Assessing the Preparedness of the Canadian Health Care System Infrastructure for an Alzheimer’s Treatment

KEY FINDINGS

- Potential disease-modifying therapies could prevent or delay early-stage Alzheimer’s disease from progressing to dementia but raise challenges for health care systems in diagnosing and treating a large population.

- We use a simulation model to assess the preparedness of the Canadian health care system infrastructure to diagnose and treat people with mild cognitive impairment due to Alzheimer’s disease if a future therapy becomes available.

- If a therapy becomes available in 2021, we estimate that average annual wait times for diagnosis and treatment in Canada could peak at 28 months and persist for decades if there are not policies and practices to alleviate the burden on dementia specialists and increase capacity for biomarker testing and treatment delivery. Depending on policies, we estimate that 166,000 to 485,000 Canadians could progress from mild cognitive impairment due to Alzheimer’s disease to Alzheimer’s dementia while on wait lists.

- The most pressing constraint is the capacity of dementia specialists to evaluate and diagnose early-stage patients. The use of both neuroimaging and cerebrospinal fluid biomarkers for diagnostic testing could decrease wait times.

- Canada faces the challenge of large geographic areas with sparse populations and limited access to specialty care, as well as potentially long lead times to add neuroimaging equipment to public facilities.

- Expanding capacity would require coordinated efforts among multiple stakeholders to increase awareness and investment, and to implement policies that ensure adequate capacity to deliver a future Alzheimer’s therapy.
Alzheimer’s disease (AD) is a chronic neurodegenerative disorder that leads to cognitive and functional decline, dementia, and premature death. Similar to other aging societies, Canada faces an increasing burden of this disease on patients and their caregivers, as well as on health care and long-term care resources. Approximately 614,000 Canadians had dementia in 2018, of which about two-thirds had Alzheimer’s dementia (Alzheimer Society Population Health Expert Panel, 2016). The Alzheimer Society Population Health Expert Panel estimates that dementia prevalence will increase to 987,000 by 2033. No disease-modifying therapy to treat this serious condition exists today, but efforts to slow or even halt the progression of the disease are under way in varying stages of clinical trials. There is guarded optimism that a disease-modifying therapy could become available in the coming years (Aisen, 2017; “Alzheimer’s Disease: A Time for Cautious Optimism,” 2015), as several therapies are in later stages of clinical trials. Table 1 shows Alzheimer’s disease-modifying therapies currently in Phase 2 and Phase 3 clinical trials. These therapies target beta-amyloid and tau, the hallmark proteins that accumulate in the brain as plaques and tangles and are associated with Alzheimer’s dementia.

The majority of disease-modifying therapies being studied in current trials target early stages of the disease—when there are symptoms of memory loss and cognitive but not functional decline, also described as mild cognitive impairment (MCI)—or even earlier, before symptoms manifest. The aim of these therapies is to delay or prevent progression of early-stage AD to Alzheimer’s dementia. Because MCI can be a symptom of a variety of conditions, it is critical to diagnose the AD pathology as the underlying cause of cognitive impairment to determine whether the specific treatment would be indicated for a given individual. Currently, there are diagnostic guidelines for MCI due to AD (Albert et al., 2011), but these are not recommended for routine clinical practice in Canada, as there is no disease-modifying therapy available (Gauthier et al., 2011; Gauthier et al. 2012). Once a therapy is introduced, the goal would be to ensure that all eligible individuals with early-stage AD have access to it as soon as possible, to halt or slow the progression of the disease to manifest dementia.

The possibility of a future Alzheimer’s disease-modifying therapy for early stages of the disease has significant implications for health care delivery systems in terms of diagnosing and treating a large population (Liu et al., 2017; Hlávka, Mattke, and Liu, 2018). We estimate that 1.4 million Canadians over age 50 will have MCI in 2020 (Statistics Canada, 2018a; Petersen et al., 2018), most of whom are not likely to have been evaluated for AD at an early stage. The health care delivery system would face

Without the appropriate health care infrastructure, there is a significant risk that some people who would benefit from an available therapy would not be able to access treatment in a timely manner.
the challenge of detecting and diagnosing a large number of people with existing MCI at one time, in addition to new cases occurring over time. Without the appropriate health care infrastructure, there is a significant risk that some people who would benefit from an available therapy would not be able to access treatment in a timely manner.

This report presents an analysis of the preparedness of the Canadian health care system to treat people with early-stage Alzheimer’s disease should a disease-modifying therapy become available. Following our earlier work in the United States and Europe (Liu et al., 2017; Hlávka, Mattke, and Liu, 2018), we draw on publicly available data and expert insights to refine a simulation model that quantifies the capacity of the health care system to diagnose and treat people with early-stage AD. We present projections for several scenarios under high-level assumptions; none of the scenarios is meant to provide precise predictions of the future, given uncertainties related to the profile of a new therapy, patient uptake, and future capacity growth. Our goal is to demonstrate the magnitude of the potential capacity challenges to inform strategies for expanding capacity.

