Chapter Five

21st CENTURY CRIME LABS

Well-equipped and well-managed state and local crime labs are a critical element of a local agency's ability to solve crimes. However, although advances are being made in forensic technology, the nation's 350 crime labs often do not have the resources to acquire and apply these technologies.

The $75 million initiative proposed by the President in FY 2000 is a big step toward dramatically improving the nation's state and local crime labs, which provide 95 percent of the forensics support to local law enforcement agencies. This initiative would establish a regional forensic support network of forensics experts from federal national laboratories, universities, and other research programs.

A crucial part of this initiative is to improve DNA testing by complementing ongoing FBI initiatives to enhance their effectiveness. This would include funds for research on rapid high-throughput technologies and methods for rapid processing of evidence samples and DNA testing, which is performed on samples both to build a felon database and to help solve crimes.

The National Commission on the Future of DNA Evidence has strongly recommended rapid development of the DNA database. In Virginia alone, this database has already identified dozens of suspects in old, unsolved cases for which there were no leads. Nationwide, over the past decade, on the basis of DNA testing, 53 people

have been released from death row.[1] In Pennsylvania, as of December 1998, only about 1,000 of the roughly 10,000 samples from convicts collected had been analyzed.[2] Until this backlog can be addressed, the database cannot be fully effective, and more crimes will be committed by suspects who would otherwise be identified by DNA evidence from earlier crimes.

Arguably of greater importance is the need to provide resources sufficient to test all evidentiary samples that might help solve known crimes, including not only homicides and rapes but assaults and burglaries. As one forensics expert has put it, "Money should be assigned to solve this problem since every woman or child sexually assaulted deserves a genetic diagnosis" (Ballantyne, 1999).

The United Kingdom has been more aggressive than the United States in promoting DNA analysis, [3] which is done in the UK not only in murder and rape cases but also in burglaries—clearing hundreds of cases per week.[4] In the United States, all 50 states authorize DNA sampling of convicted felons, and every state collects samples from sex offenders. Some states, such as Virginia, collect data from a wide variety of felons; Pennsylvania takes samples only from those convicted of certain crimes (Henson, 1998). New York, following the practice of many states, allows DNA testing of certain convicts; however, New York City Police Commissioner Howard Safir has proposed taking DNA samples along with fingerprints of everyone arrested. So far, Louisiana is the only state that tests everyone arrested.[5]

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[1] "Fla. Justice Has 'Grave Doubts' on Guilt of Some Convicts," *Washington Post,* December 25, 1998.

[2] Pennsylvania expects to add about 4,000 new samples each year (Henson, 1998).

[3] The UK is introducing many innovations through its National Strategy for Police Information Systems; some of them may be applicable to the United States. The British established the world's first national DNA database, introduced the Police National Network to link all police forces with a modern data network, and has implemented Phoenix, a national computerized criminal record database giving police and courts access to details of millions of criminal records.

[4] Although concerns about protecting privacy and civil rights may be stronger in the United States than in Great Britain, a critical review of the British experience could be useful.

[5] "Official Wants Sample of DNA Taken at Arrests," *Houston Chronicle*, December 15, 1998.

The U.S. system is neither fully automated nor fully integrated. The FBI has been successful in building consensus in the United States to use the STR (short tandem repeats) methodology, which is several orders of magnitude faster and more readily automated than the restriction fragment length polymorphism (RFLP) technology. To take full advantage of the STR methodology, local labs would require technology and training, including training of new personnel and continuing education for personnel experienced in older technologies. The training called for is comparable to college courses, which could best be provided by federal funding for FBI centralized training and for regional forensic sciences courses at local universities.

ONGOING FBI DNA INITIATIVES

The DNA Identification Act of 1994 authorizes the FBI to establish DNA indexes for persons convicted of crimes, samples recovered from crime scenes, and samples recovered from unidentified human remains. All 50 states have passed legislation requiring convicted offenders to provide samples for DNA databasing. The states have collected approximately 600,000 DNA samples and analyzed more than 250,000. All 50 states have been invited to participate in the FBI's National DNA Index System (NDIS). NDIS allows states to exchange DNA profiles and perform interstate comparisons of DNA profiles. For interested states, the FBI provides Combined DNA Index System (CODIS) software, together with installation, training, and user support, free of charge to state and local law enforcement laboratories performing DNA analysis.[6] The FBI also provides quality assurance standards for DNA testing.[7]

Of the original funding, $25 million went to the FBI and about $40 million to state and local agencies. Within four years, the FBI expects millions of genetic profiles to be available for rapid retrieval and comparison (Henson, 1998).

