24, 2021.
from the border. With a warrant, USPIS can conduct presumptive field tests of substances using similar handheld Raman spectroscopy detectors, similar to CBP.

The USPS Contraband Interdiction and Investigations group is standing up an investigative support center that will focus on illicit drugs to directly support postal inspectors and field divisions. USPIS is also in the process of investing in advanced analytic techniques to make use of individual package data combined with historical seizure data, local knowledge, and information across USPS databases to develop models that proactively target suspicious packages and identify their location within the USPS network. Strengthening predictive modeling will streamline targeting, detection, interdictions, and investigations. New and developing trends, identified through interdictions and information-sharing with the HIDTAs, the U.S. Drug Enforcement Administration (DEA), and DEA’s Special Operation Division can be used to update the models. The mandated inclusion of AED on incoming international mail will provide further information to assist USPIS in this effort, in addition to CBP’s efforts at the ISCs, although it must be noted that international packages only represent roughly 10 percent of USPS’s total package volume. USPIS is also focusing on using the darknet as a primary tool for gathering intelligence, building investigations, and combating the use of the mail system for distribution. Darknet investigations have grown from a small group of postal inspectors to a network of specialized law enforcement experts coordinating interagency drug investigations.

VULNERABILITIES IN DETECTION OF SMUGGLING OF SYNTHETIC OPIOIDS ACROSS THE SOUTHWEST BORDER (STEP 6)

Primary Vulnerabilities Undetected synthetic opioids are smuggled across the southwest border.

Causes of Vulnerabilities Traditional smuggling challenges make detection difficult.

Impact of Vulnerabilities Foreign-origin opioids smuggled across the border can be placed directly in the domestic mail or express cargo systems, where the likelihood of screening and detection are low.

While international mail and express cargo remain conduits for smuggling of illegal drugs, current trends indicate a shift from traditional shipping methods to the southern border. GAO and U.S. Immigration and Customs Enforcement have concluded that Mexican drug-trafficking organizations are the primary conduit for fentanyl

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124 Interview 34, August 24, 2021.

125 Interview 34, August 24, 2021.


destined for the United States.\textsuperscript{129} According to DEA, the most common smuggling method used by Mexican transnational criminal organizations involves transporting drugs through land POEs in passenger vehicles with concealed compartments or commingled with legitimate goods on tractor trailers.\textsuperscript{130} Largely because of the antiquated and disorganized nature of Mexico’s national postal service (Correos de Mexico), the volume of fentanyl sent from Mexico through the international mail is trivial,\textsuperscript{131} although it is unknown whether shipments through ECC systems are similarly small.

The illicit nature of border smuggling operations makes it difficult to quantify the volume of fentanyl flowing from Mexico to the United States. Chinese producers are also shipping fentanyl precursors to Canada before the drug is trafficked across the U.S. northern border. However, according to the U.S.–China Economic and Security Review Commission, this occurs less frequently than the trafficking across the U.S. southern border.\textsuperscript{132} USPIS identified that a key issue it is seeking to understand is how fentanyl enters the domestic mail system once it has been smuggled over the border and noted that USPIS would like to work with CBP and Homeland Security Investigations to close that gap in knowledge.\textsuperscript{133}

CBP inspections at the southwest border also involve a targeting process that relies on the ATS as well as the advance electronic manifest information that commercial cargo-carrying vehicles must submit prior to arrival at a land POE. As with inbound international mail and express cargo, CBP is authorized to conduct detailed inspections of vehicles and individuals at ports of entry without a warrant and can use drug-sniffing canines or other intelligence for this purpose. However, the sheer number of vehicles and people at POEs present challenges to screening by CBP for fentanyl or other illicit cargo.

For example, in 2019, more than 73 million privately owned vehicles and 6.4 million commercial trucks crossed the southwest border from Mexico, as did over 49 million pedestrians.\textsuperscript{134} CBP has the capacity to scan approximately 2 percent of privately owned vehicles, and 16 percent of commercial vehicles arriving at southwest border POEs.\textsuperscript{135} Interviewees noted that CBP does screen pedestrian traffic, using canines and X-rays of luggage, but that additional requirements and paperwork are needed given that secondary pedestrian screenings require compliance with additional constitutional protections as agents are physically patting down and touching people.
Coincidently, according to CBP seizure data, there has been a substantial rise in the number of fentanyl seizures involving pedestrians since 2020.

Nonintrusive inspection technology for vehicles includes items such as angled mirrors on metal rods to look under vehicles, fiber-optic scopes, and large-scale X-ray and gamma-ray imaging systems that are designed to help CBP detect narcotics and weapons or materials that pose potential nuclear or radiological threats, without requiring a CBP officer to physically open or offload passenger or commercial vehicles. Depending on availability, land POEs may deploy officers with canines to walk among the vehicles in waiting areas before reaching an inspection booth.

As noted in Appendixes B and C, fentanyl seizures occur between POEs as well; illegal drugs and other contraband may be transported into the United States through manned and unmanned aerial vehicles, maritime vessels, and cross-border subterranean tunnels. Law enforcement agencies have identified more than 200 tunnels since 1990, primarily along the western half of the southwest border. Border areas most vulnerable to tunnel construction are near the POEs at San Ysidro, Otay Mesa, and Calexico in California, as well as San Luis Nogales in Arizona. It has been suggested that the high-purity, low-bulk characteristics of synthetic opioids could quickly lead to the use of drones for smuggling over the southwest border and that CBP needs to prepare for such a development.

However, most Southwest Border Patrol sectors still rely largely on obsolete systems and infrastructure with limited capabilities because they have deployed only about 28 percent of the surveillance and subterranean technology solutions previously planned, even after receiving more than $700 million in funding since FY 2017 for this purpose. Shifting priorities, surveillance camera tower construction delays, and a lack of available subterranean technology solutions have been identified as key hindrances. This is further compounded by the lack of available staff to operate and respond to technology alerts (from ground sensors, imaging sensors, and tower-based cameras).

There is a history of critical CBP staffing shortages, particularly at POEs with the highest seizure rates, such as at the San Diego and Tucson field offices, where CBP has failed to allocate sufficient permanent staff.

In 2019, GAO identified a series of CBP directives, handbooks, and other official instructions specifying policies and procedures that have not been updated in nearly two decades, despite a requirement that they be reviewed and updated as necessary every three years. Many of these likely need updating to reflect changes in technology, operating conditions, or the inspection process, but as of September 12, 2021, this recommendation is still listed as “open.” The Narcotics Interdiction Guide Handbook has not been updated since 1999. The handbook communicates the procedures necessary to ensure a uniform standard for narcotics examinations; it is also intended to serve as a procedural guideline for examining inspectors and those who will review the results of examinations.

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Similarly, the Canine Enforcement Program Directive was last updated in 2002. The directive defines the operational policy of the National Canine Enforcement Program, specifically the deployment of detector dogs in antiterrorism initiatives and interdictions of smuggled narcotics and currency. Neither the handbook nor the directive addresses fentanyl.
Appendix H

OTHER VULNERABILITIES RELEVANT TO DISRUPTING THE SUPPLY OF SYNTHETIC OPIOIDS

Disrupting the illegal supply of synthetic opioids requires robust drug surveillance data to understand the extent of the illegal drug phenomenon and its health and crime-related consequences for individuals and communities. Such data is necessary to inform the development of effective demand- and supply-reduction interventions. In addition, policymakers and practitioners alike must understand the emerging role of social media in the distribution and selling of synthetic opioids online and identify policy levers to address this new aspect of the threat. Law enforcement is being challenged in unprecedented ways to interdict and disrupt the distribution and selling of synthetic opioids, and the complexity of information-sharing underscores the challenges law enforcement faces in doing so. This appendix explores the challenges that counterdrug efforts face, focusing on three themes and identifying options for addressing them.

METHODS

This appendix draws on work presented elsewhere in this report with a particular aim to identify common vulnerabilities that were highlighted during the interview and data collection periods of the research efforts. The many gaps and vulnerabilities having to do with data related to drug policy and analysis were apparent. The research team for the Commission faced several data acquisition and analysis challenges. Consultations with key experts formerly involved with federal drug policy offered a unique view on the vulnerabilities of existing data collection and surveillance mechanisms. Those findings were incorporated into this appendix, and they served as the basis for how to examine future data challenges posed by illegally supplied synthetic opioids.

Additional findings regarding the online vulnerabilities were noted by researchers working to understand the online landscape of the illegal supply of synthetic opioids. Several members of the research team with legal backgrounds undertook additional analyses of social media terms of service to offer comparisons of what legal and policy tools might be available or could present vulnerabilities.

Law enforcement information-sharing vulnerabilities were collected and compiled through interviews. A research member with a law enforcement background examined the challenges and vulnerabilities faced by local law enforcement, and what law enforcement data systems exist to better facilitate information-sharing and coordination.

To aid the Commission, the authors focused on common vulnerabilities, gaps, and possible responses when it comes to countering the illegal supply of synthetic opioids. Not all vulnerabilities or gaps relevant to the problem of illegally supplied synthetic opioids were mapped. However, several unique challenges presented by these new and emerging drugs, which are easier to conceal, cheaper to make, and advertised openly online will possibly
require additional structures, approaches, and authorities. Analysis here was built on a series of interviews with subject-matter experts, including government officials, an analysis of internal and publicly available documents and reports, and information gleaned from site visits.

Specifically, the research addressed vulnerabilities in three areas:

1. gaps in surveillance of illegal drug markets in the United States
2. challenges associated with the supply of synthetic opioids and related chemicals on social media platforms
3. gaps in law enforcement information-sharing and coordination.

Table H.6 at the end of this appendix summarizes the vulnerabilities identified in each of these areas.

GAPS IN SURVEILLANCE OF ILLEGAL DRUG MARKETS IN THE UNITED STATES

Existing Gaps

Reliable and timely data of public health and public safety indicators are essential to understanding the extent of the illegal drug phenomenon and its consequences, including health harms and related crime. Further, drug surveillance data are necessary for understanding the relationship that demand- and supply-reduction interventions have and how markets are trending or transitioning. Because data on drug use, such as overdose or emergency department episodes, are often some of the initial outcome measures that alert to shifting drug supply patterns, these elements are considered alongside traditional drug supply and market surveillance data. With the increasing complexity of drugs available in markets, including new psychoactive substances (NPSs), surveillance systems also play a critical warning role in detecting rapid changes and emergent risks. Correspondingly, sound policy formulation and implementation and assessment decisions require timely, valid, and reliable data.

Unfortunately, these decisions are often made in the absence of such data. The problem is compounded when the data exist but are not routinely made available for policy-relevant analysis. This is especially true for federal law enforcement data, which is information directly relevant to the Commission’s mission. In 2001, the National Research Council published a report, commissioned by the Office of National Drug Control Policy (ONDCP), to assess the adequacy of the data informing drug policy and to identify gaps in that knowledge base. Many of the criticisms and recommendations of that report are still relevant and applicable today.

Currently, policymakers’ understanding of the market for illicitly manufactured synthetic opioids in the United States is limited due to a series of major data issues. The United States presently lacks good information on key trends and drug market indicators pertaining to both drug demand and drug supply. These lacunae emerge from limitations and imprecisions in existing data collection methods and how information is disseminated and the lack of data collection in certain areas.


The consequences from these data gaps are profound. And while many of the data gaps also apply to drugs other than opioids, the sheer volume of harms caused by synthetic opioids makes the impact of these data gaps particularly acute in relation to this class of drugs. Owing to data limitations, it is difficult to properly assess the various supply- and demand-reduction strategies that have been implemented or to set targets for demand-reduction interventions that have not been implemented. The lack of good data also precludes researchers, as well as public safety and public health authorities, from undertaking cross-jurisdictional comparisons on how various localities are affected by illegal drug supply and how well the local public health and public safety responses work. Correspondingly, the ability of public authorities to properly allocate funds for various drug policy efforts is severely limited.

In the short term, the lack of valid, reliable, and timely information prevents key stakeholders from detecting and gaining a quick understanding of rapid market changes, such as the emergence of previously unknown fentanyl analogues or the introduction of new counterfeit products. This is further complicated when policymakers or practitioners are limited in quantifying the magnitude of existing markets or how fentanyl may shape emerging use patterns. These lacunae hamper the adoption of timely, lifesaving responses. The remainder of this appendix first focuses on the most important information gaps pertaining to both drug demand and drug supply. Next, the causes of the current information gaps are highlighted. Last, given the direct relevance to the focus of the Commission, gaps in federal law enforcement data for informing drug policy are discussed in greater detail.

Principal Information Gaps

With respect to indicators pertaining to the demand for opioids in the United States, even very fundamental questions are difficult to answer. To start with, there is no good estimate of the prevalence of illicit opioid use in the United States. Specifically, the Commission had difficulties estimating the numbers of those who have used heroin, illegally manufactured fentanyl and other synthetic opioids, or diverted prescription opioids in the past month, as well as estimating the number of people with an opioid-use disorder in the United States. Additionally, there is only scant qualitative evidence on the intensity of illicit opioid use, which limits the understanding of whether and to what extent the arrival of more potent synthetic opioids with shorter duration of effect has resulted in increased frequency of use. The United States also lacks good data on expenditures by people who use opioids, necessitating the production of estimates based on relatively old data and complex modeling.

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approaches. As a consequence, the drug policy community does not have a good idea of the volume of total illicit opioid consumption in the United States and at what prices (see Appendix B for an attempt to quantify the total annual fentanyl consumption in the United States in light of existing data limitations).

On the supply side, data could be improved in key areas, including the range of chemicals that is on offer in the market and at what purities and prices across the different stages of the supply chain. Other related gaps in existing data include information on how synthetic opioids are mixed with other drugs and how synthetic opioids are marketed (e.g., is fentanyl sold explicitly as fentanyl? Is it sold as “dope,” “down,” or another generic term for opioids? Is it sold as something different?). Also, in what formulations are synthetic opioids sold (e.g., pills or powder)?

Some of these measures do exist but are limited in their availability or how systematically they are collected, analyzed, or reported. Law enforcement data on drug seizure events were analyzed in Appendix B to describe recent trends, but many drug seizure databases and measures lack the precision needed to better understand markets in transition to fentanyl. For example, given fentanyl’s increased potency, measures on purity become more important. Given the lower concentration of fentanyl sold in powders or pills in illegal markets, many laboratory or field-test kits cannot accurately quantify or report this measure.

Causes of Current Gaps

The reasons behind current data gaps can be broadly placed in three groups. First, existing data collection efforts frequently suffer from methodological and technical shortcomings, resulting in data products of limited quality or utility. Second, the results of existing data collection efforts are often not shared effectively. And third, in many relevant areas, data collection efforts are missing altogether. The Commission addresses each broad group in turn below.

Underpinning all these issues are resource limitations and constrained budgets available for various data systems. Many of the gaps discussed below can be directly linked to funding considerations; by extension, investing in data systems is one of the principal ways to address these gaps. However, not every data gap requires substantial investment, and some relatively inexpensive options, such as wastewater analysis, exist. Moreover, modifying existing data collection and analysis systems to better assess new challenges involving new drugs will require new directives and protocols and not necessarily new systems. In the discussion of possible solutions presented in the Commission’s report, the Commission has attempted to provide an indication of costs as appropriate.


Other Vulnerabilities Relevant to Disrupting the Supply of Synthetic Opioids

Poor Quality of Data Collection

Reliance on Prevalence Surveys

The primary source of national-level prevalence of drug use is the National Survey on Drug Use and Health (NSDUH). This nationally representative household survey has a sampling frame drawn from the general population. Unfortunately, hard-to-reach groups such as frequent drug users are seriously underrepresented in household surveys. One reason is that such populations may be less likely to participate in surveys, which is particularly the case for highly stigmatized drugs such as heroin and other nonprescription opioids, including illegally manufactured fentanyl. Further, people may misreport their drug use, mistakenly reporting use of fentanyl or other synthetic opioids for heroin. Second, NSDUH is a survey of the noninstitutionalized U.S. population ages 12 and older living in households. As such, it is likely to leave out of its sampling frame numerous people who use drugs but whose living situation does not meet the sampling criteria, (e.g., they are incarcerated, in mental health facilities, or homeless and not living in shelters). Thus, NSDUH heavily underestimates the prevalence of heavy users, who account for the majority of overall drug consumption. In addition, even where heavy users do participate in the survey, they may underreport stigmatized behaviors such as drug use. Specifically to the challenge posed by synthetic opioids, NSDUH currently does not have a category for illegally manufactured fentanyl or synthetic opioids more broadly, precluding the collection of even rudimentary fentanyl-specific data. Besides national prevalence surveys, there is no other standing mechanism to regularly collect data on drug use and related behaviors by people who use drugs.

Analytical Limitations

Existing data collection is also hampered by limitations on current analytical efforts and existing capacities to undertake required analyses. To illustrate, data on drug-related deaths are based on death certificates issued by state and local medical examiners and coroners. There is no nationwide standard for death investigations and certifications, which means variation across states and localities in their capacities and procedures can affect drug-
related mortality surveillance. While improvements have been made, areas of concern that can affect the quality of data collection include (1) the extent to which toxicological examinations look for substances beyond the one that is suspected to be the underlying cause of death or look for NPS more broadly; (2) the extent to which examinations can detect NPS, as well as (3) the extent to which all contributing substances in multidrug cases are captured in the death certificate.