The following sections present our conceptual framework, simulation model, and projections. We discuss the design of the model and show historical and projected capacity trends that affect diagnosis and treatment. We show the impact of capacity constraints

<table>
<thead>
<tr>
<th>Candidate</th>
<th>Sponsor</th>
<th>Clinical Trial Phase</th>
<th>Expected Primary Completion Date</th>
<th>National Clinical Trial Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti–beta-amyloid antibodies</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Gantenerumab</td>
<td>Hoffmann-La Roche</td>
<td>Phase 3</td>
<td>May 2022</td>
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<td>Eisai/Biogen</td>
<td>Phase 3</td>
<td>July 2022</td>
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<td>Eli Lilly</td>
<td>Phase 2</td>
<td>October 2020</td>
<td>NCT03367403</td>
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<tr>
<td>Anti-tau antibodies</td>
<td></td>
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<td>ABBV-8E12</td>
<td>AbbVie</td>
<td>Phase 2</td>
<td>April 2021</td>
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<td>Biogen</td>
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<td>July 2021</td>
<td>NCT03352557</td>
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<tr>
<td>RO7105705</td>
<td>Genentech</td>
<td>Phase 2</td>
<td>June 2020</td>
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<tr>
<td>BACE inhibitors</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Elenbecestat (E2609)</td>
<td>Eisai/Biogen</td>
<td>Phase 3</td>
<td>November 2023</td>
<td>NCT03036280</td>
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<td>CNP520</td>
<td>Novartis/Amgen/ Banner Alzheimer’s Institute</td>
<td>Phase 2/3</td>
<td>July 2024</td>
<td>NCT03131453</td>
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<td>Vaccines</td>
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<td>CAD106 (anti–beta-amyloid)</td>
<td>Novartis</td>
<td>Phase 2/3</td>
<td>August 2024</td>
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<td>AADvac1 (anti-tau)</td>
<td>Axon Neuroscience</td>
<td>Phase 2</td>
<td>June 2019</td>
<td>NCT02579252</td>
</tr>
</tbody>
</table>

NOTES: Anti–beta-amyloid and anti-tau antibodies are monoclonal antibodies that are typically administered by intravenous or subcutaneous infusions. BACE inhibitors are oral drugs that block beta-secretase, which is a beta-site amyloid precursor protein-cleaving enzyme that is thought to prevent the accumulation of beta-amyloid. Alzheimer’s vaccines are injections of antigens or preformed antibodies with the aim of triggering antibody responses.

a Eisai has announced that the readout of the primary endpoint is targeted for 2022; the primary completion date of the study is March 7, 2024.
b LY3002813 is being evaluated alone and in combination with LY3202626, a BACE inhibitor.
on wait lists, waiting times, and the number of people progressing from MCI due to AD to Alzheimer’s dementia. A technical appendix that provides additional detail about the data and methods is available online. It is our hope that the analysis will facilitate dialogue among stakeholders and help ensure timely access, should an Alzheimer’s disease–modifying therapy become available.

**Conceptual Framework and Simulation Model**

**Conceptual Framework**

The clinical pathway by which a disease-modifying therapy would influence the health system is depicted in Figure 1. This pathway is the basis for our simulation model. We conceptualize the pathway into three main clinical phases—screening, diagnostic, and treatment—that occur for people with normal cognition or MCI, and disease progression of MCI due to AD to Alzheimer’s dementia.

In this framework, older adults would undergo cognitive assessment in primary care settings via an assessment of functional deficits and a short instrument, such as the Folstein Mini–Mental State Examination (MMSE) (Folstein, Folstein, and McHugh, 1975), Modified MMSE (Tombaugh et al., 1996), or the Montreal Cognitive Assessment (Ciesielska et al., 2016) (screening phase). Next, people who exhibit cognitive impairment might be evaluated to ensure no reversible and treatable causes exist (i.e., hematologic, metabolic, mood, or pharmacological causes). Those with no treatable or reversible features, which would be consistent with a diagnosis of MCI, would be referred to a dementia specialist for further evaluation, including additional cognitive and functional assessments, and possible referral to testing for the presence of amyloid and/or tau biomarkers to determine whether the MCI is...
likely due to Alzheimer’s disease (diagnostic phase). After a positive biomarker test, a dementia specialist would determine whether treatment is indicated. If indicated, patients could be treated with a therapy that would reduce the risk of progression from MCI to Alzheimer’s dementia (treatment phase). For people with untreated MCI due to Alzheimer’s disease, the disease would continue to progress. Compared with treated MCI patients, untreated MCI patients have a higher risk of progressing to a later stage of the disease with manifest dementia, at which point the assumed treatment would no longer be effective.