Already, the DNA database is credited with helping to solve nearly 200 crimes. In more than 200 other cases, "the national computer

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[6]FBI press release, October 13, 1998.

[7]See *http://www.fbi.gov/lab/report/dnatest.htm* for a listing of these standards.

system was able to link DNA from a crime scene in one jurisdiction with DNA from a crime scene elsewhere" (Henson, 1998).

TECHNOLOGY PLAYS ROLE IN NEW ORLEANS CRIME REDUCTION

The Integrated Ballistic Identification System (IBIS)[8] at the new New Orleans Police Department (NOPD) Crime Lab is being used to prevent murder and other violent crime. IBIS can automatically link a particular gun to multiple crimes in which it was used. Each gun fired leaves unique marking on bullets and shell casings, and this evidence—once input into a central computer—allows investigators to match weapons to suspected criminals. IBIS also provides the NOPD with access to the forensic and technological expertise of the Bureau of Alcohol, Tobacco and Firearms (ATF). The NOPD now has online access to the ATF's firearms-related database, which greatly expands the ability to search for violent criminals.

During a recent 18-month period, the NOPD made 59 cold matches and numerous suspect matches between shootings and/or firearms recovered. This overall crime gun program in New Orleans is now viewed as a model for the rest of the United States to follow.

STATUS AND NEEDS

The NIJ recently published a review of the status and needs of forensic sciences in the United States (NIJ, 1999). Here we summarize findings from three topic areas: (1) training, (2) technology transfer, and (3) methods research, development, testing, and evaluation (RDT&E).

Training

Initial training currently is largely on the job. Uniform or consensus entry-level academic background requirements do not exist for all forensic disciplines. Every forensic scientist should undergo training

[8]The ATF's IBIS and the FBI's Drugfire system are competing bullet and cartridge case identification systems.

in quality assurance, but the number of formal classes is limited. Forensic scientists must be able to provide effective expert testimony; some expert witness training is currently available. The NIJ review's recommendations for training included the following:

- NIJ should fund forensic academic research and development programs.
- All forensic scientists should have formal quality assurance and expert witness training.
- Laboratory directors and supervisors should be provided management training.
- The profession should utilize existing and explore other delivery systems for forensic science training; examples include the FBI's LABNET and NLECTC's JUSTNET.
- Distance-learning centers accessible to forensic laboratories should be identified.
- All training needs should be funded using a combination of direct federal funds, fines and forfeitures, and foundation grants (NIJ, 1999, pp. 8–15).

Technology Transfer

The Federal Laboratory Consortium defines technology transfer as "the process by which existing knowledge, facilities, or capabilities developed under federal research and development funding are utilized to fulfill public and private needs" (NIJ, 1999, p. 17). The NIJ review (NIJ, 1999, pp. 24–26) made the following recommendations for improving technology transfer:

- Prepare a directory of technologies available at the national laboratories.
- Prepare a directory of key contacts in the national laboratories and the forensic community.
- Establish a steering committee and technical advisory focus group.

- Form strategic (working) partnerships.
- Identify sources of funding.

Methods RDT&E

The majority of crime labs in the United States engage in the following nine types of activities: [9]

- *Latent print examinations.* Although courts have for many years accepted the work performed in latent print (fingerprint) examinations, current needs include improved recovery and visualization methods, interoperability and improvement of search and retrieval systems, and shared databases for use in training and harmonization efforts.
- *Questioned document examinations.* This discipline is said to be in a chaotic state, because courts have questioned the scientific basis of handwriting identification, as well as because of ongoing changes in the ways that documents are created and transmitted. Current needs include validation of the scientific basis for handwriting examination, harmonization of comparison criteria, improved nondestructive methods for determining characteristic features of documents, image-enhancement methods for linking documents to machines, and shared databases of writing and machine-document exemplars for use in training and harmonization efforts.
- *Firearms/toolmarks and other impression evidence examinations.* Courts routinely accept identifications of firearms, tools, and other implements through comparison of microscopic impressions on questioned and authenticated specimens. Nevertheless, current needs include validation of the basis for impression evidence identifications, development of portable nondestructive analytical approaches for characterizing features of bullet impact areas, and statistical analysis of performance of algorithms used in automated pattern recognition.