Further, the current reporting system based on the tenth revision of the International Classification of Diseases (ICD-10) has dedicated codes only for a handful of specific drugs, such as heroin. Fentanyl is not one of these drugs, and so the only way for a fentanyl death to be explicitly included in the system is for a coroner or medical examiner to record that information in a text field. These drug-specific data challenges are exacerbated by capacity limitations on the part of coroners and medical examiners, lack of unified procedures and data reporting formats, and barriers to interoperability stemming from the absence of federal standards mentioned above.

With respect to analyses of drug samples seized by law enforcement, information yielded by law enforcement labs is also often limited, perhaps reflecting the fact that supporting a criminal case remains the primary objective to which they dedicate their limited resources. In general, laboratories and drug seizure analyses work to support investigations and close out cases of drug law violations, not to monitor or surveil markets. In practice, this means that some laboratories only test samples if they are part of a court case. Further, laboratories typically test only for controlled substances, which may miss relevant information on chemicals that are not illegal but nevertheless are important for the production of illegal drugs, such as fentanyl precursors.

Along similar lines, laboratories often do not test the purity of submitted samples, because such information is irrelevant for the outcome of the criminal case where, in most cases and for most drugs, sentencing is based on the weight of the total sample, not of the active ingredient. State and local labs also frequently do not report the total amount of the seizure to the U.S. Drug Enforcement Administration (DEA), preventing the inclusion of such information in national databases. For example, one data manager noted that drug seizures that resulted in a plea deal may not even be sent to the lab for analysis.

**Data Reporting Lags**

Another considerable problem with the lack of sharing is not the refusal or lack of data to share, but the time lags behind data collection, analysis, and reporting. For example, national overdose death record information furnished

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22 Interview 40, September 2, 2021.


24 The recent growth in drug-related mortality has in turn placed additional strain on coroners and medical examiners because of the time and labor intensity of drug-related examinations (National Science and Technology Council, Executive Office of the President, “Strengthening the Medicolegal-Death-Investigation System: Improving Data Systems,” September 2016).

25 Interview 34, August 24, 2021.

by the U.S. Centers for Disease Control and Prevention (CDC) are reported with a year lag. CDC has worked to reduce this lag to less than a year in its provisional data series for drug overdose deaths, but individual-level decedent data are not made available to researchers until the beginning of each year (i.e., death data for the year 2020 will not be made available until January 2022). Drug seizure data that are publicly available from DEA, including from the National Forensic Laboratory Information System (NFLIS), which reports state-year aggregate cases of seizure events, are generally published with a lag of a year. Individual-level data from NFLIS are not publicly released. Other drug seizure data information is not made available at all to the public.

Last, no national infrastructure exists for timely data sharing, particularly with respect to disseminating information on notable changes in illegal markets in the form of an early warning system. Several efforts to establish a rudimentary early warning system have been implemented, but they fall short of a true standing national system bringing together key stakeholders across various jurisdictions, along the lines of the European Early Warning System implemented by the European Monitoring Centre for Drugs and Drug Addictions with support from Europol.

Lack of Data Collection in Some Areas

There also continue to be areas where systematic data collection efforts are limited or nonexistent at all. This is particularly the case with respect to market surveillance efforts directly involving efforts to understand the experience and decisionmaking by illicit market participants including people who use and/or sell drugs. Correspondingly, there is very little information on drug use and distribution that does not come to the attention of the public health and criminal justice systems or become part of a criminal case.

Moreover, even in instances where either public safety or public health systems are involved, gaps in data collection persist. For instance, samples obtained by law enforcement from participants of diversion or deflection programs may not get analyzed because there is no ongoing criminal investigation. Similarly, drug samples involved in nonfatal overdoses do not get routinely analyzed, and while subsequent hospital toxicology may offer important insights, the sharing of hospital-based data remains a work in progress.

Gaps in existing data have also been exacerbated by recent discontinuations of national data systems such as the Arrestee Drug Abuse Monitoring (ADAM) network and the Drug Abuse Warning Network (DAWN). Table H.1 summarizes the identified concerns with available data to inform drug market surveillance.

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27 The National Drug Early Warning System (NDEWS) is one example (National Drug Early Warning System, homepage, undated) or NPS Discovery (Center for Forensic Science Research and Education, “NPS Discovery,” webpage, undated).

28 European Monitoring Centre for Drugs and Drug Addiction, “Early Warning System on NPS,” webpage, undated.

29 Interview 3, July 29, 2021.

30 As the European Monitoring Centre for Drugs and Drug Addiction pointed out, “Monitoring illicit drug use is difficult because of the hidden and complex nature of drug-using behaviours” (European Monitoring Centre for Drugs and Drug Addiction, Assessing Illicit Drugs in Wastewater: Advances in Wastewater-Based Drug Epidemiology, Luxembourg: Publications Office of the European Union, 2016).

31 Interview 24, August 18, 2021.

Table H.1
Overview of Existing Data Issues with Respect to Monitoring Synthetic Opioid Markets in the United States

<table>
<thead>
<tr>
<th>Measure of Interest</th>
<th>Current Data System</th>
<th>Data Quality</th>
<th>Data Sharing</th>
<th>Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>User population, size, behaviors, makeup</td>
<td>NSDUH and some other surveys</td>
<td>Low; estimates biased downward, cannot measure use of fentanyl or synthetic opioids</td>
<td>Good; data reported each year, though with considerable lags</td>
<td>Moderate; annual surveys, but heaviest use behaviors outside of sampling frame</td>
</tr>
<tr>
<td>Supply of synthetic opioids in drug markets</td>
<td>Federal and state/local seizure databases (e.g., NFLIS, STARLIMS)</td>
<td>Moderate; do not include all relevant measures, like purity or price</td>
<td>Low to none; very little public data are available on drug seizure measures; year or more lags in public reports</td>
<td>Moderate; estimates are not random samples, not all seizures may be recorded or analyzed</td>
</tr>
</tbody>
</table>

NOTE: NFLIS = National Forensic Laboratory Information System. NSDUH = National Survey on Drug Use and Health.

Gaps in Federal Law Enforcement Data for Informing Drug Policy

Federal law enforcement agencies maintain several databases, including NFLIS and the System to Retrieve Information from Drug Evidence (STRIDE), both managed by the DEA, among others. These information systems contain data potentially useful for analysis and policymaking; however, they are underutilized for these purposes. Admittedly, these databases were created by law enforcement agencies for administrative purposes, as archives of arrests and inventories of drugs seized to assist in the prosecution of illicit drug traffickers, not as research databases.

However, when analyzed by researchers, while acknowledging the data’s limitations, they can provide compelling insights into the supply of and demand for illicit drugs, including synthetic opioids, and whether counterdrug efforts are effective.

Most of these federal law enforcement databases are administrative in nature. They were developed and implemented to support the agencies in executing their missions. Rather than probability-based surveys that provide population estimates of the prevalence of incidents of interest, these data systems are convenience samples (albeit large ones) of incidents that become known to law enforcement through investigations. Probability-based surveys are commonly implemented by demand-reduction agencies to provide estimates of illicit drug use and related beliefs, attitudes, and behaviors among populations of interest (e.g., NSDUH maintained by the Substance Abuse and Mental Health Services Administration). They permit analysts to make statements about past-year drug use. On the other hand, statements derived from administrative data systems related to drug seizures apply only to the cases known to law enforcement, so data on seizures of cocaine at the U.S. southwest border do not estimate the total flow of cocaine into the United States but only record the amount seized.

However, given the covert nature of drug trafficking, these administrative data systems often are the only sources of data on these activities. A major advantage of these data systems is their timeliness, especially compared to the more

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33 STRIDE was replaced by STARLIMS in 2014 as the DEA’s new laboratory drug evidence data system of record.
methodologically rigorous population surveys. The latter typically have a time lag of one to two years before the
data are released. Administrative data, on the other hand, may have time lags as short as one or two quarters. But,
because of the lower level of methodological rigor, policymakers must recognize the limitations of these data when
making decisions based on them. Ideally, these data should be analyzed within the context of the more rigorous
data or in combination with two or more administrative data systems.

For example, if two or more data systems are indicating that the supply of cocaine appears to be increasing based
on increased observation of maritime movements, seizures at the southwest border, and falling prices (see below for
descriptions of the relevant data systems), then policymakers may be more comfortable in formulating a policy
response. Additionally, data on drug seizure or undercover buys are analytically confirmed by forensic laboratories,
including DEA’s Special Testing and Research Laboratory. These chemical analyses can offer more understanding
of trends in drug markets as people who use drugs may not often know the precise chemicals or purities of the
drugs they purchase from street dealers. This is crucial given the ongoing evolution and emergence of new
psychoactive substances that are designed to circumvent drug control laws.

Table H.2 summaries the major law enforcement databases most commonly used by federal authorities in the
formulation, implementation, and assessment of policy (see ONDCP’s “National Drug Control Strategy: Data
Supplement 2020”34 for a detailed list of the data systems commonly consulted by drug control agencies). The
table compares the level of aggregation, data elements, strategic value, and limitations of these systems.

- **STARLIMS**: STARLIMS is the DEA’s laboratory information management system. It provides DEA with
a forensic inventory of drugs seized through investigations by the agency. It is the successor to DEA’s
STRIDE. Among the data contained in the system are the price and purity of illicit drugs obtained
through undercover purchases. These data have been used to estimate the availability of various illicit
substances and assess the effectiveness of drug policy under the assumption that as prices increase,
availability (or supply) decreases.35 It is unclear whether DEA is continuing to produce its analyses of
trends in the price and purity of heroin, cocaine, and methamphetamine. The 2019 National Drug Threat
Assessment contained charts of trends in these measures; however, the 2020 assessment did not.36 Rather, it
contained what appear to be qualitative assessments of prices by individual DEA field offices.

- **National Forensic Laboratory Information System—Drug**: This is DEA’s network of federal, state, and
local forensic toxicology laboratories. These labs process and analyze drugs seized by state and local law
enforcement. Approximately 75 percent of the nation’s forensic toxicology laboratories participate. Given
that NFLIS comprises data from different labs, measures on observations are not as robust as those from
STARLIMS, focusing on the drugs detected, weights, formulations, dates, and locations of seizures. There
are no measures on price, and few labs quantify the purity of drugs.

- **Automated Reports and Consolidated Ordering System (ARCOS)**: This system provides information to
DEA on pharmaceutical manufacturers’ and distributors’ transactions of controlled substances. The data
provide useful information on distribution trends of these substances, helping to target diverted
prescription medications. This data system does not contain observations for illegally produced or
trafficked drugs like cocaine, heroin, or novel synthetic opioids.

February 2020b.
March 2, 2021a.
### Table H.2
**Drug Supply Measures for the Federal Government**

<table>
<thead>
<tr>
<th>Data System</th>
<th>Agency</th>
<th>Level of Aggregation</th>
<th>Data Elements</th>
<th>Strategic Value</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>STARLIMS</td>
<td>DEA</td>
<td>Individual observations</td>
<td>Drug seized; amount; purity; price (if purchased; packaging; location</td>
<td>Trends in price/purity; assessment of counterdrug measures</td>
<td>Convenience sample; lack of systematic undercover purchase methodology; lag in analysis</td>
</tr>
<tr>
<td>NFLIS</td>
<td>DEA</td>
<td>Individual observations</td>
<td>Drug seized (controlled and uncontrolled); purity; amount; location</td>
<td>Trends in local availability; detailed data on diverted pharmaceuticals</td>
<td>Convenience sample; no data on price</td>
</tr>
<tr>
<td>NSS</td>
<td>DEA/EPIC</td>
<td>National</td>
<td>Drug seized; amount; seizing agency; conveyance; packaging; location</td>
<td>Trends in deconflicted seizures; input for estimates of flow</td>
<td>Not all federal LE agencies contributing; few state and local LE contribute; deconflicting possibly not fully implemented</td>
</tr>
<tr>
<td>SEACATS</td>
<td>CBP</td>
<td>Individual observations</td>
<td>Drug and precursor chemicals; people involved; amount; location; modes and methods of conveyance</td>
<td>Input for estimate of low; trends in trafficking methods</td>
<td>Convenience sample</td>
</tr>
<tr>
<td>ARCOS</td>
<td>DEA</td>
<td>Individual observations</td>
<td>Drug (controlled pharmaceutical); quota limits; distribution</td>
<td>Input for estimating diversion of controlled substances</td>
<td>Data subject to update due to incomplete reporting by pharmaceutical companies</td>
</tr>
<tr>
<td>CCDB</td>
<td>DoD/DIA</td>
<td>International</td>
<td>Drug; conveyance; amount; location; seized/jettisoned</td>
<td>Input for estimates of drug flow; assessment of counterdrug measures</td>
<td>Subjective assessment of movements; poor coverage for drugs other than cocaine</td>
</tr>
</tbody>
</table>

OTHER VULNERABILITIES RELEVANT TO DISRUPTING THE SUPPLY OF SYNTHETIC OPIOIDS

- **National Seizure System (NSS):** DEA maintains this data system through its El Paso Intelligence Center (EPIC). It provides data on all seizures made by DEA, the Federal Bureau of Investigation (FBI), and the U.S. Department of Homeland Security (U.S. Coast Guard and Customs and Border Protection [CBP]), and state and local law enforcement. NSS is the successor to the federal-wide Drug Seizure System. One purpose of NSS is to deconflict seizures to avoid double-counting. It is unclear whether this deconfliction is done routinely or whether other federal agencies that seize drugs (e.g., the National Park Service, U.S. Forest Service) routinely participate. In recent years, data from individual agencies are being cited by the government rather than data from NSS.

- **Consolidated Counterdrug Data Base (CCDB):** This data system is an interagency effort to document the movement of drugs from source countries to the United States. It is maintained for the interagency by the Defense Intelligence Agency (DIA). While the intent is to include all drugs, the primary focus of CCDB is the movement of cocaine.

- **Seized Assets and Case Tracking System:** SEACATS is the information system of record for all enforcement incidents related to CBP and U.S. Immigration and Customs Enforcement (ICE) and Homeland Security Investigations (HSI) operations. It is managed by CBP’s Office of Field Operations and collects incident-level measures on people and assets seized during investigations, including drug and precursor chemical seizures. SEACATS is used to track seized asset events as they are processed by law enforcement, resulting in a many-to-one series of measures for each seizure event. For example, a drug seizure event may include multiple unique observations for when the item was seized and when it was processed by CBP’s laboratory. Measures include weights, ports of entry, modes of transportation, and methods of conveyance.

In general, the data are provided to the public by law enforcement only in summary form (e.g., annual reports, public relations releases), if at all. Access to the data files is often restricted to law enforcement personnel. When the data are made available to policymakers and researchers, challenges in using the data include the lack of documentation on the databases and the absence of formal public use files and lack of transparency on the methods used in collecting the data. Often there is no codebook or data dictionary to assist in discovering what variables are available and in assessing limitations. Data are also not stored in means or methods that make for easy analysis, with many observations seemingly coded by hand by operators, resulting in many data entry errors and spelling mistakes. Authorities have made efforts to improve data recording, but challenges remain given how the primary function of these data systems is for investigations and not surveillance of markets or broader policy trends.

For example, in the past, DEA has made the STARLIMS/STRIDE data available to a limited number of researchers, sometimes over multiple years. However, the content of the files was inconsistent from year to year so that in any given year, new variables appeared without explanation. On the other hand, DEA has been reluctant to relinquish control of the data and subsequent analyses. However, if law enforcement were to consult with their demand-side partners, who regularly provide well-documented public use data on sensitive topics, it may be possible for them to provide researchers with wider and more routine access to these data systems while protecting the misuse of sensitive data.

As a comparison, Canadian law enforcement agencies partner with the Drug Analysis Service, which is part of Health Canada, to analyze drug seizure data. Those data are publicly available on request and offer key insights, in near real time, of drug market trends. See Appendix B.

**CHALLENGES ASSOCIATED WITH THE SUPPLY OF SYNTHETIC OPIOIDS AND RELATED CHEMICALS ON ONLINE SOCIAL MEDIA**

The Commission’s analysis of online vendors observed advertising on legitimate or public platforms such as social media, business-to-business (B2B), and classified ad websites are described in greater detail in Appendix E.
Intentional misclassification of advertisements for synthetic opioids and fentanyl precursors has been observed across several accounts and platforms that are open to anyone using search engines, as opposed to darknet marketplaces that require additional skills and tools to anonymize browsing and gain access. Misclassification or coded use of terms is likely used to elude content moderation by the respective platforms.

The growth of these online communication platforms, including easy-to-access social media websites, present new challenges for counterdrug efforts while creating opportunities for chemical manufacturers, most of whom appear to be in the People’s Republic of China and could be operating as legitimate chemical or pharmaceutical companies, and those interested in synthesizing fentanyl, such as Mexican-based transnational criminal organizations (TCOs). Vendors can find buyers by easily creating listings that use large and unmonitored web platforms. Listings sometimes purport to be able to fulfill multi-kilogram orders and guarantee delivery to Mexico. Information on content, price, or contact can easily be embedded in photos or hidden in text, which might not be discovered by existing platform-moderation protocols.