Simulation Model

Our simulation model is a Markov model that simulates transitions between disease states and a systems dynamic model that simulates health care system capacity constraints within the MCI state. We have applied this model to assess the preparedness of the health care systems in the United States (Liu et al., 2017) and six European countries (Hlávka, Mattke, and Liu, 2018); see the online appendix for a model overview. In this model, individuals move through the disease states—from no cognitive impairment (i.e., no MCI and no Alzheimer’s dementia), to MCI, to Alzheimer’s dementia—according to transition probabilities derived from the literature (Table A.1 in the online appendix). Within the MCI state, people are diagnosed (for MCI due to AD) and treated based on a systems dynamic model with outflows constrained by infrastructure capacity. We model three capacity constraints: availability of dementia specialists, biomarker testing, and treatment delivery. For the two dementia specialist visits in the diagnostic phase of our framework, the model is optimized such that specialists do not take on a new patient for an initial visit if they do not have the capacity to provide confirmatory visits for existing patients in the same year.

We incorporated Canadian data on the population, disease prevalence, mortality, and historical workforce and infrastructure into the model. See appendix Table A.1 for the model parameter values and their respective sources.

We model three capacity constraints: availability of dementia specialists, biomarker testing, and treatment delivery.

Model Assumptions

Our analysis relies on several assumptions to model a hypothetical future therapy. Our assumptions about patient uptake, contraindications, and the treatment delivery and effectiveness are consistent with those used in our prior U.S. and European studies that were informed by expert input (Liu et al., 2017; Hlávka, Mattke, and Liu, 2018). For this analysis of the Canadian health care system, we apply the same general assumptions regarding the treatment, uptake, and disease transitions unless otherwise noted.

To adapt assumptions for Canada, we consulted with 18 experts familiar with clinical practice, care delivery, patient needs, and the policy environment in Canada. The experts were identified by a targeted search of the literature and websites of academic institutions and by snowball sampling in which interviewees recommended other experts for our recruitment process. We selected interviewees based on their clinical specialties, expertise, and contributions to the field, and to ensure geographic representation across provinces. The interviewees included clinicians and practitioners of neurology, geriatric medicine, geriatric psychiatry, family medicine, and pharmacy. The interview questions were related to the following domains: clinical pathway, detection and diagnosis, treatment and monitoring, data, and policies and practices. Our assumptions include the types of specialists involved in the diagnosis of MCI due to AD and the relative role of Positron Emission
Tomography (PET) scans and cerebrospinal fluid (CSF) tests to measure biomarkers.

The key assumptions in our analysis are as follows:

- A disease-modifying therapy for patients with MCI due to AD becomes available in 2021.1 Our analyses are based upon an anti–beta-amyloid monoclonal antibody therapy, because anti–beta-amyloid candidates are the furthest along in clinical trials. We further assume that the therapy would be delivered by intravenous administration.

- We assume that individuals age 50 and older are eligible for annual cognitive screening. We modeled the population 50 years and older because most later-stage clinical trials include ages as young as 50 (e.g., U.S. National Library of Medicine, 2018a, 2018b, 2018c, 2018d, 2018e).2 Screening starts in 2020 as patients and providers anticipate the approval of the therapy. Annual screenings may be conducted by general practitioners. We assume their capacity to conduct cognitive screening and functional assessments would be unconstrained. We assume that 80 percent of individuals age 50 and older would consent to screening each year. Of those who screen positive for MCI, we assume 50 percent would seek further evaluation from a dementia specialist. These proportions are based on expert input collected in the original development of the model.

- Further evaluation would be conducted by a dementia specialist, who we assume could be a neurologist, geriatrician, or psychiatrist. We assume that 10 percent of all psychiatrists in Canada may be involved in evaluation of patients with MCI possibly due to Alzheimer’s disease. Individuals would be referred to testing for biomarkers if the evaluation confirms MCI and does not find an alternative explanation for MCI (e.g., prior stroke) or a reason not to pursue treatment (e.g., presence of another life-limiting disease). Of those with confirmed MCI that is possibly due to Alzheimer’s disease, we assume that 90 percent of patients would seek biomarker testing, based on expert input in the original development of the model.

- In Canada, we assume that biomarker testing may be performed with a PET scan for amyloid deposits in the brain, or with a CSF test.3 Based on input from Canadian experts regarding the potential availability of PET scanners and patient preferences, our base case assumption is that 80 percent of tests would be performed using PET and 20 percent would be performed using CSF; in alternative scenarios, we assume that 50-percent PET and 50-percent CSF would be used. We assume that 45 percent of people with MCI have clinically relevant biomarker levels that warrant anti–beta-amyloid monoclonal antibody therapy (Ong et al., 2015; Doraissamy et al., 2014).