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[9] The information in this section is from NIJ (1999), pp. 27–51, which includes considerable additional discussion and explanation.

- *Crime scene response and related examinations.* The quality of analyses depends heavily on the quality of evidence recognition, documentation, collection, and preservation. Current needs in this area include sample location, identification, capture, and stabilization technology in a kit suitable for recovery of trace evidence, portable and remote hazardous materials detectors, and computerized crime scene mapping supported by the Global Positioning System (GPS) and multimedia capture technologies.
- *Energetic materials (explosives and fire debris) examinations.* See also Hannum and Parmeter, 1998. Very few laboratories routinely analyze postblast debris. Needs include improved methods for assessing the size, construction, and composition of improvised explosive devices from macroeffects at postblast scenes, enhanced cleanup techniques for postblast debris, method development for recovery of explosive and ignitable liquid residues from a variety of matrices, enhanced field-detection capabilities and mapping technologies for bomb scene investigation assistance, and continued validation of the current methods by intralaboratory studies.
- *Postmortem toxicology and human performance testing.* Although courts routinely accept these laboratory determinations, interpretive controversies still exist in several areas of toxicology. Current needs include nondestructive analytical techniques, well-controlled studies of the effects of drugs on the operation of motor vehicles and complex equipment, more-accurate methods for determining time of death, and a central database of postmortem "incidental" drug findings in deaths unrelated to drugs.
- *Forensic biology and molecular biochemistry.* Forensic DNA analysis allows for the biologic comparison between an individual's genetic makeup and biological evidence found at a crime scene. Current needs include robotic methods to replace the time consuming process of extracting biologic fluids and tissues, including differentials for semen strains; access to microchip technology to enhance and advance DNA testing methods; and sampling devices for stabilizing evidence during in-field collection.
- *Transfer (trace) evidence evaluation.* Trace evidence materials include transfer evidence of all types except biological fluids. These commonly include paints, hairs, fibers, glass, and building

materials. Current needs include standardization of trace analysis methodologies, enhancements of nondestructive techniques for analysis of materials, and development and coordination of databases.

- *Controlled substance examinations.* The determination of controlled substances is the most common service delivered by forensic laboratories all over the world. Current needs include standardization of methods, automation of sampling and analysis, remote sensing equipment, and nondisruptive ("through the packaging") sampling.

EXAMPLES OF LAB CASELOADS

A recent audit (California State Auditor, 1998) of California's 19 local forensic laboratories[10] noted the following:

- "The Sacramento crime lab received 468 sexual assault cases for examination in calendar year 1997. Of those 468 cases, 317 were submitted without an identified suspect, while the remaining 151 cases had identified a suspect. Based on previous historical trends, approximately 328 of these sexual assault cases (70 percent) have potential serological evidence that can benefit from forensic DNA analysis."[11]
- Laboratories that provide services for law enforcement agencies may also support other agencies. The Kern County, California, forensic laboratory, for example, performs DNA analyses for the county's Family Support Division. It handles approximately 200 forensic DNA cases and 400 paternity cases per year.[12]

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[10]County district attorneys' offices, county sheriffs' offices, or city police departments operate 19 local laboratories that serve the approximately 77 percent of California's population residing in 13 counties. The State Department of Justice operates an additional 11 laboratories that serve the remaining counties in the state; the recent audit covered only the 19 local forensic laboratories.

[11]District Attorney, Sacramento County, letter, December 2, 1998, included in California State Auditor, 1998, p. R-40.

[12]District Attorney, Kern County, letter, December 2, 1998, included in California State Auditor, 1998, p. R-23.