The online space in advertising synthetic opioids and fentanyl precursors is largely unregulated and unmonitored. Several major online platforms have taken steps to censor the availability of fentanyl or other drugs on their websites, but vendors have circumvented screening algorithms.\(^{37}\) In some cases, the fact that precursors are not controlled means that there is no legal requirement to proactively monitor and remove listings. While B2B websites might be more willing to screen out bad actors as untrustworthy sellers, or those transacting in illegal goods might reflect poorly on websites, there could be less of an impetus for social media platforms to suppress listings that contain as little as a picture of the chemical and a means of contact. Websites such as Tumblr and Pinterest might not even be fully aware of the extent of the problem since they are focused more on monitoring and removing obscenity and indecency on their sites, such as child pornography and nudity.

The Commission determined that social media sites like Facebook could play an important role in reducing the supply of fentanyl and synthetic opioid precursors in the United States if they chose to monitor and moderate content concerning these chemicals. Analysis in Appendix E showed that Pinterest and Facebook had the largest incidence of content relating to fentanyl and precursors. Facebook’s role in providing access to fentanyl was known for years and mentioned in congressional testimony in 2018.\(^{38}\)

The analysis presented here documents whether certain social media sites specifically prohibited the sale of fentanyl and synthetic opioid precursors through an examination of terms of service, community standards and guidelines,\(^{39}\) rules of behavior, and any documentation the social media site provided concerning its interactions with law enforcement. These documents were reviewed by a team member with experience in document review for relevant language or quotations, and then the relevant language was reviewed by a legal expert.\(^{40}\) Facebook was chosen as a case for content moderation given the popularity of the platform and because Facebook has suggested that the company has made significant efforts to moderate content on its website concerning complex issues such as hate speech, terrorism, political extremism, and misinformation.\(^{41}\)


\(^{39}\) *Community standards* or *guidelines* are terms the social media sites use for identifying rules or guidance on what is or is not acceptable to post on their platform.

\(^{40}\) Research focused on documents collected on political extremism. Documents concerning the Facebook Oversight Board were collected by the research team librarian from individual online searches. The research team reviewed a total of 115 documents, including government documents, policy reports, reports from Facebook, news reports, nonprofit reports, and academic articles.

\(^{41}\) See, for example, Guy Rosen, “Community Standards Enforcement Report, Second Quarter 2021,” webpage, August 18, 2021.
Terms of Service Can Provide the Basis for Content Monitoring and Moderation

A terms-of-service agreement between a social media website, such as Facebook, and a user spells out the rights of the parties. An important function of a terms-of-service agreement is that it will allow the owner of a website, such as Facebook, to reserve the right to terminate a user’s account if the user violates the agreement. The agreement can also indicate that the social media platform will be monitoring how its users behave and the content they post on the website. The terms-of-service agreement can state that the website reserves the right to remove content and may be used to limit liability for content posted on the social media website. Terms-of-service agreements may be paired with community-standard documents that outline rules of behavior on the website, which serve to buttress the rights outlined in the terms-of-service agreements.

The research team examined six social media sites commonly used by sellers of fentanyl and synthetic opioid precursors: Facebook, Twitter, Pinterest, LinkedIn, Tumblr, and Flickr. The Commission reviewed their terms of service for such factors as whether they banned criminal actors or criminal activity in general, whether they specifically banned drugs (legal or illegal), and whether they had a process for engagement with law enforcement. Additionally, the Commission examined whether there was a limitation of liability for content on the platform. Table H.3 summarizes how the six social media sites compare on these different dimensions.

Table H.3
Examining Terms of Service from Social Media Sites

<table>
<thead>
<tr>
<th>Term</th>
<th>Facebook</th>
<th>Twitter</th>
<th>Pinterest</th>
<th>LinkedIn</th>
<th>Tumblr</th>
<th>Flickr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bans criminal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actor</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Language for specific bans of sale of drugs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illegal only</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Limitation of content liability on platform</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Process for law enforcement</td>
<td>x (delayed notification possible)</td>
<td>x (will notify)</td>
<td>x (will notify)</td>
<td>x</td>
<td>x (may seek costs, will notify)</td>
<td></td>
</tr>
</tbody>
</table>

Currently, Facebook’s terms of service and community standards do not appear to directly address the sale of, or transactions concerning, fentanyl, synthetic opioids, or related precursors, although they forbid drug sales. Facebook’s community standards state the following:

To encourage safety and compliance with common legal restrictions, we prohibit attempts by individuals, manufacturers, and retailers to purchase, sell or trade non-medical drugs, pharmaceutical drugs and marijuana.  

Facebook relies on its terms of service and community standards to determine what content it will monitor and moderate on its platform. If it included fentanyl and synthetic opioids specifically in its terms of service and community standards, it might provide a way for Facebook to reduce the sale of fentanyl and synthetic opioid precursors on its website. Facebook’s terms of service states that it uses a combination of technologies, from artificial intelligence (AI) to a team of more than 35,000 people to monitor the safety and security of the Facebook platform.

The Commission’s review found significant variations among and between social media platforms in their terms of service and community standards (i.e., what they cover, how they cover it, and the language used). There was no standard language describing illegal activity or drug sales. However, many social media sites have processes for law enforcement to get in contact with them or receive information from them, although the process for notification of website users concerning requests for information from law enforcement varies significantly. Still, all six of the social media sites ban illegal activity, and a majority (four out of six) ban the sale of illegal drugs, with a minority (two out of six) also banning the sale of any drugs, legal or illegal, on their platform.

Twitter provides an example of the language specifically used to ban criminal activity on its platform:

You may not use our service for any unlawful purpose or in furtherance of illegal activities. This includes selling, buying, or facilitating transactions in illegal goods or services, as well as certain types of regulated goods or services. In some cases, we may ask you to contact a law enforcement agency and have them contact us via our law enforcement request page to ensure we have enough context to enforce this policy. In addition to reports received, we proactively surface activity that may violate this policy for human review.

Goods or services covered under this policy include, but are not limited to: . . . drugs and controlled substances.

This language provides a good basis for Twitter to address transactions concerning fentanyl or synthetic opioid precursors. Its content moderation activity, however, would be voluntary; five of the six websites in the study (including Twitter) had terms of service that include clear language to avoid liability for anything posted on the site. For example, LinkedIn’s terms of service include this caveat:

By using the Services, you may encounter content or information that might be inaccurate, incomplete, delayed, misleading, illegal, offensive or otherwise harmful. LinkedIn generally does not review content provided by our Members or others. You agree that we are not responsible.

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43 Facebook, Courage Against Hate, July 2021.
44 Twitter, “Twitter Terms of Service,” webpage, effective August 19, 2021.
Such statements serve to limit the responsibility and liability for content posted on a social media website. Similar provisions exist in a majority of the terms of service and community standards that the research team reviewed (five out of six). A recent law review article stated, “According to Section 230 of the Communications Decency Act, social media platforms cannot be held liable for users’ violations of their terms of service and are simultaneously expected to moderate objectional content, thereby serving as Good Samaritans.” Section 230 of the Communications Decency Act enacted by Congress in 1996 is another important factor to consider in the context of content moderation on social media websites. However, the Commission did not explore in great detail how revisions to Section 230 might affect the illegal trade in synthetic opioids or related chemicals that are facilitated through online social media platforms. Congress will need to take additional efforts and appropriate steps to understand this issue.

Social Media Platforms Are Likely to Prefer Self-Regulation Rather Than External Regulation

With social media platforms such as Facebook, Twitter, Pinterest, LinkedIn, Tumblr, and Flickr serving as emerging conduits for supplying fentanyl and synthetic opioid precursors, a course of action to address those supply routes will need to be determined. The two obvious options are self-regulation of website content by the social media platforms themselves or external regulation imposed by Congress, an agency of the U.S. government, or the courts. Currently, Facebook is facing an antitrust lawsuit filed by the Federal Trade Commission (FTC), which was amended on August 19, 2021.

On August 5, 2020, 20 state attorneys general sent a joint letter to Facebook requesting that Facebook make greater voluntary efforts to block harmful content. In an interview with the New York Times, Attorney General Gurbir S. Grewal of New Jersey (who signed the letter), stated that if Facebook did not take action, “we always have a variety of legal tools at our disposal.” As one law review author concluded,

> In other words, Grewal appeared to be suggesting that if Facebook failed to do a better job of blocking hate speech and other harmful content, state prosecutors would seek legal remedies against it, thus opening the door to direct legal regulation of Facebook’s content moderation policies.

Given the alarming rise of synthetic opioids in the United States, perhaps now is a good time to request that Facebook and other social media platforms voluntarily extend the coverage of their community standards and terms of service by explicitly adding fentanyl, synthetic opioid, and other related precursors. Further, Facebook and other social media platforms should be asked to report on, and be held accountable for, how effective their systems are at identifying fentanyl and synthetic opioid precursors and removing them. Social media websites like Facebook could play an important role in reducing the supply of fentanyl and related precursors if they chose to self-regulate content on their platforms concerning these chemicals.

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47 U.S. Code, Title 47, Telecommunications; Chapter 5, Wire or Radio Communication; Subchapter II, Common Carriers; Part I, Common Carrier Regulation; Section 230, Protection for Private Blocking and Screening of Offensive Material.
51 See Lenny Bernstein and Joel Achenbach, “Drug Overdose Deaths Soared to a Record 93,000 Last Year,” Washington Post, July 14, 2021.
Self-regulation, in this case, could take the form of the social media platforms explicitly prohibiting content concerning fentanyl and synthetic opioid precursors in their terms of service and (if applicable) community standards, as well as voluntarily adding fentanyl and synthetic opioid precursors, their Chemical Abstracts Service (CAS) numbers, and their International Union of Pure and Applied Chemistry names to their AI technologies and “hash” databases for content moderation. Because of the dynamic and changing nature of codewords associated with fentanyl or other related chemicals, for this type of self-regulation to be effective, social media platforms would need to commit to ongoing updating of the codewords and compounds that are included in these prohibitions. Along with taking steps to increase self-regulation, these platforms would need to partner more with law enforcement, by either creating or enhancing ongoing federal law enforcement partnerships.

In the longer term, it would be helpful for social media platforms to publish on their public websites a comprehensive monthly report cataloging the prevalence of fentanyl and synthetic opioid precursors on their social media platforms, with details about how effective their systems are at identifying that content and removing it. This report could be modeled on current practices that social media companies use to counter hateful speech to comply with requirements established by the European Union. Additionally, social media companies should be given incentives to improve and implement image-screening technology for content about fentanyl or synthetic opioid precursors.

There are several options to consider in addition to the self-regulation of these social media platforms. The U.S. Department of Justice, the FBI, and other federal law enforcement agencies could undertake a comprehensive effort to investigate and prosecute online vendors of fentanyl and synthetic opioids and systematically gather intelligence and data about the online supply network of fentanyl and synthetic opioids in the United States.

Congress could evaluate the importance of using incentives to encourage social media platforms to monitor their platforms and delete content concerning fentanyl and synthetic opioid precursors, perhaps as part of its consideration of changes to Section 230 of the Communications Decency Act, specifically, the provisions concerning liability of social media companies for harm caused by content published on their platforms. Congress could also conduct a study of whether and how Congress should provide new authorities and enforcement powers to FTC or another government agency to oversee content moderation activities of social media websites concerning fentanyl and synthetic opioid precursors. Such a study could consider the best models for content monitoring activities on social media websites and develop best practices for a formalized content monitoring function for fentanyl and synthetic opioid precursors that would be required by legislation for all social media websites.

GAPS IN LAW ENFORCEMENT INFORMATION-SHARING AND COORDINATION

Overview

Synthetic opioids are entrenched in some drug markets in specific regions across the United States, and analysis of seizure and overdose death data show that fentanyl is expanding in previously untouched parts of the western United States (see Appendix B). Such geographic concentration and diffusion points to two law enforcement goals to help disrupt and mitigate a worsening overdose crisis: first, how to address the worsening problem in highly affected areas where synthetic opioids are supplied in novel products or in new ways, and second, how to prevent the emergence of illegally manufactured fentanyl from expanding to other currently less-affected drug markets.

Addressing both goals has become a significant challenge for law enforcement, and shortfalls in information and intelligence-sharing strategies have been highlighted in other aspects of emerging security threats (e.g., terrorism, extremism). Further, law enforcement at all levels (federal, state, local, tribal, and territorial) plays an important role in combating the supply of illegal substances. Specific to synthetic opioids, analysis throughout this body of work shows that fentanyl and other synthetic opioids are supplied in ways that may elude existing supply-reduction efforts (e.g., online sourcing and mail delivery, supply of undetectable novel compounds that are uncontrolled). Further, they are concealed in forms that elevate risk to buyers (e.g., counterfeit tablets or mixed with stimulants), making it challenging to law enforcement to disrupt and interdict the flow of these drugs.

The Commission, in this section, sought to examine the role of domestic law enforcement in the United States, especially how existing efforts for information-sharing and coordination may be leveraged (or improved) to respond to ongoing changes in drug trafficking and retail distribution. The Commission’s analysis focuses on gaps in law enforcement intelligence information-sharing and coordination with respect to combating the trafficking of synthetic opioids within the United States. The Commission does not address information-sharing and coordination with international law enforcement agencies. In its analysis of domestic gaps, the Commission first briefly describes the major federal agencies and initiatives in this area, then discusses what it learned from document reviews and interviews about potential gaps that remain in intelligence information-sharing in this area and outlines possible options for addressing those gaps.

Law Enforcement Agencies at the Federal, State, and Local Levels Are Involved in Combating the Synthetic Opioid Threat

At the federal level, some of the primary agencies involved in combating the synthetic opioid threat include the U.S. Department of Justice (e.g., the FBI, DEA, U.S. Attorney’s Office), the U.S. Department of Homeland Security (e.g., CBP, HSI, ICE), and the U.S. Postal Service and U.S. Postal Inspection Service (USPIS), among other agencies.

There are also various initiatives at the federal level relevant to this area such as the Organized Crime Drug Enforcement Task Force (OCDETF) Program of the Department of Justice, which conducts multijurisdictional investigations of significant drug-trafficking and money-laundering networks, and ONDCP’s High Intensity Drug Trafficking Areas (HIDTA) Program, which coordinates and provides funding to joint initiatives of federal, state, local, and tribal agencies to carry out activities to address the specific drug threats. In addition to the HIDTAs’ and fusion centers’ task forces, there are numerous other task forces at the federal, state, and local levels involved in addressing the drug-related threat. All of these entities have a role in combating the synthetic opioid threat. The sheer number of them illustrates the complexity and challenges associated with law enforcement information-sharing in this area as discussed below.

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54 The Commission has not dedicated a portion to the evolving law enforcement response that involves harm-reduction strategies given the Commission’s mandate to focus on reducing supply. The Commission recognizes that harm-reduction efforts are important features in the overall strategy.
55 In addition, the OCDETF Fusion Center (OFC) collects and analyzes drug and related financial investigative information and intelligence from a variety of sources to support OCDETF’s coordinated, multijurisdictional investigations of significant drug-trafficking and money-laundering networks.
56 Fusion centers were created in response to the 9/11 Commission Report critique about information-sharing gaps. While fusion centers are designed to combat the threat of terrorism, they also serve all crimes and all hazards, which has significant overlaps with law enforcement (and other public safety agencies) in general, as well as HIDTAs.
Information-Sharing Specific to the Synthetic Opioid Threat

It is critical to understand that there are additional law enforcement concerns that are interwoven with synthetic opioid trafficking. Violent crime occurs throughout the flow of synthetic opioids, from the initial producers and suppliers to the end users and into correctional facilities. Property crime and other types of disorder (criminal or noncriminal) also occur throughout synthetic opioid supply networks. Thus, information systems used for all types of law enforcement investigations are also used in synthetic opioid investigations. Last, distribution, sales, and purchases of synthetic opioids do not necessarily occur in a vacuum and have significant overlap with other drugs. This explains part of the reason why there is not a stand-alone program or effort on synthetic opioid information-sharing only.

Intelligence Information-Sharing Networks

Table H.4 lists the five major law enforcement intelligence information-sharing portals identified by interviewees. Except for the OCDETFs, these portals are not specific to synthetic opioids or drug-related crime per se, but rather are information-sharing portals intended to provide a range of intelligence information needed by law enforcement to detect, interdict, and investigate all types of crimes.