- If an individual’s biomarker level is clinically relevant, she or he returns to a dementia specialist who determines whether treatment is indicated. If there are no contraindications and the individual consents, the individual is referred for treatment. Of people with MCI who test above a certain biomarker level, we assume that 80 percent would have no contraindications or other reasons to pursue for treatment (based on expert input).

- We assume that the therapy would be delivered by intravenous infusion every four weeks for one year, following protocols for a typical immunotherapy. We further assume that treatment reduces the relative risk of progression from MCI due to AD to Alzheimer’s dementia by 50 percent after treatment.

**Current Patient Demand and Capacity Estimates**

**Patient Demand**

Figure 2 shows the expected patient demand in the screening and diagnostic phases of the clinical pathway in 2020. We estimate that there would be 1.4 million Canadians who screen positive for MCI in 2020, 0.6 million patients who would seek and be eligible
for biomarker testing, and 0.2 million patients who would be determined eligible for treatment.

Specialist Workforce

In Canada, neurologists, geriatricians, and psychiatrists are the specialists that typically diagnose cognitive impairment and dementia (Alzheimer Society of Canada, 2018). We use historical workforce data from the Canadian Medical Association and workforce projections from the Fraser Institute (Canadian Medical Association, 2018; Globerman, Barua, and Hasan, 2018). Table 2 shows the total number of specialists, which is expected to increase from 6,341 in 2020 to 8,097 in 2050, or by about 28 percent.

While these three types of specialists are usually referred to for further evaluation, not all neurologists, geriatricians, and psychiatrists conduct cognitive evaluations. In particular, psychiatrists provide a broad range of services related to mental health conditions as well as psychotherapy, and geriatric psychiatrists are a small subspecialty in Canada. Based on our assessment of expert input, we assume that 10 percent of psychiatrists in Canada would provide visits to evaluate patients who may have cognitive impairment and diagnose Alzheimer’s pathology. We make assumptions about the specialists’ excess capacity and willingness to provide more visits for the MCI population to model specialist workforce capacity. Overall, we assume that those psychiatrists, neurologists, and geriatricians could increase their capacity for visits by 5 percent to meet the demand of new MCI patients seeking further evaluation. This simplifying assumption could be conceptualized as all specialists in this group providing 5 percent more visits, half of the specialists conducting 10 percent more visits, or something in between.

Although we model dementia specialist capacity at the national level, there is geographic variation in the availability of physicians within Canada that would affect access to MCI detection and diagnosis. Figure 3 shows the distribution of physicians across administrative health regions within provinces. Most regions have at least 100 family medicine physicians per 100,000 people, but some more remote areas have fewer. The geographic variation across all specialist physicians (not just dementia specialists) shows more density clustered around the southern border, and three regions have no specialists.

Table 2 shows the projected workforce of specialists who may diagnose early Alzheimer’s disease.

### TABLE 2
Projected Workforce of Specialists Who May Diagnose Early Alzheimer’s Disease

<table>
<thead>
<tr>
<th>Year</th>
<th>Neurologists</th>
<th>Geriatricians</th>
<th>Psychiatrists</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>1,072</td>
<td>310</td>
<td>4,959</td>
</tr>
<tr>
<td>2030</td>
<td>1,161</td>
<td>336</td>
<td>5,369</td>
</tr>
<tr>
<td>2040</td>
<td>1,261</td>
<td>364</td>
<td>5,831</td>
</tr>
<tr>
<td>2050</td>
<td>1,369</td>
<td>396</td>
<td>6,332</td>
</tr>
</tbody>
</table>

**Sources:** Canadian Medical Association, 2018; Globerman, Barua, and Hasan, 2018.

**Note:** We assume 10 percent of all psychiatrists in Canada would provide visits to diagnose Alzheimer’s pathology in people with MCI.
Diagnostic Technology

A diagnosis of Alzheimer’s disease requires confirmation using biomarkers (beta-amyloid and/or tau) (Portet et al., 2006). In research and specialized clinical settings, Canadian providers use two different methods to confirm the presence of the Alzheimer’s pathology: neuroimaging using PET with fluorodeoxyglucose (FDG) tracers that bind to beta-amyloid in the brain and CSF measurement of beta-amyloid and tau levels (Moore et al., 2014). Given the limited clinical utility of establishing the exact diagnosis at the present time, in light of the lack of a disease-modifying therapy for Alzheimer’s, the 4th Canadian Consensus Conference on the Diagnosis and Treatment of Dementia recommends neither PET nor CSF outside of research purposes (Gauthier et al., 2012).