In September 1998, the San Francisco police lab "halted routine testing of DNA samples, saying the two full-time criminalists [i.e., forensic scientists] could not keep up with the work."[13]

A less exotic—but no less important—backlog exists in fingerprint identification. In some departments, there is a substantial backlog of prints taken in homicide investigations, to say nothing of lesser crimes. Delays in fingerprint identification, in effect, may discourage investigators from taking prints in the first place. This is both a staffing and technology problem. In February 1997, it was disclosed that the FBI had fallen at least three months behind in conducting background checks on suspects of murder, rape, robbery, and other felonies. With 50,000 new requests arriving every day, a backlog of 2.8 million orders had developed.[14]

Virginia's four regional crime labs review 75,000 cases annually—half being drug analyses. The labs prioritize cases by court date.[15] On average, evidence waited about 48 days in the regional labs before being tested.[16]

Given insufficient resources to meet the demand, Wisconsin forensic laboratories have had to develop case management coping strategies. Some were considered reasonable (e.g., no drug cases submitted until after all plea bargaining is over) while others were compromises necessary to cut costs (e.g., selecting one sample with the highest probability of containing semen in a sexual assault case).[17]

Yet another backlog is in the test firing and ballistics cross checking of guns suspected of being used in crimes. There are presently two

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[13]"Attorneys Assail Police DNA Labs," *San Francisco Chronicle*, December 23, 1998.

[14]To address this, the FBI is developing an Integrated Automated Fingerprint Identification System, which will provide 10-print, latent print, subject search, criminal history request services, document submission, and image request services to FBI service provider and to federal, state, and local law enforcement users. For more information, see web site *http://www.fbi.gov/programs/iafis/iafis.htm/*.

[15]This is consistent with the goal of not having to go to trial without having completed lab analysis of evidence, but it may not be the best way *to solve the most cases*. Prompt analysis of the most recent evidence would likely be the most useful method for solving cases, while leads are still hot and tracking a suspect is most feasible.

[16]*Potomac News*, May 18, 1998.

[17]Michael J. Camp correspondence, March 14, 1999.

competing systems of ballistics testing: the FBI's, which is less costly, and the ATF's,[18] which is said to be better in some respects. The National Institute of Standards and Technology has brokered discussions to share databases, but further reconciliation is needed.

EQUIPMENT AND FACILITY NEEDS

> [The California audit] determined that 10 of the 19 laboratories use outmoded equipment that they must soon replace. Outmoded equipment can result in high maintenance costs, unreliable test results, and unacceptably low laboratory performance. It can also limit opportunities for staff to develop their skills using modern techniques (California State Auditor, 1998, p. 24).

The California audit noted the following (California State Auditor, 1998, p. 24):

- At least four laboratories should replace outdated gas chromatograph/mass spectrometer (GC/MS) instruments. The GC/MS is a powerful tool used to identify drug samples, arson evidence, and other materials collected at a crime scene. Replacement of the GC/MS in one lab would cost an estimated $70,000.
- At least three labs should replace their Fourier Transform Infrared Spectrometers (FTIRs). The FTIR is an expensive instrument that analyzes different substances, such as drugs, plastics, and paints. Replacement of the FTIR in one lab would cost an estimated $61,000.
- Eight GC instruments, which separate mixtures into individual components, were found in need of replacement, at an estimated cost of $35,000 each.
- Many outdated microscopes were found in need of replacement, as at estimated cost of $2,000 to $10,000 each.

The California audit estimated that it would cost more than $221 million to construct new facilities for the laboratories that do not

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[18] In 1997, the ATF laboratories processed 2,915 forensic cases; spent 320 days providing expert testimony in the courts; spent 226 days at crime scenes; and spent 238 days providing training to federal, state, and local investigators and examiners.

currently meet the standards recommended by forensic laboratory design literature. The audit estimated an additional cost of nearly $2 million annually for the 13 laboratories without adequate quality control systems to implement and maintain these systems. It also recommended staff training that would cost an estimated $600,000 annually. The audit recommended that consideration be given to consolidating or regionalizing services, including DNA testing (California State Auditor, 1998, p. 42).

PROSPECTS FOR IMPROVED CRIME LABS

The above demonstrates the importance of crime labs and shows why funding for them to acquire modern technology and the training necessary to maintain high quality standards should be politically popular. Nevertheless, budgeting for forensics laboratories is generally hit-or-miss and is often inadequate to meet public and law enforcement expectations. Clearly, the federal government has a role to play in supporting this public good.

Courts are putting pressure on forensic science to revise Rule 702 of the Federal Rules of Evidence, to add information on the reliability of evidence, such as DNA evidence. This motivates the need for federal funding of research on the reliability of forensic evidence.

At a minimum, the federal government should encourage the nationwide development and maintenance of crime lab capabilities that are adequate to ensure that no violent felony investigation or prosecution is endangered or abandoned by lack of timely forensic support.