Table H.4
Intelligence Information-Sharing Portals

<table>
<thead>
<tr>
<th>Portal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPIC(^a)</td>
<td>The El Paso Intelligence Center (EPIC) is an all-threats center with a focus on the Western Hemisphere and a particular emphasis on the southwest border. EPIC’s primary focus is on criminal activity within the United States. EPIC is comprised of over 20 agencies and offers tactical, operational, and strategic intelligence support to FSLTT and international law enforcement organizations. The center provides access to law enforcement systems; collaboration occurs daily through exchanges with law enforcement analysts and operators and routine engagement with FSLTT partners. EPIC directly supports synthetic opioid investigations and interdictions by working with and providing information to FSLTT law enforcement officers. This includes supporting wiretaps and pole camera monitoring, as well as providing information regarding “hits” on targets of interest.</td>
</tr>
<tr>
<td>HSIN(^b)</td>
<td>The Homeland Security Information Network (HSIN) is DHS’s official system for sharing sensitive but unclassified information between FSLTT and international and private-sector partners. The system supports daily operations (such as counter narcotics and combating transnational organized crime), planned events, and incident management and emergency response. HSIN users can securely request, share, and access information and resources to support their mission needs. A separate feature, HSIN-Intel, includes the ability to exchange information for those associated with HDTAs, fusion centers, or other recognized intelligence agencies.</td>
</tr>
<tr>
<td>Portal</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>RISS Program&lt;sup&gt;c&lt;/sup&gt;</td>
<td>The RISS (Regional Information Sharing Systems) Program provides law enforcement with analytical and investigative support services, an event and target deconfliction system, and other information-sharing capabilities. There are six regional RISS centers and two primary user systems that are applicable to this research: RISSIntel and RISSafe. The program offers other services to law enforcement agencies as well, including through RISSNET. Other initiatives supported by RISS applicable to synthetic opioid investigations are the RISS Money Counter Network that stores currency serial numbers; the RISS Property and Recovery Tracking System, which often has direct ties to drugs; and special equipment to support investigations. RISSafe is an event deconfliction system designed for information-sharing to support officer safety. It provides event and target deconfliction through the RISSafe Watch Center, ensuring that officers know about any potential conflicts that could affect their safety. The system is also integrated with SafetyNet and Case Explorer. RISSIntel is an application that allows for searches that integrate over 60 RISS and partner intelligence databases. Both RISSafe and RISSIntel are used in synthetic opioid–related cases and investigations.</td>
</tr>
<tr>
<td>OCDETF Fusion Center&lt;sup&gt;d,e&lt;/sup&gt;</td>
<td>The Organized Crime Drug Enforcement Task Force (OCDETF) Program is an effort that was established combat illegal drugs in the United States and the violence associated with it. OCDETF is a task force comprised of over 500 federal prosecutors, 1,200 federal agents, 5,000 state and local police whose actions include information-sharing, targeting, intelligence-sharing, and other efforts to combat transnational organized crime to include drug-trafficking networks. Specific to information-sharing, the OCDETF Fusion Center (OFC) is a platform that allows information- and intelligence-sharing specific to drug trafficking. According to DOJ, OFC has the largest single repository of federal and foreign investigative reporting.</td>
</tr>
<tr>
<td>FBI Law Enforcement Enterprise Portal (LEEP)&lt;sup&gt;e&lt;/sup&gt;</td>
<td>LEEP is a secure internet-based platform for law enforcement agencies that provides investigative tools and analytical resources. Users with access to LEEP can also access RISSNET as well as the National Data Exchange, the National Gang Center, and other tools providing information that support officer safety and case collaboration.&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
</tbody>
</table>


<sup>a</sup> U.S. Drug Enforcement Administration, U.S. Department of Justice, “El Paso Intelligence Center,” webpage, undated.


The intelligence information-sharing portals differ in their focus, function, and who has access to them (Table H.5). For example, the FBI’s Law Enforcement Enterprise Portal (LEEP) supports law enforcement investigations for crime in general by providing access to multiple tools, whereas the Homeland Security Information Network (HSIN) is specific to homeland security threats, and only OCDETF is specific to drug-related crime. Several databases are intended to support investigations, whereas EPIC is strictly focused on tactical intelligence.

### Table H.5
**Comparison of the Five Major Intelligence Information-Sharing Portals**

<table>
<thead>
<tr>
<th>Portal</th>
<th>Focus</th>
<th>Function</th>
<th>Who Has Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPIC</td>
<td>All crimes/all threats; focus on Western Hemisphere, in particular criminal activity within the United States with an emphasis on the southwest border</td>
<td>Focuses on collection and dissemination of tactical intelligence; tactical database</td>
<td>Federal, state, and local law enforcement agencies</td>
</tr>
<tr>
<td>HSIN(^a)</td>
<td>Threats to the homeland; provides access to homeland security and counterterrorism data</td>
<td>Shares sensitive but unclassified homeland security data</td>
<td>Federal, state, local, tribal, territorial, international, and private-sector partners(^b)</td>
</tr>
<tr>
<td>RISS</td>
<td>Law enforcement, all crimes</td>
<td>Intelligence information-sharing for investigations and deconfliction purposes</td>
<td>Law enforcement only</td>
</tr>
<tr>
<td>OCDETF OFC</td>
<td>Drug-related criminal intelligence and crimes, counternarcotics</td>
<td>Prosecutor-led, multiagency approach to enforcement</td>
<td>U.S. Attorney’s Offices, ATF, DEA, FBI, IRS, ICE, Coast Guard, U.S. Marshals Service, Criminal and Tax Divisions of DOJ, state and local agencies</td>
</tr>
<tr>
<td>LEEP</td>
<td>Law enforcement</td>
<td>Web-based investigative tools; analytical resources</td>
<td>Law enforcement agencies, intelligence groups, CJ entities</td>
</tr>
</tbody>
</table>

NOTES: ATF = Bureau of Alcohol, Tobacco, Firearms and Explosives. CJ = criminal justice.


Previous assessments of information-sharing capabilities have noted the overlap in some analytic capabilities between HIDTAs, fusion centers, RISS, the FBI Joint Terrorism Task Force, and FBI Field Intelligence Groups. In addition, the Government Accountability Office (GAO) identified instances of overlap in investigative support activities between these entities. According to interviewees, DHS, DOJ, ODNI, ONDCP, the FBI, HIDTAs, the National Network of Fusion Centers, and RISS have undertaken various steps to address GAO’s concerns including cross-entity participation on governance boards and colocation of entities to increase efficiencies through shared facilities and resources to reduce overlap through coordinated or collaborative products, activities, and services. Several interviewees, for instance, gave examples across the HIDTA network of colocating analysts from different agencies in HIDTAs’ Investigative Support Centers or in the state or major urban-area fusion centers.

Access and Use of Information-Sharing Systems

During the interviews, the Commission sought to understand how intelligence and information about synthetic opioids get to the local police officer or agent. Interviewees commented that a key challenge was the fact that not every law enforcement officer has access to all five of the major intelligence information-sharing portals described in the previous section. Local law enforcement officers, for example, may not have an RISS or HSIN account. Even so, law enforcement officers need to have a password to access each of the individual information-sharing portals. As one interviewee explained: “We set it up so you can get into the shopping mall but now you have to get into each of the stores.”

Overall, there is no single database that assists with synthetic opioids only, or one investigative database that acts as a clearinghouse for investigations. Rather, like law enforcement, these tend to be decentralized. One interviewee offered the following advice:

To get all the information, you’d have to have all these stakeholders in one place to share. The fusion centers do a great job of sharing information. The HIDTAs, EPIC [El Paso Intelligence Center]. Great storehouses of information. But you have to know what you’re looking for before you can share.

This in itself represents a gap—even with information and intelligence being collected and shared, it is not easily accessible.

The RISS Program is one way that local law enforcement intelligence databases are being connected: A law enforcement agency either uses RISS as its intelligence system or allows connectivity to the agency’s intelligence database. Although there are approximately 9,500 law enforcement–equivalent justice agencies in RISS, a gap noted by an interviewee was that this still represents a fraction (more than half) of the many law enforcement agencies around the country. Further, RISS doesn’t own the data per se but is dependent on what information law enforcement agencies are willing to share. Some agencies are willing to share a great deal of investigative information, while others may only share limited suspect information.

With respect to EPIC, its Watch Operations have federal policies in place that require federal agencies to call in for a federal drug ID number. This information then feeds into the analysis of trends and tracking of drug seizures. Each agency is responsible for inputting their information. An interviewee estimated that 75 percent of calls to the

EPIC Watch Center are from state and local law enforcement. Still, the interviewee noted that many law enforcement officers do not know about EPIC.

Another limiting factor is that these intelligence information-sharing systems are only as good as the information they contain. This problem is not limited to national intelligence-sharing efforts, as interviewees indicated that it seemed to be a pervasive issue as it comes to combating the synthetic opioid problem. Also, interviewees acknowledged that there is a reluctance by some law enforcement agencies to share case information: “Poaching” and a sense of competition between agencies still exist. That is, some agencies may inquire about leads, or “fish” for information instead of collaborating on cases. This behavior is consistent with long-standing law enforcement culture58 and was noted throughout interviews.

Last, interviewees commented that the intelligence products provided by the federal government are not always that useful to local law enforcement. As one interviewee explained, local law enforcement knows a lot about what is happening on the streets within their jurisdiction, whereas federal intelligence partners may not always have that same visibility. Sometimes there is a disconnect in terms of what each one knows. “We don’t really have a platform that allows for seamless communication between the intelligence community and law enforcement at the local level—partly due to clearance issues between HIDTAs, fusion centers, and partners in RISS.” Further, interviewees noted there is a translation issue between the way information is disseminated and written for law enforcement. An interviewee explained, the hardest part is that HIDTAs and their Investigative Support Centers know how to talk to law enforcement; however, the federal government’s standards for intelligence reports and products and how they are written do not always translate to how local police officers think about a threat.

In summary, there are several limitations in information-sharing aimed at disrupting the supply of synthetic opioids using greater law enforcement targeting. First, the actual knowledge of the various systems and the tools behind them (e.g., LEEP enabling access to other features) is unknown, especially as it relates to combating synthetic opioids. Second, information, whether tactical or strategic, may not reach the officer who needs it. Further, the products disseminated by the various entities may not be effective. Last, resources are not universal across law enforcement and supporting entities. These include personnel such as analysts.

The Unique Law Enforcement Challenge of Online Marketing of Drugs

The online buying, selling, and marketing of opioids on social media sites and the darknet presents a major challenge to law enforcement agencies, particularly state, local, tribal, and territorial. Interviewees commented that most law enforcement officers know little about the darknet. From an investigative perspective, many local law enforcement agencies do not have the tools or training to conduct such complicated investigations. Further, most agencies do not have policies on how to conduct online investigations especially as they relate to drugs, and they lack specially trained investigators or analysts in this area. As one interviewee commented, they now have tons of investigative leads that could be followed up on if enough resources were available to work the online threat. These resource constraints are not limited to investigations into the darknet but include other aspects of technology-facilitated trafficking, distribution, and purchase of synthetic opioids or products containing synthetic opioids. Federal capability is needed because online selling is not tied to a single jurisdiction.

The use of cryptocurrency presents law enforcement with other notable challenges associated with the move to online buying and selling of drugs because the value of seized cryptocurrency (or cryptocurrency being used in an investigation or controlled buy) changes.

Interviewees noted that the Joint Criminal Opioid and Darknet Enforcement (JCODE) team is a joint effort to address the online threat. In 2018, Attorney General Sessions announced the creation of JCODE as a new tool to fight online drug trafficking with dozens of special agents, intelligence analysts, and professional staff assigned to JCODE to focus on the issue of online opioid trafficking.  

Created in 2018, JCODE combines the efforts of the USPIS, HSI, Drug Enforcement Administration (DEA), U.S. Customs and Border Protection, Department of Justice, Financial Crimes Enforcement Network, Naval Criminal Investigative Service, Department of Defense, and Bureau of Alcohol, Tobacco, Firearms and Explosives. As many of these markets cross borders, Europol is also an invaluable international partner in JCODE’s work to make a global impact on darknet drug trafficking. “The law enforcement personnel assigned to JCODE specialize in threats where traditional criminal activity intersects with sophisticated technological platforms,” FBI Director Christopher Wray said.

Summary of Law Enforcement Information-Sharing and Coordination Challenges

There are over 17,000 law enforcement agencies and nearly 700,000 full-time sworn law enforcement officers in the United States. The majority of law enforcement agencies are small, with nearly half of all local police departments having fewer than ten officers. State and local law enforcement work independently and together on pressing drug and gang issues and enforcement. For example, all local police agencies serving populations of 1 million or more participate in drug task forces; 92 percent of these departments participate in gang task forces. Contrast this with agencies serving small populations (2,499 or fewer residents), where 31 percent participate in drug task forces and 3 percent in gang task forces. These statistics, however, are independent of individual law enforcement agencies that have dedicated units (or personnel) for narcotics enforcement. These statistics highlight that law enforcement agencies differ widely in their capabilities and information-sharing needs.

The fragmentation of law enforcement agencies and training is a limiting factor when it comes to better targeting and responding to emerging trends in local markets or trafficking patterns. Local authorities, for example, may not have the training or equipment to robustly analyze drug seizures to detect emerging synthetic opioids or investigate the online sale of drugs on the darknet. This is important as the illegal supply of synthetic opioids is not concentrated in major urban areas, as was prior drug distribution and use problems. Today, anyone can use the internet and mail systems to transact small quantities of synthetic opioids, suggesting that nonmetro and rural areas may face this problem without warning. Some jurisdictions, particularly more rural areas, may be less prepared given limited tools, lack of intelligence or threat sharing, and the proper protocols and procedures to investigate.

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62 Shelley S. Hyland and Elizabeth Davis, Local Police Departments, 2016: Personnel, Bureau of Justice Statistics, Office of Justice Programs, U.S. Department of Justice, NCJ 252835, October 2019, revised January 27, 2021. In 2016, there were 12,300 local police departments in the United States; 71 percent serve populations of less than 10,000 residents; about half of local police departments employed fewer than ten officers.

online or mail-based drug trafficking. Thus, information-sharing is needed to better prepare law enforcement in some parts of the country.

Law enforcement information-sharing and training related to combating the synthetic opioid threat involves sharing of information about investigations and about drug-related overdoses and drug distribution networks, as well as the sharing of case information for deconfliction purposes. There are five major information-sharing networks and three national deconfliction systems, yet it is clear from the Commission’s work that not all law enforcement entities (HIDTAs, fusion centers, etc.), analysts, investigators, or police officers have access to the same networks for intelligence information-sharing or for case deconfliction purposes.

**FINAL POINTS**

Additional resources, approaches, and data systems will be needed to enhance the policymaking and law enforcement response to the illegal supply of synthetic opioids. The nature of the supply of these chemicals presents unique challenges, and criminal groups seem to exploit open platforms, such as social media, to transact in synthetic opioids or related precursors. Existing data collection and analysis systems, including those that collect measures on seizures as well as those related to outcome events like overdoses, are severely lacking and not well suited to the fast-moving nature of this problem (i.e., new drugs may not be properly identified or measured in drugs seized or in tissue samples analyzed).

Law enforcement fragmentation and the sheer number of law enforcement entities involved especially at the regional and local levels also presents additional challenges to enhanced coordination and information-sharing, especially of more complex investigations of online networks. This is particularly important for nonurban or nonmetro jurisdictions, given that drugs can be posted easily, bypassing traditional efforts to investigate drug transactions. Thus, there is a need to continue to support and fund efforts to educate law enforcement on information-sharing tools available to them and their specific use related to synthetic opioids. Initiatives that dedicate federal and state/local resources to fund positions and tools that support information-sharing specific to the synthetic opioid threat may also be needed.

The federal government is uniquely placed to expand the monitoring of emerging trends in drug markets and strengthen the capacities of local law enforcement agencies. The use of social media platforms by criminals to transact in these substances and related precursor chemicals will require additional attention. Congress in particular might need to consider ways to encourage or require greater self-monitoring and reporting by online platforms, similarly to how such websites continue to monitor and remove child pornography.