It is unclear whether PET imaging, CSF assays, or both types of biomarker testing would be preferred in Canada if an Alzheimer’s therapy becomes available. Current clinical trial protocols typically require an amyloid PET scan to identify abnormal brain amyloid levels in trial participants, and interviewees noted that patients may prefer a less invasive test such as this one. However, increasing PET scanner capacity would require substantial investment in capital, staff, and building upgrades. There are currently 51 PET scanners in Canada (Sinclair et al., 2018), which are primarily used for oncologic diagnoses and evaluation (Mattison, Gauvin, and Wilson, 2018).

Measurement of liquid biomarkers in CSF is less costly than PET scans, and lumbar punctures to retrieve CSF could be performed in many facilities. A challenge in the use of CSF assays has been standardization of thresholds and laboratory assays; however, there has been significant progress in validating CSF biomarkers as an alternative to PET (Bjerke and Engelborghs, 2018; Hansson et al., 2018). Current clinical use of CSF measurement of biomarkers is about 20 percent (Laforce et al., 2016). While using CSF could result in lower costs relative to PET, interviewees noted challenges such as the ready availability of physicians who regularly perform lumbar punctures and patient preference for neuroimaging versus lumbar punctures. In addition, there is currently no guidance on either where CSF samples would be analyzed or how to implement a
robust laboratory network to conduct the CSF assays (Laforce et al., 2016).

Due to the currently limited PET and laboratory capacity for routine biomarker testing to diagnose AD in Canada, substantial investment in one or both methods would be required to scale diagnostic capacity for early-stage Alzheimer’s patients. Given the uncertainty over which method would be preferred in Canada in the future, we analyze two sets of assumptions that reflect the following:

- **Base case biomarker testing assumption:** 80 percent of biomarker testing performed using PET and 20 percent using CSF. This assumes that PET would be the primary method used, particularly in urban areas, where about 80 percent of the Canadian population resides. We assume that capacity growth in PET scanners and cyclotrons, including capital and personnel training, would be similar to historical growth rates in Canada (see appendix Figure A.2).

- **Alternative biomarker testing assumption:** 50 percent of biomarker testing performed using PET and 50 percent using CSF. This assumes that there would be investment in CSF testing, which could include establishing protocols for lumbar punctures and expansion of laboratory networks, in addition to continued growth in PET capacity similar to historical trends. Although CSF would be less costly than PET, we assume that there would still be investment in PET, particularly in urban areas and for people who are unable to undergo a lumbar puncture due to anatomical reasons or contraindications, or have an aversion to the procedure.

In our analysis, we do not model capacity constraints for CSF testing because physicians are capable of performing lumbar punctures in theory, although many would need retraining to become more comfortable with the procedure. However, it is reasonable to assume that physicians who are capable of performing other minor, routine procedures could be trained to perform lumbar punctures with the right support. While lumbar punctures are currently more typically being performed in a hospital setting by neurologists or other specialists, they could be done with only a procedure room and a recovery room for patients to lie down in after the procedure, if needed.

In contrast, we assume that access to PET scans would be limited by the capacity of scanners and cyclotrons. Cyclotrons are required to produce the radioactive tracers used to bind to beta-amyloid and are typically located within approximately 320 kilometers of PET sites (Giamis, 2012) because the half-life of the radiopharmaceutical containing the fluorine-18 (\(^{18}\)F) isotope is relatively short. In addition, florbetaben \(^{18}\)F is the only amyloid tracer currently commercially approved in Canada (DrugBank, 2018a). Figure 4 shows the geographic distribution of current PET scanners and cyclotrons in Canada.

**FIGURE 4**
PET Scanners and Cyclotrons Capable of Manufacturing Amyloid Tracers in Canada

SOURCES: 2016 Census (Statistics Canada, 2017), Canadian Agency for Drugs & Technologies in Health (Sinclair et al., 2016; Sinclair et al., 2017), Canadian Association of Nuclear Medicine (2015).

NOTES: This map shows 51 PET scanners at 45 sites (Sinclair et al., 2016; Sinclair et al., 2017; Canadian Association of Nuclear Medicine, 2015). Of the 45 sites, 5 are private clinics (Canadian Association of Nuclear Medicine, 2015). The gray shading indicates the area that is within 320 kilometers of a PET cyclotron. There are 12 cyclotrons, including two in Toronto (Garland and Morrison, 2015). Population density is shown by health region (per the 2016 Census).
The gray shaded area indicates the coverage area given a 320-kilometer radius around each cyclotron. Although the cyclotron coverage area is predominantly across the southern part of Canada, where most of the population resides, there are still relatively few PET scanners to accommodate the expected number of people with MCI who could seek PET imaging, and no scanners in northern parts of Canada.