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64 *Case or target deconfliction* refers to law enforcement agencies investigating a case on the same target or suspect and sharing that information—that is, identifying independent investigations that are targeting the same person, location, or vehicle (Kent Shaw, “Avoiding Agency Conflicts in the Field: Deconfliction Is an Essential Officer Safety Tool,” *California Narcotic Officer*, Spring 2017).
Table H.6  
Summary of Vulnerabilities Identified in Surveillance, Online Social Media Platforms, and Law Enforcement Coordination and Information-Sharing

<table>
<thead>
<tr>
<th>Vulnerability</th>
<th>Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surveillance of Illegal Drug Markets in the United States</strong></td>
<td>The United States lacks good information about key trends and drug market indicators pertaining to both drug demand and drug supply. These lacunae emerge from limitations and imprecisions in how data are currently collected, methods for disseminating information, and the lack of data collection in certain areas.</td>
</tr>
<tr>
<td>Due to data limitations, it is difficult to properly assess the various supply- and demand-reduction strategies that have been implemented or to set targets for demand-reduction interventions that have not been implemented.</td>
<td>Principal information gaps include the following: There is no good estimate of the prevalence of illicit opioid use in the United States; there is only scant qualitative evidence on the intensity of illicit opioid use; good data on expenditures by people who use opioids are lacking.</td>
</tr>
<tr>
<td><strong>Federal law enforcement data are not routinely made available for policy-relevant analysis.</strong></td>
<td>On the supply side, good data on the range of chemicals being offered in the market are lacking, including at what purities and prices across the different stages of the supply chain.</td>
</tr>
<tr>
<td>Most federal law enforcement databases are administrative in nature. They were developed and implemented to support the agencies in executing their missions.</td>
<td>There are time lags in data collection, analysis, and reporting, and there is no national infrastructure for timely data sharing, particularly with respect to disseminating information on notable changes in illegal markets in the form of an early warning system.</td>
</tr>
<tr>
<td>When data are made available, challenges in using the data include a lack of documentation on the databases, an absence of formal public-use files, and a lack of transparency about the methods used to collect the data.</td>
<td>Rather than probability-based surveys that provide population estimates of the prevalence of incidents of interest, these data systems are convenience samples (albeit large ones) of incidents that become known to law enforcement through investigations.</td>
</tr>
<tr>
<td>Thus, statements derived from administrative data systems related to drug seizures apply only to the cases known to law enforcement. Therefore, data on seizures of cocaine, for example, at the southwest border do not estimate the total flow of cocaine into the United States, only the amount seized.</td>
<td></td>
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</tbody>
</table>
## OTHER VULNERABILITIES RELEVANT TO DISRUPTING THE SUPPLY OF SYNTHETIC OPIOIDS

<table>
<thead>
<tr>
<th>Vulnerability</th>
<th>Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The Supply of Synthetic Opioids and Related Chemicals on Social Media Platforms</strong></td>
<td></td>
</tr>
<tr>
<td>Social media platforms do not appear to monitor drug-related content on their own platforms. Little information might be shared with law enforcement.</td>
<td>Reducing online advertising and sales relies on voluntary compliance by online platforms, which might not be forthcoming, absent credible enforcement alternatives.</td>
</tr>
<tr>
<td>Search engine results facilitate online access to synthetic opioid advertising.</td>
<td>The online space in advertising synthetic opioids and chemical precursors is largely unregulated and unmonitored.</td>
</tr>
<tr>
<td>There is significant variation among and between social media platforms’ terms of service and community standards in terms of what topics they cover, how those topics are covered, and what language is used.</td>
<td>There is no standard language describing illegal activity or drug sales.</td>
</tr>
<tr>
<td><strong>Law Enforcement Information-Sharing and Coordination</strong></td>
<td></td>
</tr>
<tr>
<td>Numerous federal, state, local, tribal, and territorial law enforcement agencies have a role to play in combating the synthetic opioid threat. There are also numerous task forces that address drug-related threats.</td>
<td>The sheer number of entities underscores the challenges associated with law enforcement information-sharing in this area.</td>
</tr>
<tr>
<td>There are five major law enforcement intelligence information-sharing portals. However, only one portal—Organized Crime Drug Enforcement Task Forces (OCDETF)—is specific to synthetic opioids or drug-related crime per se.</td>
<td>Intelligence information-sharing portals differ in focus, function, and who can access them.</td>
</tr>
<tr>
<td>The buying, selling, and marketing of opioids online on social media sites and the darknet presents a major challenge to law enforcement agencies, particularly state, local, tribal, and territorial.</td>
<td>Additional law enforcement concerns, such as violent crime, property crime, and other types of disorder, are interwoven with synthetic opioid trafficking. Thus, information systems used for all types of law enforcement investigations are also used in synthetic opioid investigations. Many local law enforcement agencies do not have the tools or training to conduct darknet investigations. Furthermore, most agencies lack policies on how to conduct online investigations, especially those concerning drugs, and lack specially trained investigators and analysts.</td>
</tr>
</tbody>
</table>

**NOTE:** This table does not present an exhaustive list of vulnerabilities and challenges. Rather, it highlights those identified during this analysis.
Appendix I

HOW MUCH CAN MONEY-LAUNDERING CONTROLS REDUCE THE U.S. SYNTHETIC OPIOID MARKET?

A potential vulnerability of higher-level drug traffickers is their need to launder large amounts of cash. Each year, some high-level traffickers of cocaine, heroin, and other high-priced drugs have been convicted in U.S. courts because they could not avoid entanglement with the financial system even though they were able to separate themselves from the drugs. These drug traffickers were caught as a result either of the information generated by Suspicious Activity Reports (SARs) filed by banks and other financial institutions or some other aspect of the anti-money-laundering (AML) system that exists in almost all countries.

The purpose of this analysis is to examine what is known about the actual and potential role of AML for reducing the flow of synthetic opioids, primarily fentanyl at this time, to the United States. The trade involves two countries in addition to the United States: the People's Republic of China (PRC) as the source of the precursors to fentanyl and Mexico as the nation in which the precursors are processed before shipment of fentanyl to the United States. The analysis examines how each country has implemented money-laundering controls against drug traffickers and how much increased AML effort in any of the three countries might reduce the supply of synthetic opioids in the United States.

This appendix is based on a review of the following sources:

- Mutual Evaluation Reports by the Financial Action Task Force (FATF); for the PRC, Mexico, and the United States, detailed reports have been published on the functioning and effectiveness of the nation’s AML efforts
- studies of the structure of drug markets generally and of the extent of money laundering related to drug markets
- journalistic and gray literature reports, as well as academic studies on the effectiveness of AML controls.

In addition, project interviews with officials were used largely to test findings from other sources specifically on international money-laundering methods. Data on drug seizures or counts of individuals sentenced for violating federal AML laws were furnished to the Commission for this report.

The analysis suggests that there is no evidence that AML has substantially reduced drug markets in the past. Moreover, there are structural aspects of drug distribution, in particular the modest share of revenues that require laundering and the fact that AML targets a small number of those involved in the drug trade, that make it unlikely to have much effect in general. For synthetic opioids that pessimism is made even stronger by the extraordinarily small share of total revenues associated with the production of the drug. Though more-intense investigation and prosecution of money laundering in both the PRC and Mexico might yield more cases against high-level traffickers, there is no basis for believing that this will reduce the flow of synthetic opioids to the United States.
However, the Commission notes the barriers to providing a definitive assessment of the potential of intensified AML. AML may still serve useful ends in disrupting transnational criminal organizations (TCOs).

THE CONNECTION BETWEEN DRUG TRAFFICKING AND MONEY LAUNDERING

The Demand for Money-Laundering Services

Two erroneous assumptions bedevil analysis of the connection between money laundering and drug distribution:

- It is often asserted that drug sales account for a large share of all the money that is laundered globally.\(^1\) Though estimates in this area are extremely imprecise,\(^2\) it is very unlikely that this is true; white-collar crime (e.g., embezzlement, fraud, tax evasion) and corruption are globally much larger according to most systematic estimates.\(^3\)
- It is assumed that all drug revenues need to be laundered. In fact, the majority of the value added in drug distribution goes to low-end dealers who earn modest amounts from the trade. These dealers spend money on daily expenses and have no need to launder their earnings. A 2020 analysis suggests that for a major heroin market, perhaps no more than one-quarter of total revenues would require formal laundering.\(^4\)

Nonetheless, high-level drug traffickers do launder large absolute sums. When HSBC was fined in 2012 for its failure to file SARs on suspected money laundering by drug dealers in its acquired Mexican affiliate branches, the U.S. government alleged that the amount was in excess of $880 million.\(^5\) Pablo Escobar and his associates were laundering about $600 million annually in the late 1980s.\(^6\) However, those large figures were associated with multiple drugs, not just opioids, and fentanyl’s low prices imply that its producers receive much lower revenue streams than heroin producers in the past did for producing the same amount of MME (morphine-milligram equivalent), a standard way of assessing the amount of active ingredient.

Drug dealers launder money for two distinct reasons, one internal to the market and the other external. The first reason is that large sums have to be moved within the drug trade. The only dealers who need to launder money internally are those moving money internationally. High-level wholesalers receiving cash from customers can pass on the sum of payments from all their customers (minus the wholesalers’ value added) to their supplier without

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laundering. Only the importer who seeks to send the money out of the country has to launder it. For example, an exporter from Mexico receives payment for delivery of 100 kg of heroin, which might at that point be worth $2 million to $3 million. As noted above, financial institutions are legally required to monitor and report unexplained deposits of large amounts of cash; hence placement in banks is risky. Similarly, carrying large amounts of cash across borders, whether by plane or car, is risky because border authorities (and highway patrol) have the right to search and seize such currency if an adequate explanation cannot be offered. Finally, there is also risk of robbery by other criminals.

The second reason drug dealers launder money is to enjoy the fruits of their illegal commerce—to be able to spend money for such goods and services as houses, cars, and travel beyond what can be purchased with cash. Making such expenditures often requires the ability to show that the large sums involved in the purchase were acquired legally—which is exactly the goal of money laundering.

How Do Money-Laundering Controls Reduce Drug Markets?

Assume that AML becomes more effective in the sense that a drug dealer faces (1) a higher risk of being detected when trying to launder money (the result of improved bank filing of SARs, more investigative resources, better targeting); (2) having assets seized (e.g., more or better border inspection activities); or (3) receiving a long sentence for money laundering (e.g., changes in sentencing laws, better trained prosecutors). How does that affect a drug market? Again, there are two channels, one on the money-laundering supply side and the other on the demand side, since AML prosecutions can target both the customer for money laundering (drug dealer) and the provider of money-laundering services.

With the higher risk of being caught or penalized, a professional money launderer will need to receive a higher compensation for providing the service. That increase in cost in turn increases costs for the drug dealer (channel 1), reducing the share of profits the dealer gets to enjoy (channel 2). In theory, drug dealers will raise prices to maintain the return for the risks they take in entering this market or occupation. The higher prices will lead to lower consumption.

One principal limitation of this logic model is that the cost of money-laundering services does not now represent a large proportion of the overall drug distribution system’s cost structure. As discussed below, money laundering may cost less than 5 percent of the total being laundered, which itself is much less than total revenue. Even doubling a minor cost does not radically alter the system’s overall costs, so resulting effects on retail prices may be modest.

On the money-laundering demand side, more effective AML increases the riskiness of being a drug dealer. The dealer now has to calculate not only the probability of being caught with the drugs themselves but also the risks associated with laundering the revenues since the customer of a money launderer will also be charged with a money-laundering offense. That higher risk will lead drug dealers to require higher compensation for their services; again, that likely will lead to higher prices and lower consumption.

7 Traffickers can choose to send the money out of the country and then launder it in their home country. That is the situation described in Melvin Soudijn and Peter Reuter, “Cash and Carry: The High Cost of Currency Smuggling in the Drug Trade,” Crime, Law and Social Change, Vol. 66, 2016, and summarized below.
This analysis reflects a commonly used economic model of drug markets. That model, known as the “risks and prices” model of drug prices, rests on a few economic principles.

- At least for markets that are mature (i.e., have been operating at scale for some years), the usual “single price” rule is applicable. Though prices may vary across sellers (reflecting convenience, perceived quality and safety, customer search activities) the range of variation is modest, and prices do not bounce around greatly over time.
- There is an economic logic to the change in prices across distribution levels, reflecting the risks to which dealers are exposed from the government (arrest, drug seizure, asset seizure) and from other market participants (theft, injury).
- The time-and-materials costs of moving drugs are modest. The major driver of the high prices of illegal drugs is the risk compensation just discussed.
- As a result, drug dealers enjoy high “accounting profits” (dollar revenues that greatly exceed dollar costs), but their “economic profits” are “normal” (justified); otherwise, other people (“wannabes”) would enter the market and bid down prices.

The concept of “free entry” bidding down prices runs contrary to journalistic accounts of drug cartels. And indeed, markets for niche drugs may not be competitive in this sense, and importation, in particular, may require specialized skills or contacts, but domestic drug distribution really does not take much in the way of specialized skills. It basically involves buying a large bag of powder, repackaging that into smaller bags, and selling those smaller bags. So, there are always people waiting in the wings ready to try their hand at drug dealing if the price markups become greater than is justified by the (considerable) risks involved in drug selling.

Not everyone believes in this model of drug markets, and like all models, it is a simplification of reality. Though it has not been empirically tested, it may also apply to the market for money-laundering services; this market is also characterized by competition, few barriers to entry, and active search by customers.

Notwithstanding the presence of drug selling on the internet or the obvious appeal of anonymous cryptocurrencies, at least until now cash has been king for drug dealers, much more so than for other kinds of criminal earnings such as fraud and embezzlement. Estimates of the share of drug transactions that are made through the web, even including those on the dark web (the part of the web that can only be accessed through special software and that is not indexed by search engines) always suggest far less than 10 percent by value. A November 2021 announcement by Europol about the takedown of what was described as the world’s largest dark web market reported only about $170 million in transactions over a 17-month period. Moreover, not all those transactions involved drugs. Relative to global drug market revenues of hundreds of billions of dollars, these are trivial figures.

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11 Figures are according to Global Drug Survey, which are not representative and probably skew to online or internet use (David Pegg, “Global Drug Survey 2015 Shows More People Buying Online Than Ever Before,” *The Guardian*, June 7, 2015).

It is widely believed that the rise of cryptocurrencies will lead to a large increase in the share of web purchases, but the uptake has been slow, even as of 2021.\textsuperscript{13} Many factors have been suggested, such as the low technological skill and limited access to computers of many of those who use cocaine, methamphetamine, and opioids heavily. These customers are also likely to have limited ability to save money so as to buy in the somewhat larger quantities that characterize internet-mediated transactions.\textsuperscript{14} That said, there is little literature on the use of cryptocurrencies for money laundering, and this technology is rapidly evolving.

Even at the highest levels of the trade, transactions are almost exclusively in cash. For example, there is one analysis of the accounts of six enterprises in the Netherlands whose sole line of business was to transport the sales proceeds of Colombian cocaine smugglers back to Colombia.\textsuperscript{15} The businesses operated between 2003 and 2008. Each enterprise handled tens of millions in euro notes each year for customers who needed to transport millions of euros from each cocaine shipment. The first task was to convert the small and medium-size bills into €500 notes to allow for concealment in specially constructed backpacks; each courier carried between €200,000 and €400,000. That initial conversion cost 3 percent of the value, and the total cost, including payments to couriers (airfare plus a modest cash payment) and the occasional loss, was well over 10 percent of the revenues, perhaps as much as 15 percent.

Likewise, when HSBC was fined more than $1 billion in 2012 for laundering drug market revenues through its recently acquired Mexican affiliate, it was again the handling of currency that was so striking: Mexican drug dealers had developed cash boxes that fit the specific shape of the teller’s windows in the HSBC branches,\textsuperscript{16} indicating just how much the bank was involved in laundering cash specifically. A study of money-laundering cases from the Royal Canadian Mounted Police, of which more than three-quarters involved drug dealing, found cash to be central in 94 of the 149 cases.\textsuperscript{17} Recent U.S. Department of Justice drug cases often provide details of how traffickers handle large sums of cash.\textsuperscript{18}

A more recent analysis of 30 investigations into organized crime cases in the Netherlands also found a predominant role of cash, including in online drug-trafficking cases, where traffickers exchanged at least some of the

\textsuperscript{13} For a recent discussion of the role of cryptocurrencies in illegal drug markets, see the 2020 report on the cryptocurrency enforcement network (Cyber-Digital Task Force, Office of the Deputy Attorney General, U.S. Department of Justice, Cryptocurrency Enforcement Framework: Report of the Attorney General’s Cyber Digital Task Force, October 2020). There are no systematic estimates of the scale of drug transactions that use cryptocurrency, but there is a dearth of evidence of very large operations. For example, a very long-running cryptocurrency operator in the dark web (Bitcoin Fog) had handled only $335 million in the course of a decade, even though it transacted in many other criminal markets, not just drugs (Office of Public Affairs, U.S. Department of Justice, “Individual Arrested and Charged with Operating Notorious Darknet Cryptocurrency ’Mixer,’” press release, April 28, 2021).

\textsuperscript{14} As shown in Appendix E, existing literature suggests that the volume of transactions on darknet marketplaces range from single grams to tens of thousands of grams. As another indication of the volume of internet-mediated transactions, the size of seizures at international mail facilities, a large share of which can be expected to originate with an online order, is around 10 grams (g); see Appendix C. By contrast, retail transactions at physical markets are much smaller, with daily consumption estimated at 0.5 g among daily users (see Appendix B).


cryptocurrency earned online for cash. A Dutch criminologist (personal observation) notes that this specific method has been less frequently used in recent years; it has been largely replaced by the use of underground banking networks, but traffickers still have to handle cash. Cash is the curse of the drug trade.

Money launderers may charge more to launder drug money, representing the higher risk that they incur of being caught, given that drug enforcement is more intense than enforcement against most kinds of white-collar crime or corruption. Laundering drug moneys may also generate longer sentences than laundering the fruits of tax evasion, also likely to increase the prices that money launderers charge for laundering a given amount of money.

Can Money-Laundering Controls Reduce Drug Markets: Analytic Frame

The AML system, in more or less its current configuration, has been in place in the United States for almost 30 years. What is the evidence about its effect on different drug markets during that period?

This is a difficult, perhaps even impossible, research question. Measures of the size of drug markets are imprecise. For example, the 2019 estimates of the U.S. heroin market, themselves the latest in a series of such estimates with increasingly sophisticated methodology, show a plausible range of $17 billion to $85 billion. Prices are also measured imprecisely. There is no agreement on how to measure the intensity of AML enforcement. To the Commission’s knowledge, no paper has directly addressed empirically how much AML has raised the price of any drug. Here, the Commission offers some theoretical reasons for being skeptical that AML has had a substantial effect. Cocaine will serve as the example, but the argument would be identical for heroin and fairly similar for cannabis and methamphetamine. The Commission leaves to later an extrapolation to fentanyl.

Money laundering is either provided by the dealer or is purchased from others, sometimes a professional money launderer. The Commission has already noted the two components, internal (for paying other drug dealers) and external (enabling consumption expenditures and capital accumulation). The drug trade is highly pyramided; a small number of distributors at the high end and a very large number of retailers at the bottom. Production of cocaine and heroin is similar, with many growers at the bottom. The supply chain for heroin is described in Appendix C as an hourglass shape, with a few individuals responsible for smuggling and the high-end distribution within the United States, and very large numbers at the beginning and end of the trade. That model produces a very uneven earnings distribution at the drug-dealer level. Only those earning more than, say, $100,000 will need to launder money for consumption purposes. That probably excludes all retail dealers and perhaps most of those selling at the low wholesale level.

Assume that before the creation of an AML regime, a high-level drug dealer charged his customers (themselves lower-level dealers) $20,000 per kilogram of cocaine and received $20 million annually in gross revenues. The high-level dealer in this example can be seen as the first buyer of cocaine at entry into the United States, purchasing in amounts of 50 to 100 kg once a month. As a consequence of the risks imposed by the AML regime, assume that he now has to pay 10 percent of the proceeds to a money launderer and hence receives only $18 million. Under the assumption of competition between drug dealers, which seems a reasonable characterization of such a market, the

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21 The vast majority of drug traffickers are male; hence the use of male pronouns.

$20 million previously just compensated the dealer for risks (legal and otherwise) and other costs. In the face of reduced net returns, the dealer will raise prices to customers and thus increase the retail price of cocaine. Numerous studies have shown that even for addictive drugs, demand is responsive to price, though the elasticity is always estimated to be less than one. A 10-percent increase in retail price might reduce consumption by 5 percent.

However, increases in the high-level price charged by the trafficker have modest effects on retail prices. The most commonly used version of the risks and prices model (explained previously) suggests that this increase will raise the price at retail level not by roughly 10 percent but by roughly $2,000 per kilogram. Since the cocaine sells at retail at $100,000 per kilogram (equivalent to $50 per street gram, which is 50-percent pure), that will raise the price to the customer by about 2 percent. It seems then unlikely that more-intense AML, even if it increases risks associated with the laundering of drug moneys, will raise retail cocaine prices substantially and thus much reduce consumption.

How the AML System Works

The United States has had laws prohibiting the effort to conceal the criminal origins of funds since 1970 (the Bank Secrecy Act). The central element of the AML system is the requirement that financial institutions and designated nonfinancial businesses and professions report suspicious activities (customers, transactions) to the Financial Crimes Enforcement Network (FinCEN), a unit in the U.S. Department of the Treasury.

Each year FinCEN receives literally millions of SARs as well as other forms such as Currency Transaction Reports (CTRs), which are then accessible to a large number and variety of federal, state, and local investigative (e.g., border control, tax bureaus) and police agencies. The term financial institution is broadly defined; it is not just banks but includes broker dealers and certain kinds of insurers if they are incorporated as U.S. businesses.

An investigation of a drug dealer whose money flows are within the jurisdiction of U.S. AML laws may be enabled, even initiated, by the SAR database, even if no money-laundering charges result. For example, the SAR database allows investigators to identify the counterparties for financial transactions with a drug-dealing suspect if the transactions are in a place and of a nature that places them under the jurisdiction of U.S. laws. The system also facilitates international cooperation so that the investigators can learn about counterparties in other countries, though cooperation is highly variable across countries. The Egmont Group of financial intelligence units (FIUs) facilitates international cooperation.


24 The illegal cannabis trade would differ somewhat, since much of the market is supplied by small-scale domestic producers who sell very locally; the distribution chain for them is much shorter. For methamphetamine, there may be a small number of producers in other countries, so the upper half of the funnel in Figure C.4 in Appendix C would be replaced by a narrow and short straight line.

25 Public Law 91-508, an act to amend the Federal Deposit Insurance Act to require insured banks to maintain certain records, to require that certain transactions in United States currency be reported to the U.S. Department of the Treasury, and for other purposes, October 26, 1970. A clear, accessible description of the U.S. AML laws can be found in Stefan D. Cassella, B. Frederic Williams, and Frank D. Whitney, Federal Money Laundering: Crimes and Forfeitures, 2nd ed., Huntington, N.Y.: Juris, 2020.

26 Between 2015 and 2020, FinCEN received an average of 5.4 million SARs each year. This estimate derives from a RAND Corporation analysis of FinCEN data.


Since 1989 an international body, FATF, has set the rules for national AML regimes. The FATF 40 Standards spell out the statutory and institutional systems that each country is required to put in place. Every eight to ten years, each country is evaluated for its compliance with FATF requirements (technical compliance) and, in the latest round, for success in meeting 11 identified key goals that an effective AML/CFT framework should achieve. This results in a lengthy (about 250 pages) Mutual Evaluation Report (MER). For the PRC, the most recent MER was completed in 2019. Mexico’s most recent MER was published in 2018; the U.S. MER was published in 2016. Later in this appendix, the Commission discusses the “scores” of these MERs. Though the MERs are very fine grained in terms of technical compliance, they provide broad-brush descriptions of implementation, so that there is just a brief reference to the nature of crimes that are prosecuted through AML.

Failure to meet the FATF standards can lead to serious consequences, particularly for those countries, such as Iran and the DPRK, that the FATF identified as having significant strategic deficiencies that they have failed to address. In these cases, the FATF calls on all members and jurisdictions to impose a variety of due diligence and other countermeasures in order to protect the integrity of the international financial system. Only a very few countries have been on the FATF blacklist (Iran and North Korea are perennially on the list), but the threat of blacklisting is taken seriously. Almost all countries have an AML system that in outline meets FATF requirements. However, there is no evidence that AML has been effective in reducing what are known as “predicate crimes” (i.e., the crimes that generate the funds). This is distinctly an “absence of evidence” observation and not an “evidence of absence” conclusion. It is troubling, however, that after 30 years of FATF rules, no evidence is available.

U.S. USE OF AML AGAINST DRUG TRAFFICKING

The U.S. Department of Justice regularly uses AML statutes to bring prosecutions against drug traffickers. Table I.1 presents data on the number of people who were charged in federal court both with money-laundering offenses and with drug selling, as well as with each of these offenses individually. As the table shows, less than 10 percent of those charged with drug selling or manufacture are also charged with money laundering. On the other hand, drug sellers account for a large share of all the money-laundering prosecutions, roughly 35 to 40 percent.

Some states prohibit money laundering, but it is believed that these state statutes generate few cases. The FATF MER for the United States notes that there is little evidence of active enforcement of AML in the 36 states that, as of 2016, had AML statutes. For example, “The State-level information provided generally indicates that States do not prioritise ML [money laundering].”

received 1,021 requests and 914 spontaneous disclosures from other FIUs. In the same year, FinCEN sent 779 spontaneous disclosures and 409 requests. With very few exceptions, these numbers represent notable increases in comparison with prior years. As another indicator of the extent of international cooperation, the MER noted that 39 percent of investigations run by OCDETF involved coordination with a foreign entity.


30 In 2020 and 2021, FATF issued very brief follow-up reports focused on specific deficiencies highlighted in the 2019 MER.

31 FATF, “High-Risk Jurisdictions Subject to a Call for Action—21 February 2020,” webpage, undated.

32 This comment is according to FATF and Asia–Pacific Group on Money Laundering, *Anti–Money Laundering and Counter-Terrorist Financing Measures: United States—Mutual Evaluation Report*, December 2016, p. 63, which further states, “The assessment team based its conclusions on: discussions with Federal, State and local LEAs [law enforcement agencies] and prosecutors about how and when they identify and investigate ML [money laundering]; statistics of the numbers of Federal ML investigations and prosecutions undertaken annually; and numerous representative cases.”
Table I.1
Number of People Prosecuted Federally for Drug Dealing and for Money Laundering, 2016–2020

<table>
<thead>
<tr>
<th>Year</th>
<th>For Money Laundering</th>
<th>For Drug Trafficking</th>
<th>For Both Drug Trafficking and Money Laundering</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>1,354</td>
<td>19,658</td>
<td>542</td>
</tr>
<tr>
<td>2017</td>
<td>1,275</td>
<td>19,636</td>
<td>508</td>
</tr>
<tr>
<td>2018</td>
<td>1,297</td>
<td>18,768</td>
<td>464</td>
</tr>
<tr>
<td>2019</td>
<td>1,177</td>
<td>19,849</td>
<td>442</td>
</tr>
<tr>
<td>2020</td>
<td>820</td>
<td>16,390</td>
<td>296</td>
</tr>
</tbody>
</table>

SOURCE: Data furnished to the Commission by the U.S. Sentencing Commission.

The fact that few drug dealers are actually charged with money laundering is not proof that AML fails to contribute substantially to drug enforcement. The requirement that financial institutions file SARs, CTRs, and other similar reports creates large and useful databases. An investigative agency that has targeted person A as a possible drug dealer may inquire of the FinCEN database whether any filings connect A to other people who might also be involved in the drug trade. That may lead to a stronger case against A and to cases against those other people. The U.S. Drug Enforcement Administration (DEA) makes more requests to FinCEN for use of its database than any other agency.  

No study has assessed the frequency with which AML databases lead to successful drug convictions. The problem is that the connection between the databases and the prosecution may be quite indirect. Literally thousands of agencies have access to these databases. Prosecutors may not include money laundering in the charges and may not even reference the SARs in the indictment, since the SARs allowed them to obtain direct evidence of the drug trafficking itself and thus eliminates the need to mention the SAR.

The 2016 MER of the United States included a criticism that is echoed in the MERs for the PRC and Mexico—namely, that little use is made of the money-laundering statutes in indictments. Many federal prosecutors believe that given the long sentences associated with drug dealing, there is little point in taking on the expense and difficulty of adding money-laundering charges as well. Money-laundering charges are inherently technical and difficult to explain to a jury. Some experts believe that these charges are also difficult for the prosecutors themselves to understand. Thus, AML’s role in the effort to suppress drug markets currently remains obscure.

THE SPECIFIC CHALLENGE OF SYNTHETIC OPIOID TRAFFICKING

The Commission begins by examining the role of AML in controlling the major drug markets (cocaine, heroin, marijuana, and methamphetamine) to provide a contrast. The AML system is more likely to detect large dollar transactions rather than small ones for many reasons: Bank staff are trained to pay more attention to large rather than small transactions, particularly if they involve cash, reflecting the perception and assessment that money

34 Financial institutions and government agencies are prohibited from disclosing any information that would reveal the existence of a SAR.
How much can money-laundering controls reduce the U.S. market?

Launderers are unlikely to spend their time on small amounts of money. Of course, patterns of many small transactions of a repetitive kind can signal an effort to evade the filters of AML laws, such as mandatory reporting of cash deposits of more than $10,000. “Smurfing” is perhaps the best-known money-laundering scheme; many deposits are made just below the filing limit. The pattern can be even more extreme than that (i.e., low-level agents known as money mules may make a very large number of small deposits through many accounts that have been acquired from individuals through small payments). Schemes to recruit “money mules” can often ensnare unwitting individuals; the FBI has a website explaining how to avoid being recruited for these purposes.

Thus, small transactions are not necessarily overlooked by the AML system. However, a drug trade that generates small revenues both in individual transactions and in total is unlikely to be susceptible to control by the AML system. When synthetic opioids were entering the United States directly from the PRC, total payments to the Chinese producers and exporters were estimated to be less than $20 million. With fentanyl selling on the web from Chinese sites in 2018 at barely $5,000 per pure kilogram, a wholesaler who purchased 100 g (equivalent in MME doses to about 3 kg of pure heroin) had only to transfer less than $1,000 to the seller. That is a very small transaction for the AML system to detect as suspicious. Thus, it was unlikely that AML would be an effective tool against fentanyl when the market was configured for direct importation, although FinCEN did receive numerous reports of structuring efforts.

The shift to a three-way trade makes some difference. Since changes in the PRC’s law in 2019, synthetic opioids, still primarily fentanyl, enter the United States through Mexico. Mexican TCOs import precursors from the PRC and use them to generate fentanyl for sale to the United States. The revenues earned by the Chinese producers are smaller than they were when the fentanyl was directly imported from the PRC.

The revenues generated by the TCO sales of fentanyl in the United States are much larger than those generated in earlier years by the direct importation from the PRC. Fentanyl now enters the United States at much lower purity and at a much higher per pure gram price. As noted in Appendixes B and C, the export price of fentanyl is about $210,000 per pure kilogram, and total consumption of fentanyl in the United States is only about 3.5 to 5 metric tons. Based on these estimates, total revenue from exporting fentanyl to the United States likely ranges from $700 million to $1 billion, less than estimates of revenues from exporting heroin or cocaine, $1.32 billion and $4.29 billion, respectively.

35 A customer can file for an exemption to this reporting. For example, a retail store that has a large volume of cash purchases each day may file for such an exemption from the bank where it routinely deposits receipts. See Financial Crimes Enforcement Network, U.S. Department of the Treasury, “Guidance on Determining Eligibility for Exemption from Currency Transaction Reporting Requirements,” FIN-2012-G003, June 11, 2012.

36 For some specific cities and businesses, the reportable level has been set at $3,000. The Bank Secrecy Act (Public Law 91-508, an act to amend the Federal Deposit Insurance Act to require that insured banks maintain certain records, to require that certain transactions in United States currency be reported to the U.S. Department of the Treasury, and for other purposes, October 26, 1970, Title II, Reports of Currency and Foreign Transactions) states that money service businesses (MSBs) “that provide money transfer services must obtain and record specific information for each money transfer of $3,000 or more, regardless of the method of payment” and keep the record for “five years from the date of transaction.”


39 The $1,000 figure is presumably more than $500 because the drug trade is characterized by large quantity discounts.
Moreover, seizures of synthetic opioids at ports of entry indicate that there are more high-value shipments than when fentanyl came directly from the PRC (see Table I.2).\textsuperscript{40} That suggests that importers in the United States will have to launder large amounts of money as part of the business (described as channel 1 in the previous section). Thus, it appears United States AML could potentially play more of a role in controlling synthetic opioid trafficking in the three-way trade. The Commission turns to this in the final section when comparing the roles of AML in the PRC, Mexico, and the United States.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Seizures &gt;10 kg (Air and Land)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>1</td>
</tr>
<tr>
<td>2015</td>
<td>1</td>
</tr>
<tr>
<td>2016</td>
<td>17</td>
</tr>
<tr>
<td>2017</td>
<td>34</td>
</tr>
<tr>
<td>2018</td>
<td>19</td>
</tr>
<tr>
<td>2019</td>
<td>39</td>
</tr>
<tr>
<td>2020</td>
<td>75</td>
</tr>
</tbody>
</table>

\textsuperscript{40} The seizures from Mexico are low purity. However a 10-kg shipment of 5-percent pure fentanyl will still have an export value of $160,000, given the per–pure kilogram price of $312,000.


THE PRC AND MONEY LAUNDERING

The PRC now has a major problem with money laundering more generally. This problem is a consequence of the government’s 2017 decision to limit the amount of money that an individual resident can send out of the country annually to the equivalent of less than $50,000.\textsuperscript{41} With the rapid expansion of the Chinese economy and the growth of a large population of wealthy households with an interest in diversifying their assets to include foreign holdings, this restriction has created a demand for ways of moving funds overseas against the law. The result is a large number of money-laundering organizations (MLOs) housed in the PRC but with nodes in the United States and Latin America. They serve both Chinese and foreign customers; indeed, their task is eased by matching the needs of these two groups of customers. Chinese customers want to exchange their Chinese renminbi for dollars in the United States; drug dealers want to move dollars to Mexican pesos in Mexico and can do so by having the Chinese buy goods in the PRC for export to Mexico. The chain is closed when the importers of the Chinese goods transfer the funds to the account of the Mexican TCOs, minus their margin for completing the transaction. The needs of the two groups complement each other; the Commission examines this in more detail in the section on Mexico. The Chinese MLOs (CMLOs) have other methods for moving money as well.
Much of the money coming out of the PRC through the MLOs may be legitimately earned. It is only the effort to evade the AML regime that makes those funds illegal in their transfer. Of course, the MLOs also launder money that has been generated illegally in the PRC, whether through embezzlement, acceptance of bribes, or drug dealing.

The Chinese government lists drug revenues as one of the major sources of illicit funds in the country. However, the estimate provided in the 2019 PRC MER is just $20 billion, a very small figure for a country of 1.35 billion people with a gross domestic product (GDP) of $15 trillion. In contrast, the U.S. estimate of drug markets is about $100 billion for a population of 310 million (2016 figure) and a GDP of $21 trillion.\(^\text{42}\) The assessment team cites the *National Risk Assessment Report of Money Laundering and Terrorist Financing of China 2017*, which based the revenue figures on court judgements from 2013 to 2015. However, the Commission could not independently verify the accuracy of that figure.