**Infusion Delivery**

We assume that a disease-modifying therapy would be delivered intravenously, and we explore an alternative scenario in which infusion delivery is not a barrier because capacity has been expanded or a treatment can be delivered subcutaneously or orally. Many intravenous therapies currently in development would be delivered every few weeks for a period of 12 to 24 months. While other modalities and treatment durations may eventually be adopted in clinical practice, we model a hypothetical therapy that would be administered approximately every four weeks for a total of 14 infusions per patient over the course of one year.

Given the lack of publicly available infusion data in Canada, we use an index approach consistent with our prior European analysis. Our estimates of the capacity to deliver infusions are based on the relative capacity of the Canadian health care system derived from four indicators: hospital beds, active nurses, magnetic resonance imaging (MRI) scanners, and PET scanners (see appendix Table A.2). We use Organisation for Economic Co-operation and Development (OECD) data to develop a capacity index for Canada relative to the United States (OECD, 2018), which we use to scale the per capita infusion capacity projected for the United States (see appendix Figure A.3). As there are private infusion clinics that deliver certain infusions in Canada (Patented Medicine Prices Review Board, 2016), we assume the same relative rate of growth in infusion capacity as in the United States. As in our prior analyses, we assume that excess capacity for new patients in existing infusion clinics is 10 percent, while 80 percent of the capacity in new infusion clinics could be dedicated to administering the Alzheimer’s therapy.

**Simulation Results Under Selected Capacity Scenarios**

**Base Case Scenario**

Our base case scenario reflects historical capacity trends projected forward and our assumptions related to specialist availability, biomarker testing performed (80 percent PET and 20 percent CSF), and our capacity index for infusions.

Figure 5 shows the wait lists under these assumptions. The main constraint initially is the backlog due to the availability of specialists to evaluate patients who screen positive for MCI. We estimate that the specialists’ capacity for visits would be 269,000 visits in 2020, which is less than half of the projected 693,000 people with MCI who may seek evaluation by a specialist and would require two visits in our model. The specialist constraint would not be eliminated until 2049, at which point the backlog
of patients would have been seen, and only incident cases would require evaluation going forward.

Figure 6 illustrates how these wait lists translate into average wait times. Focusing on PET as the primary method for biomarker testing could result in overall average annual wait times of over two years in the initial years and cause sustained wait times of four to seven months between 2040 and 2050. The waiting period for infusions is comparatively short, as most patients are delayed in the earlier diagnostic and screening phases.

Alternative Scenarios

We assess alternative scenarios that reflect concerted efforts to expand capacity in order to eliminate some of the barriers to diagnosis and treatment of people with MCI due to AD. The key assumptions that vary across the three alternate scenarios we considered are shown in Table 3.

Alternative scenario 1 reflects expanded use of CSF biomarker testing such that 50 percent of biomarker testing is conducted using PET and 50 percent using CSF. This may be possible if resources are dedicated to performing lumbar punctures and to conducting assays. It may be possible that capacity for CSF testing could rapidly be expanded if planning, policies, regulations, and reimbursements encourage investments. This may require training, developing standard protocols, and establishing laboratory networks with adequate reimbursement. In addition, the development of new technologies, such as blood-based assays (Blennow, 2017; Nakamura et al., 2018) would help facilitate expansion of biomarker testing capacity. Compared

TABLE 3
Capacity Assumptions Across Scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Specialists</th>
<th>Biomarker Testing</th>
<th>Infusions</th>
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</thead>
<tbody>
<tr>
<td><strong>Base case</strong></td>
<td>Neurologists, geriatricians, and 10% of psychiatrists with 5% excess capacity for visits</td>
<td>80% PET with historical capacity projected forward; 20% CSF with no capacity constraint</td>
<td>Level estimated using a general health care capacity index, with historical capacity projected forward</td>
</tr>
<tr>
<td><strong>Alternative scenario 1:</strong></td>
<td>Same as base case</td>
<td>50% PET with historical capacity projected forward; 50% CSF with no capacity constraint</td>
<td>Same as base case</td>
</tr>
<tr>
<td>Investment in CSF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Alternative scenario 2:</strong></td>
<td>Same as base case</td>
<td>50% PET with historical capacity projected forward; 50% CSF with no capacity constraint</td>
<td>No capacity constraint</td>
</tr>
<tr>
<td>Investment in CSF and infusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>delivery (or nonintravenous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>administration)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Alternative scenario 3:</strong></td>
<td>No capacity constraint</td>
<td>No capacity constraint</td>
<td>No capacity constraint</td>
</tr>
<tr>
<td>No capacity constraints</td>
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with the base case scenario, the waits for biomarker testing are eliminated if CSF can be used for 50 percent of the biomarker testing (Figure 7). Thus, the extent to which PET and CSF biomarker testing are used in Canada would have significant impact on patients’ access to the therapy. However, even in the scenario with investment in CSF, delays in access would extend through 2046 but would primarily be due to waits for specialists and infusions.