### Money-Laundering Controls in the PRC

The Chinese government takes money laundering seriously. Not only does it report large amounts repatriated as a result of its investigations ($8.64 billion between 2014 and 2016), but it also shows a large number of cases investigated or prosecuted. The 600,000 cases in the period from 2013 to 2017 averages to 120,000 per annum; in fact, the numbers rose steadily over that period. Even on a population basis, it far exceeds the number in the United States. However, the quality of cases (i.e., the importance of the offenders targeted) may be much less than in the United States.

The MER for the PRC, published in 2019, provides many valuable statistics and insights about the PRC’s AML efforts.\(^\text{43}\) For example, Table I.3 shows that, in the period 2013–2017, 233,000 money-laundering confiscations involved drug trafficking; these constitute 39 percent of all money-laundering confiscations. The forfeiture value though was quite modest, roughly $450 million or about $2,000 per case.\(^\text{44}\) Most other classes of money-laundering cases have a much higher average forfeiture value. For example, though there are only one-third as many money-laundering cases involving corruption, they generate ten times more in total forfeitures; tax cases were less than 10 percent as numerous but generated more than twice as much in forfeitures of various kinds. It appears that these drug-trafficking cases are likely to involve primarily low-level dealers.

Interpreting these statistics is difficult. For example, one expert group noted the following:

> In 2018, courts across the country concluded 4,825 cases involving money laundering, in which 11,428 individuals received sentences. Among them, however, only 47 cases were specifically identified as money laundering, involving 52 people who were sentenced, data shows.\(^\text{45}\)

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\(^{44}\) Forfeiture value is the sum of three distinct elements tracked in the MER: “Instrument Forfeiture Value,” “Proceeds of Crime Value,” and “Property Confiscated.”

Table I.3
Property Confiscations for 2013–2017

<table>
<thead>
<tr>
<th>Predicate Conviction</th>
<th>Cases Investigated or Prosecuted</th>
<th>Value of Forfeitures, in Renminbi</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>Trafficking drugs</td>
<td>233,236</td>
<td>2,835,068,000</td>
</tr>
<tr>
<td>Illegal gambling</td>
<td>67,283</td>
<td>3,284,112,000</td>
</tr>
<tr>
<td>Corruption or bribery</td>
<td>71,048</td>
<td>29,235,445,000</td>
</tr>
<tr>
<td>Smuggling humans</td>
<td>1,962</td>
<td>57,965,000</td>
</tr>
<tr>
<td>Counterfeiting goods</td>
<td>43,589</td>
<td>5,568,591,000</td>
</tr>
<tr>
<td>Tax crime</td>
<td>14,696</td>
<td>6,613,440,000</td>
</tr>
<tr>
<td>Money laundering, Art. 191</td>
<td>77</td>
<td>175,078,000</td>
</tr>
<tr>
<td>Receiving stolen goods, ML Art. 312</td>
<td>35,712</td>
<td>4,669,567,000</td>
</tr>
<tr>
<td>ML, Art. 349</td>
<td>210</td>
<td>48,807,000</td>
</tr>
<tr>
<td>Fraud</td>
<td>102,458</td>
<td>25,472,827,000</td>
</tr>
<tr>
<td>Sexual exploitation</td>
<td>18,034</td>
<td>454,515,000</td>
</tr>
<tr>
<td>Illegal fundraising</td>
<td>11,943</td>
<td>4,200,461,000</td>
</tr>
<tr>
<td>Smuggling</td>
<td>2,566</td>
<td>4,200,461,000</td>
</tr>
<tr>
<td>Totals</td>
<td>602,814</td>
<td>123,189,127,000</td>
</tr>
</tbody>
</table>


The MER indeed concluded that though many drug dealers were accused of money laundering, prosecutors rarely sought convictions for that offense, believing that the sentences for drug dealing were sufficiently stringent that a further conviction charge was unnecessary.\(^{46}\) That, as observed earlier, has also been said about U.S. prosecutors. It was not only true for drug offenses in the PRC, but more generally prosecutors were interested only in using money-laundering databases for proving the substantive (“predicate”) crime.\(^{47}\) Table I.4, from the MER, shows just how rarely money laundering is the conviction offense in the PRC.


\(^{47}\) According to FATF, Anti–Money Laundering and Counter-Terrorist Financing Measures: People’s Republic of China—Mutual Evaluation Report, April 2019, ¶ 137: “LEAs [law enforcement officers] at all levels access and use financial intelligence and other information to identify and trace proceeds, and to support investigations and prosecutions of predicate offences, but do so to a limited extent for AML purposes. While the LEAs that the team met with recognised the value of ‘following the money’, their focus in the development of evidence and tracing of criminal proceeds is primarily on pursuing domestic predicate offences, as opposed to ML [money laundering] and TF [terrorist financing].”
Table I.4
Convictions Entered Pursuant to the Three Money-Laundering Articles

<table>
<thead>
<tr>
<th>Year</th>
<th>Convictions Under Article 191</th>
<th>Under Article 312</th>
<th>Under Article 349</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>4</td>
<td>5,530</td>
<td>15</td>
</tr>
<tr>
<td>2014</td>
<td>2</td>
<td>9,346</td>
<td>12</td>
</tr>
<tr>
<td>2015</td>
<td>10</td>
<td>7,058</td>
<td>16</td>
</tr>
<tr>
<td>2016</td>
<td>26</td>
<td>5,549</td>
<td>23</td>
</tr>
<tr>
<td>2017</td>
<td>45</td>
<td>10,193</td>
<td>37</td>
</tr>
</tbody>
</table>


The MER and other authorities have pointed to important weaknesses in the PRC’s AML regime. For example, the 2018 State Department International Narcotics Control Strategy Report (INCSR) states the following:

> While China has taken steps to improve its AML regime, there are significant shortcomings in implementing laws and regulations effectively and transparently, especially in the context of international cooperation. China should cooperate with international law enforcement in investigations regarding indigenous Chinese underground financial systems, virtual currencies, shell companies, and trade-based value transfers that may be used for illicit funds transfers.

The MER in assessing compliance with the 40 FATF Standards (technical compliance) gives a low score to several Asian countries traditionally associated with drug trafficking, such as Thailand and China. On the 11 measures of effectiveness, the PRC’s scores are broadly similar to those of Korea and Thailand (nine low-compliance scores versus eight for Korea and nine for Thailand) but worse than those of Malaysia (two low-compliance scores for Malaysia).

Cooperation with the U.S. government is a contested topic. A 2020 Reuters article wrote this about the PRC’s Ministry of Foreign Affairs:

> The ministry said most Chinese bank-account holders about whom Washington has inquired as part of its money laundering investigations in recent years were “legitimate enterprises and individuals” in China. “After we asked the U.S. side to provide drug-related clues or evidence of enterprises and individuals, the U.S. side has not responded,” China’s Foreign Ministry said in the statement.

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49 Responding to the MER, PRC scores were upgraded in two follow-up reports.

One consistent complaint that is relevant to the Commission’s concerns is that the PRC has been slow in responding to international requests for assistance in money-laundering cases. The MER noted that the PRC had responded to only 1,244 requests for assistance from other countries over the six-year period from 2012 to 2017. It had made only 52 requests of its own to other countries in that same period. It is not part of the Egmont Group of 150 countries’ FIUs.

The government has been responsive to some of this criticism. For example, in August 2021 it announced new measures expanding the set of institutions subject to AML reporting requirements.

Chinese Money Launderers and Mexican Drug Traffickers

Both media reports and interviews with U.S. officials point to the specific role of the PRC’s MLOs in the laundering of drug revenues generated in the United States by Mexican TCOs. Though there are no systematic estimates of the share of Mexican TCO revenues laundered by CMLOs, U.S. officials believe that in recent years they have become the dominant launderers in this market. Their schemes can be labeled as trade-based money laundering (TBML).

The Commission offers a simplified account of the scheme (see Figure I.1). The scheme as operated by CMLOs matches the needs of drug traffickers whose revenues are in dollars in the United States to get their money into peso accounts in their home country, mostly Mexico, with the desire of affluent Chinese residents to move money overseas. The MLO receives the dollars from drug sellers in the United States and transfers it to a Chinese national in the United States. That individual transfers money from their bank account in the PRC to another bank account in the PRC controlled by the MLO. The Chinese individual now has dollars in the United States in exchange for the renminbi transferred in the PRC. The MLO uses its renminbi to purchase conventional legal goods to ship to Mexico, which has a vigorous $80 billion trade flow with the PRC. Those goods are sold in Mexico, and the pesos earned by a legitimate trader in Mexico is credited to the drug dealer who provided the

51 According to FATF, Anti–Money Laundering and Counter-Terrorist Financing Measures: People’s Republic of China—Mutual Evaluation Report, April 2019, ¶ 99: “China also works closely with countries in the region in the investigation of predicate offences and successively launched two joint anti-drug actions called ‘Safe Waterway’ with Laos and Myanmar. Feedback on international cooperation was mixed with some countries indicating the need for China to enhance the speed and efficiency of its processes.”

52 More precisely, “since 2012”: The report was written in 2018.


54 “Organizations subject to the AML/CTF [Counter Terrorism Finance] requirements under the new Measures have been widened to include loan companies, asset management subsidiaries of commercial banks, non-banking payment institutions, insurance agents and insurance brokers” (see Simon Hui and Zhengwei Yang, “China: China Expands Anti–Money Laundering Obligations with Measures for the Supervision and Administration of Anti–Money Laundering and Counter-Terrorist Financing of Financial Institutions,” Global Compliance News, August 20, 2021).

55 For example, one interviewee said that “given China’s massive trade portfolio, there is always an opportunity for money laundering. Some of the traditional drugs expanded across the world and money is moving globally and China has been a player in money laundering game for a while, and I think given the precursor chemical tie, it only strengthened or empowered or gained more traction, but it’s not novel” (interview 32, August 24, 2021).

The only skepticism was one comment that other launderers could provide the same service: “They [TCOs] did without them for a long time; there are plenty of third-party Mexican or U.S. citizens [they can use instead] . . .” (interview 38, August 31, 2021).

original dollars in the United States, with the trader receiving a fee for that service. There is no international flow of money through the formal financial system. The only international flows are of goods.

Figure I.1
Chinese Money Laundering of Drug Revenues

NOTE: MLO = money-laundering organization.

Two important points about this scheme:

- It is in no way tied to the PRC’s exports of synthetic opioids. The CMLOs are established by individuals who are not involved in the production of synthetic opioids. Mexican drug dealers are merely some of the customers they serve, though valued because of the complementarity of their needs to those of the Chinese customers.
- The fact that they serve two sets of clients enables the CMLOs to offer lower rates to drug dealers than have traditionally been available. As noted in a Reuters article:

  Chinese money launderers are squeezing out Mexican and Colombian rivals by undercutting them on price by as much as half, U.S. officials said. The Chinese operators have been able to do that because they levy fees on both sides of each transaction. They impose fat commissions as high as 10% on Chinese citizens eager to get money out of China. That allows the Chinese money brokers, in turn, to charge traffickers nominal fees of just a few percentage points. The money launderers still turn a
handsome profit while locking in a steady supply of coveted dollars and euros from cartel customers.\(^{57}\)

Trade-based money-laundering schemes offer a very serious challenge to AML, as noted in both FATF and U.S. government publications. For example, a 2020 FATF report on TBML noted the following:

Despite significant attention to TBML within the FATF Global Network and a broader expert community, countering this form of ML continues to be challenging for jurisdictions. The aforementioned reports of 2006, 2008, and 2012, as well as the WCO and Egmont Group’s Customs-FIU Cooperation Handbook stress TBML as a particularly complex form of ML that causes various difficulties at each stage of the investigative and detection processes. These difficulties, as well as broader challenges to international co-operation and difficulties experienced by the private sector in identifying TBML schemes, have led to a relatively low number of successful TBML investigations across the globe so far.\(^{58}\)

In the United States, in 2019, GAO stated, “According to the Department of the Treasury . . . TBML is one of the most challenging forms of money laundering to investigate because of the complexities of trade transactions and the sheer volume of international trade.”\(^{59}\) A major problem is that international trade transactions involve documents spread across many different agencies, some of which by law cannot share these documents with each other.

GAO provided useful insight into the problems facing banks in monitoring AML compliance in trade transactions they handle:

Subject-matter experts and representatives of banks we spoke with told us that a bank’s ability to identify indicators associated with TBML is limited for open-account transactions. Banks generally do not review documentation such as invoices, bills of lading, or customs declarations in open-account transactions—as would be the case for transactions that are financed by the bank and where the bank is exposed to greater financial risk.

FATF has identified a number of indicators that can be used by banks to identify potential instances of TBML, such as the following situations:

- Significant discrepancies appear between the description of the goods on the bill of lading (or invoice) and the actual goods shipped.
- Significant discrepancies appear between the value of the commodity reported on the invoice and the commodity’s fair market value.
- The type of commodity being shipped appears inconsistent with the exporter’s or importer’s regular business activities.

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\(^{57}\) What is surprising here is the high charge to the Chinese customers. Surely, this is a competitive market that should result in a modest price for these customers. Perhaps the PRC’s AML regime is effective enough that MLOs can reasonably charge high prices for their services.


However, in open-account transactions, banks would not be examining many of these documents that could allow them to identify suspicious activity associated with the trade transaction, such as under- or over-invoicing.\(^6^0\)

Trade-based money laundering is not undetectable but does present a particularly difficult challenge for AML.

**MEXICO’S AML FRAMEWORK**

The major drug revenue flow in the synthetic opioid trade now involves Mexico. Though estimates of total revenues from Mexican TCO sales to the United States are very rough, there is no doubt that these revenues greatly exceed those from precursor sales by Chinese manufacturers to Mexico.

Drug trafficking and organized crime are major problems for Mexico and have been near the top of the list of national problems since at least 2006. Money-laundering controls thus have a particularly important potential role for the national government. The 2018 FATF Mutual Evaluation Report was generally positive about Mexico’s AML efforts, while noting the challenge from drug trafficking:

> Mexico has a mature AML/CFT [counter–financing of terrorism] regime, with a correspondingly well developed legal and institutional framework. There has been a significant improvement in some areas of the country’s AML/CFT regime compared to that which existed when the country was last assessed in 2008. It is nonetheless confronted with a significant risk of money laundering (ML) stemming principally from activities most often associated with organised crime, such as drug trafficking, extortion, corruption and tax evasion.\(^6^1\)

Thus, the assessment concludes that “ML is not investigated and prosecuted in a proactive and systematic fashion. . . . Mexico still lacks the institutional and operational instruments to identify and prosecute ML cases.”\(^6^2\) The total number of investigations initiated was not small but, as in the PRC, few ML investigations result in prosecution (see Table I.5). The MER noted that 42 percent of money-laundering prosecutions involved drug trafficking. It ended the analysis by noting the very low and falling conviction rate.

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Table I.5

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<td>Investigations initiated</td>
<td>461</td>
<td>479</td>
<td>531</td>
<td>464</td>
<td>415</td>
<td>426</td>
<td>438</td>
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<td>108</td>
<td>145</td>
<td>111</td>
<td>109</td>
<td>76</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Prosecutions</td>
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<td>145</td>
<td>111</td>
<td>109</td>
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<td>43</td>
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<td>—</td>
<td>—</td>
<td>40</td>
<td>23</td>
<td>34</td>
<td>6</td>
</tr>
<tr>
<td>Convicted persons</td>
<td>12</td>
<td>19</td>
<td>19</td>
<td>17</td>
<td>11</td>
<td>15</td>
<td>10</td>
</tr>
</tbody>
</table>


Though the institutions for effective money-laundering prosecution may exist, it is clear that they are not being used in Mexico. Drug dealers face a negligible risk of being convicted of money laundering in Mexico. Interviews and findings from U.S. authorities noted that while Mexican authorities have successfully used legal tools to freeze illicit assets, efforts to seize accounts remain handicapped by limited legal authority; the country’s FIU regularly freezes suspected accounts, but the office of attorney general is more selective when it comes to seizing frozen assets.63 The State Department’s 2021 INCSR reports that “the money laundering unit of the organized crime division of FGR [Federal Prosecutor General] informally reported it obtained 10 money laundering convictions in 2019, compared with 6 convictions in 2018, according to open reporting.”64

CAN THE PRC, MEXICO, OR THE UNITED STATES USE AML TO REDUCE THE IMPORTATION OF SYNTHETIC OPIOIDS?

The motivating question for this analysis is whether money-laundering controls might provide substantial help in reducing the flow of synthetic opioids to the United States. It has considered the AML efforts of the United States, the PRC, and Mexico. All three countries have relatively robust AML regimes, according to FATF. However, each country has been subject to the same criticism of underutilizing money-laundering statutes in prosecuting offenders such as drug dealers for whom money-laundering charges would easily be added on. Certainly, there have been a small number of convictions specifically for money-laundering violations in each country. In the United States, the federal government in 2019 convicted only 1,177 individuals of money-laundering offenses, and only 420 were convicted also for drug dealing. Since drug markets are estimated to generate $100 billion in revenues in 2016, this is tiny.65 Even stronger statements can be made for the PRC and Mexico; laundering money for drug traffickers has not been targeted, as the total number of convictions has been tiny.