Table 4 shows a comparison of the projected wait times in each scenario. In alternative scenario 2, the elimination of the infusion delivery constraint could reflect adequate capacity growth of infusion services, or a therapy that does not require intravenous delivery (i.e., could be administered subcutaneously or orally). Eliminating the infusion constraint may be possible if building additional infusion center capacity becomes a priority, and/or if home infusions are utilized more widely. Assuming infusions would be

![Figure 7](image_url)

**FIGURE 7**
Projected Wait Lists and Times for Alzheimer’s Disease Diagnosis, Testing, and Treatment Under Alternative Scenario 1

**TABLE 4**
Summary of Projected Wait Times for Alzheimer’s Disease Diagnosis, Testing, and Treatment, by Scenario

<table>
<thead>
<tr>
<th>Scenario</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
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<tbody>
<tr>
<td><strong>Base case</strong></td>
<td>28</td>
<td>14</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td><strong>Alternative scenario 1:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment in CSF</td>
<td>23</td>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Alternative scenario 2:</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Investment in CSF and infusion delivery</td>
<td>23</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>(or nonintravenous administration)</td>
<td></td>
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<tr>
<td><strong>Alternative scenario 3:</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>No capacity constraints</td>
<td>0</td>
<td>0</td>
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</table>
delivered approximately every four weeks over 52 weeks for a total of 14 doses, 3.2 million infusions would need to be administered to treat the approximately 227,000 people with MCI due to AD estimated to be eligible for treatment as of 2021. Alternatively, a subcutaneous or oral therapy would not require intravenous infusion services.

Alternative scenario 3 illustrates the case in which all three capacity constraints and the associated wait times are eliminated. This assumes that there would be adequate training and task shifting such that health care providers could evaluate all patients seeking diagnosis, and that adequate expansion of PET and/or CSF capacity and infusion services occurs. While such an outcome is unlikely, given the extensive time required to train a significant number of specialists and changes in shifting tasks and preparing a broad workforce to evaluate MCI patients with diagnostic criteria currently used only in research and specialized clinical settings, this scenario demonstrates an upper bound of Alzheimer’s dementia cases that could be avoided if all capacity constraints could be overcome. Whether these constraints could be fully addressed is subject to future policies, technological advances, and drug development.

Alzheimer’s Dementia Cases Avoided in the Base and Alternative Scenarios

Figure 8 shows the cumulative incident Alzheimer’s dementia cases between 2021 and 2050 in the base case and alternative scenarios. Relative to the base case scenario, alternative scenario 1 (investment in CSF) results in a 10-percent increase in avoided dementia cases, and alternative scenario 2 (investment in CSF and infusion services) results in an 11-percent increase in avoided cases. Removing all capacity constraints results in a 28-percent increase in avoided dementia cases relative to the base case scenario. As an upper bound, we estimate that nearly 2.2 million cases of Alzheimer’s dementia would be avoided if all constraints were addressed. These results are contingent on the assumed efficacy of a 50-percent relative risk reduction in the progression of MCI due to AD to Alzheimer’s dementia each year after treatment.

Limitations

Our analysis has several limitations. We model a stylized clinical pathway that simplifies actual care patterns and make many assumptions about hypothetical scenarios in future states of the world. However, our stylized model is intended to provide a range of estimates to help identify potential capacity challenges if an AD-modifying therapy becomes available in the near future.

To model the infrastructure needed to deliver a future therapy, our analysis includes assumed specifications for that therapy. Actual specifications of a therapy will depend on the results of future clinical trials or those that are currently under way. We assume that the therapy would be indicated for people with MCI due to AD; we do not include presymptomatic individuals, and we assume the therapy would not be effective for people who have developed manifest dementia (e.g., mild dementia). If the therapy would be indicated for presymptomatic individuals, the subsequent wait times could be even longer. As the efficacy of a therapy is unknown at this time, we use the assumption of a 50-percent
reduction in relative risk of transitioning from MCI to Alzheimer’s dementia. The actual efficacy may be different and would affect patient uptake and the number of Alzheimer’s dementia cases that could be avoided. Patient uptake in response to a new disease-modifying therapy would also depend on a variety of factors, such as awareness, efficacy of the therapy, side effects, stigma associated with an MCI or dementia diagnosis, and costs. Last, the duration of treatment in our analysis is assumed to be one year, but the actual duration could be longer if chronic use is deemed necessary. If the treatment duration is longer, then more infusions would be required, and longer wait times may occur. Thus, we caution that our projected avoided dementia cases illustrate the potential magnitude of the impact rather than a precise estimate.