The Commission now considers in turn the potential for each country to contribute to stemming the flow of synthetic opioids into the United States. The analysis is built around an understanding of the flow of money

63 Interview 32, August 24, 2021.
among the three countries associated with the trade. Figure I.2 shows the flow associated with precursors from the PRC to Mexico. A very small amount of money is then sent to the PRC from Mexico in payment for those precursors, on the order of $20 million. The limited information available suggests that the payments are typically on the order of tens of thousands of dollars, not millions of dollars.

Figure I.2
The Flow of Precursors and Money Between the PRC and Mexico

More interesting are the money flows related to the fentanyl trade itself. TCOs in Mexico export the processed drug to the United States. That generates hundreds of millions of dollars in revenues that the TCOs seek to repatriate to Mexico. The individual transactions can be in the millions of dollars. As already noted, they do this mostly indirectly through CMLOs, in a triangular trade through the PRC. As represented in Figure I.3, that generates flows from the United States to the PRC and then the PRC to Mexico.

However, this is not a distinct flow, separate from other drug moneys. Mexico’s TCOs use the CMLOs to launder their drug moneys generally. These are in the billions of dollars, again moving initially from the United States to the PRC and then the PRC to Mexico. Individual transactions are frequently in the millions. Figure I.4 layers these on top of the synthetic opioid money flows.
Figure I.3
The Triangular Trade of Money, Precursors, and Drugs Among the PRC, Mexico, and the United States

Figure I.4
The Triangular Trade for Synthetic Opioids, Money, and Drug Flows

NOTE: TCO = transnational criminal organization.
Now consider more-intense AML efforts by each country. The possibility of detecting the payments for precursors from Mexico to the PRC is slight because both the total and the individual transactions are small. Further, targeting those responsible is too slow or constrained to ever significantly affect price. Conversely, the TCOs have the ability to rapidly establish new importing businesses or manufacturing locations and (for now) their access to precursor chemical sources of supply appears unlimited—to the extent that it is suspected that Mexican TCOs might begin manufacturing precursors in Mexico. Moreover, as noted, raising precursor prices will have a negligible effect on the retail price of fentanyl. Thus it is extremely unlikely that AML targeting precursor manufacturing in the PRC will have a significant effect on synthetic opioid flows to the United States.

More promising, at least at first sight, are AML efforts against the flows related to the trafficking of fentanyl into the United States. The totals and the individual transactions are one or two orders of magnitude larger. Moreover, they potentially affect the import price of synthetic opioids, which is at least two orders of magnitude higher than the price of precursors; thus this might affect the retail price.

However, there is less to this than meets the eye. The first problem is that there is not a separate money flow related to synthetic opioids that can be targeted by AML in any of the three countries. CMLOs handle money for their drug clients, without distinguishing which drug is responsible for the money. The TCOs that sell synthetic opioids sell other drugs as well. Some sell cocaine, heroin, marijuana, and methamphetamine as well as synthetic opioids; all sell at least one of these other drugs. Thus, more-intense AML will be experienced by the TCOs as a general signal, affecting the cost of drug selling generally, not synthetic opioids specifically. To that extent, any price increasing effect will be diluted.

The second problem is that even if the AML did affect just synthetic opioids, it would still only modestly affect the retail price. The import price of fentanyl as indicated in Table C.5 is $312,500 per pure kilogram compared with a retail price of $3,400,000. Extraordinary as that price seems, given that a dose is just 2 to 3 mg pure fentanyl, that results in a dose price of less than $10. Assume, optimistically, that more-intense AML raised the import price by 10 percent, to $343,000. That would raise the price of fentanyl by a little more than 1 percent. With a demand elasticity of –0.5, the result would be a decline of roughly 0.5 percent in total consumption in the United States.

That is not to say that more-intense AML by all or any one of the three countries is not worthwhile. Perhaps a cost–benefit calculation of alternative methods for achieving modest reductions in fentanyl consumption would show AML as being among the more cost-effective efforts. However, it does make more-intense money-laundering control efforts a very implausible method for achieving a substantial reduction in synthetic opioid consumption in the United States.

There are two caveats to this analysis. As briefly noted above, money-laundering controls generate potentially important intelligence and evidence. Drug-trafficking convictions that do not include money-laundering charges may nonetheless be dependent on information generated by Suspicious Activity Reports and other AML reporting requirements. More-intense AML might consist of deeper analysis of existing databases or efforts to improve the quality of reporting by financial institutions. Again, though, it would have an impact only on the import price of fentanyl and thus only slightly increase the retail price.

The other channel through which AML might affect the drug trade is disruption. Having emphasized that AML is limited by its inability to impose penalties on low-end distributors, it is useful to turn that on its head and ask if AML might have a unique ability to disrupt the high end of the market. Is it possible that repeated AML cases against high-level traffickers could lead to a disruption in the market? Whereas low-level dealers are easily replaced by other individuals who are just as competent for the job, high-end traffickers may have unique connections. In that case, removal of a few might cause the market to work less well, interrupting the flow of drugs.
There are a small number of instances in which this kind of effect has been observed. The most prominent is the 2001 heroin drought in Australia. The Australian Federal Police, in conjunction with other national police agencies, made a huge heroin seizure in Fiji in 2001 and arrested the leaders of the TCO that was responsible. That resulted in a long-term increase in prices, and a reduction in heroin-related health harms extending over at least three years. Why the suppliers were unable to adjust remains a mystery, but it does offer the example of a well-established and substantial market for imported drugs that was disrupted by the capture of the heads of a major trafficking organization.

Though the possibility of disruption cannot be dismissed, it seems an unlikely outcome for at least three reasons. First, making laundering cases against high-level traffickers in a specific drug market is challenging. Despite the substantial efforts of the federal government to seize and forfeit assets, the total amount in the period from 2016 to 2020 (the latest for which such data are available) was only $8.9 billion less than $2 billion per annum. This includes funds seized in all criminal and civil forfeiture cases, such as those involving fraud against the federal government. Although $2 billion might seem like a large figure, against estimates of hundreds of billions of dollars of money laundered each year, it is a tiny figure, perhaps no more than 1 percent. It is hard to see that AML has yet made money laundering a truly risky occupation.

Second, for established markets such as cocaine and heroin, the set of individuals who have robust connections at high levels may be quite large. The removal of the leaders of the Medellin cartel in Colombia between 1990 and 1993 did not lead to any long-lasting interruption to the market. Lieutenants of the incarcerated or killed leaders were capable of replacing their bosses rapidly. The same has been true in Mexico, as the national government has incarcerated and killed large numbers of the leading figures, with no apparent interruption to supply.


70 In 2015, the federal government estimated that $300 billion was laundered in the United States (U.S. Department of the Treasury, National Money Laundering Risk Assessment 2015, undated). The methodology was so little described that no particular authority can be given to the figure, but it is certainly plausible. The 2015 U.S. Treasury report references a 2011 UN Office on Drugs and Crime (UNODC) report on estimating illicit financial flows resulting from drug trafficking and other transnational organized crimes: “Tentative UNODC estimate based on previous estimates and trends derived from new drug and crime data.” It is hardly reassuring for the U.S. government to be citing a UN estimate based on U.S. government data.


synthetic opioid market is serviced by just this kind of large trafficking organization, not a specialized niche distribution enterprise.

Finally, the sheer variety of methods of laundering presents a fundamental challenge to any disruption effort. The U.S. MER also pointed to the great diversity of methods for laundering drug money. For example, it summarized one case as follows:

Baja Money Laundering Organization (2014): This case disrupted a ML organization that moved over USD 50 million annually in drug proceeds on behalf on Mexican-based DTO [drug-trafficking organization]. The methods used to launder money included TBML, bulk cash smuggling, shell companies and wire transfers.73

This one organization made use of four different methods, and that was even before cryptocurrencies were readily available.

While no method of laundering is impenetrable to expert law enforcement efforts, some are more difficult to identify and investigate than others. TBML, a common method used by CMLOs, is particularly difficult for these purposes, as it does not require the use of mainstream financial institutions. SARs are unlikely to provide useful leads. Instead, investigators are reliant on informants and arrestees who choose to cooperate with the government in return for reduced sentences.

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# ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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</thead>
<tbody>
<tr>
<td>ADAM</td>
<td>Arrestee Drug Abuse Monitoring</td>
</tr>
<tr>
<td>AED</td>
<td>Advance Electronic Data</td>
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<tr>
<td>AML</td>
<td>anti-money-laundering</td>
</tr>
<tr>
<td>ARCOS</td>
<td>Automated Reports and Consolidated Ordering System</td>
</tr>
<tr>
<td>ATF</td>
<td>Bureau of Alcohol, Tobacco, Firearms and Explosives</td>
</tr>
<tr>
<td>ATS</td>
<td>Automated Targeting System</td>
</tr>
<tr>
<td>B2B</td>
<td>business to business</td>
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<tr>
<td>C4ADS</td>
<td>Center for Advanced Defense Studies</td>
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<tr>
<td>CAS</td>
<td>Chemical Abstract Service</td>
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<tr>
<td>CBP</td>
<td>U.S. Customs and Border Protection</td>
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<tr>
<td>CBSA</td>
<td>Canadian Border Services Agency</td>
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<tr>
<td>CCDB</td>
<td>Consolidated Counterdrug Data Base</td>
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<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
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<td>CDSA</td>
<td>Controlled Drugs and Substances Act</td>
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<td>CFDA</td>
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<td>CJ</td>
<td>criminal justice</td>
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<tr>
<td>CRS</td>
<td>Congressional Research Service</td>
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<tr>
<td>DAL</td>
<td>Drug Administration Law</td>
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<tr>
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<td>Drug Analysis Service</td>
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<tr>
<td>DAWN</td>
<td>Drug Abuse Warning Network</td>
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<tr>
<td>DEA</td>
<td>U.S. Drug Enforcement Administration</td>
</tr>
<tr>
<td>DHS</td>
<td>U.S. Department of Homeland Security</td>
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<tr>
<td>DoD</td>
<td>U.S. Department of Defense</td>
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<tr>
<td>DOJ</td>
<td>U.S. Department of Justice</td>
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<tr>
<td>ECC</td>
<td>express consignment carrier</td>
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<tr>
<td>ECCF</td>
<td>express consignment carrier facility</td>
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<tr>
<td>EMCDDA</td>
<td>European Monitoring Centre for Drugs and Drug Addiction</td>
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<td>EPIC</td>
<td>El Paso Intelligence Center</td>
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<tr>
<td>Europol</td>
<td>European Union Agency for Law Enforcement Cooperation (also known as European Police Office)</td>
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<tr>
<td>FATF</td>
<td>Financial Action Task Force</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>FBI</td>
<td>Federal Bureau of Investigation</td>
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<td>FDA</td>
<td>U.S. Food and Drug Administration</td>
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<tr>
<td>FFRDC</td>
<td>federally funded research and development center</td>
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<tr>
<td>FinCEN</td>
<td>Financial Crimes Enforcement Network</td>
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<tr>
<td>FIU</td>
<td>financial intelligence unit</td>
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<tr>
<td>FSLTT</td>
<td>federal, state, local, tribal, and territorial</td>
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<tr>
<td>FSPP</td>
<td>Fentanyl Signature Profiling Program</td>
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<tr>
<td>FTC</td>
<td>Federal Trade Commission</td>
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<td>FTIR</td>
<td>Fourier-transform infrared spectroscopy</td>
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<td>fiscal year</td>
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<td>Government Accountability Office</td>
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<td>GMP</td>
<td>good manufacturing practice</td>
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<tr>
<td>GSP</td>
<td>good supplying practice</td>
</tr>
<tr>
<td>HIDTA</td>
<td>High Intensity Drug Trafficking Area</td>
</tr>
<tr>
<td>HIS</td>
<td>Homeland Security Investigations</td>
</tr>
<tr>
<td>HSIN</td>
<td>Homeland Security Information Network</td>
</tr>
<tr>
<td>HSOAC</td>
<td>Homeland Security Operational Analysis Center</td>
</tr>
<tr>
<td>HVAC</td>
<td>heating, ventilation, and air-conditioning</td>
</tr>
<tr>
<td>ICD-10</td>
<td>International Classification of Diseases, tenth revision</td>
</tr>
<tr>
<td>ICE</td>
<td>U.S. Immigration and Customs Enforcement</td>
</tr>
<tr>
<td>IDSS</td>
<td>Integrated Defense and Security Solutions</td>
</tr>
<tr>
<td>IMF</td>
<td>international mail facility</td>
</tr>
<tr>
<td>INCB</td>
<td>International Narcotics Control Board</td>
</tr>
<tr>
<td>ISC</td>
<td>international service center</td>
</tr>
<tr>
<td>JCODE</td>
<td>Joint Criminal Opioid and Darknet Enforcement</td>
</tr>
<tr>
<td>LEEP</td>
<td>Law Enforcement Enterprise Portal</td>
</tr>
<tr>
<td>MAH</td>
<td>Market Authorization Holder</td>
</tr>
<tr>
<td>MED</td>
<td>morphine-equivalent dose</td>
</tr>
<tr>
<td>MER</td>
<td>Mutual Evaluation Report</td>
</tr>
<tr>
<td>ML</td>
<td>machine learning</td>
</tr>
<tr>
<td>MLO</td>
<td>money-laundering organization</td>
</tr>
<tr>
<td>MME</td>
<td>morphine-milligram equivalent</td>
</tr>
<tr>
<td>MSA</td>
<td>metropolitan statistical area</td>
</tr>
<tr>
<td>MT</td>
<td>metric tons</td>
</tr>
<tr>
<td>NCB</td>
<td>Narcotics Control Bureau</td>
</tr>
<tr>
<td>NDEWS</td>
<td>National Drug Early Warning System</td>
</tr>
<tr>
<td>NFLIS</td>
<td>National Forensic Laboratory Information System</td>
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</tbody>
</table>

Abb-2 Commission on Combating Synthetic Opioid Trafficking
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>NII</td>
<td>nonintrusive inspection</td>
</tr>
<tr>
<td>NMPA</td>
<td>National Medical Products Administration</td>
</tr>
<tr>
<td>NPS</td>
<td>new psychoactive substance</td>
</tr>
<tr>
<td>NSDUH</td>
<td>National Survey on Drug Use and Health</td>
</tr>
<tr>
<td>NSS</td>
<td>National Seizure System</td>
</tr>
<tr>
<td>N-SSATS</td>
<td>National Survey of Substance Abuse Treatment Services</td>
</tr>
<tr>
<td>OCDETF</td>
<td>Organized Crime Drug Enforcement Task Force</td>
</tr>
<tr>
<td>OCR</td>
<td>optical character recognition</td>
</tr>
<tr>
<td>OFC</td>
<td>OCDETF Fusion Center</td>
</tr>
<tr>
<td>OFO</td>
<td>Office of Field Operations</td>
</tr>
<tr>
<td>OIG</td>
<td>Office of Inspector General</td>
</tr>
<tr>
<td>ONDCP</td>
<td>Office of National Drug Control Policy</td>
</tr>
<tr>
<td>OUD</td>
<td>opioid-use disorder</td>
</tr>
<tr>
<td>POE</td>
<td>port of entry</td>
</tr>
<tr>
<td>PRC</td>
<td>People’s Republic of China</td>
</tr>
<tr>
<td>RCMP</td>
<td>Royal Canadian Mounted Police</td>
</tr>
<tr>
<td>RISS</td>
<td>Regional Information Sharing Systems</td>
</tr>
<tr>
<td>SAR</td>
<td>Suspicious Activity Report</td>
</tr>
<tr>
<td>SEACATS</td>
<td>Seized Assets and Case Tracking System</td>
</tr>
<tr>
<td>SEDENA</td>
<td>Mexican Secretariat of National Defense</td>
</tr>
<tr>
<td>SEMAR</td>
<td>Mexican Naval Secretariat</td>
</tr>
<tr>
<td>STOP Act</td>
<td>Synthetics Trafficking and Overdose Prevention Act</td>
</tr>
<tr>
<td>STRIDE</td>
<td>System to Retrieve Information from Drug Evidence</td>
</tr>
<tr>
<td>TBML</td>
<td>trade-based money laundering</td>
</tr>
<tr>
<td>TCO</td>
<td>transnational criminal organization</td>
</tr>
<tr>
<td>TEDS</td>
<td>Treatment Episode Data Set</td>
</tr>
<tr>
<td>UNODC</td>
<td>United Nations Office on Drugs and Crime</td>
</tr>
<tr>
<td>UPU</td>
<td>Universal Postal Union</td>
</tr>
<tr>
<td>USAO</td>
<td>U.S. Attorney’s Office</td>
</tr>
<tr>
<td>USPIS</td>
<td>U.S. Postal Inspection Service</td>
</tr>
<tr>
<td>USPS</td>
<td>U.S. Postal Service</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>WONDER</td>
<td>Wide-Ranging Online Data for Epidemiologic Research</td>
</tr>
</tbody>
</table>
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