On the infrastructure side of the model, we focus on three key capacity constraints. We do not model capacity challenges related to cognitive screening; CSF testing; other imaging, such as MRI; radiologists and nuclear medicine specialists; and treatment monitoring. For example, there is limited access to regular medical doctors in some provinces, territories, and remote areas (Canadian Institute for Health Information, 2016b), which could make MCI detection more challenging. Similarly, availability of radiologists and technicians is limited in rural areas (Bhandari and Dinh, 2017); however, the availability of PET scanners is also low in those areas. There will likely be challenges with the capacity considerations that we did not model, and successful delivery of a new Alzheimer’s therapy will depend on a host of practitioners and planners to coordinate services. We focus on specialists, biomarker testing for diagnosis, and infusion delivery because these are likely to be the most pressing barriers and possibly the most difficult to overcome.

Our estimated capacity of specialists to conduct these visits reflects the theoretical capability and willingness of the specialists to provide the services. Although not all neurologists, geriatricians, and geriatric psychiatrists (and other psychiatrists focusing on neuropsychiatry) may choose to provide evaluation and diagnostic services to people with MCI, we made a simplifying assumption that these specialists could conduct 5 percent more visits overall than visits in the status quo. In addition, these specialists typically see different types of patients. Neurologists tend to see younger patients, geriatricians see older patients who are more likely to have comorbidities, and geriatric psychiatrists see older patients who have mood and/or behavioral issues. Our model does not stratify patients by age; we consider the entire cohort of people age 50 and older and assess patients based on average age of the cohort each year and other characteristics, such as rates of patient uptake and contraindications. For example, younger people may be less likely to seek further evaluation from a specialist, while older people would more likely be frail or have comorbidities that could preclude them from the treatment, but we use uniform patient uptake assumptions that reflect an average patient. Including age strata would allow for subgroup analysis but would be unlikely to change the overall findings of our study, given the uncertainties around the therapeutic profile, efficacy, and patient uptake.

The actual expansion of biomarker testing capacity would depend on factors such as the interplay between public and private investments and decisions. Similar to the United States, infusion services in Canada are often delivered through private clinics.

Our analysis suggests that 166,000 to 485,000 Canadians could progress from MCI due to AD to Alzheimer's dementia between 2021 and 2050 while on wait lists for diagnosis, testing, and treatment.
(or home infusion services). Although this is a proxy measure for infusion capacity, future capacity growth in Canada is unclear and will depend on arrangements between manufacturers and infusion clinics.

Given these limitations, our simulation results are meant to show the magnitude of the potential infrastructure challenges and do not predict the future or provide precise estimates.

**Discussion**

A disease-modifying therapy for AD may become available for the first time in the near future. Such a therapy has the potential to greatly reduce the number of Alzheimer’s dementia cases by delaying or preventing disease progression. However, the successful delivery of a therapy is contingent on identifying the people who would benefit from the therapy and administering the treatment in timely fashion.

Our analysis suggests that 166,000 to 485,000 Canadians could progress from MCI due to AD to Alzheimer’s dementia between 2021 and 2050 while on wait lists for diagnosis, testing, and treatment if a therapy becomes available in 2021. The wait times are most pronounced in the first few years, with the annual average waiting times peaking at 21 to 28 months in the first five years, and wait times could persist for decades. Our projections are meant to demonstrate a range of potential scenarios under different regulation, reimbursement, and coordination approaches. Actual capacity in the future will depend on how policymakers and planners address the potential infrastructure challenges. The possibility of long wait times if capacity is not expanded means it is important to start addressing the capacity challenges in a timely manner.

**Expanding the Workforce to Diagnose MCI Due to Alzheimer’s**

The most pressing capacity issue is the availability of specialists to evaluate and diagnose people with early-stage AD. In comparison with our analyses of the U.S. and European health care infrastructure, we estimate longer wait times for dementia specialist visits in Canada. We estimate that Canada has about five dementia specialists per 100,000 people, compared with about six and a half in France, eight in the United States, and 18 to 24 in Sweden and Germany, where more psychiatrists are likely to be involved in diagnosing cognitive impairment (Liu et al., 2017; Hlávka, Mattke, and Liu, 2018).

Rapidly increasing the number of specialists is difficult because of long training times. However, there are options that could help reduce the burden on specialists. Better cognitive screening tests and protocols would reduce false positives, which would reduce the number of patients needing referrals to specialists. Improved screening could also help general practitioners and specialists to prioritize patients who are at higher risk of progressing in their condition.

Another option is to train general practitioners, including primary care and family physicians, and other health care professionals to conduct more tasks in the evaluation process (see Box 1 and Box 2). Telemedicine could facilitate such training and provide guidance to general practitioners through interactions and consultations with specialists. This model could be particularly useful for rural and other areas with limited access to specialists and could expand the specialist support of primary care–led memory clinics in all areas (see Box 3).

**Expanding Diagnostic Technology and Laboratory Networks**

The extent to which capacity for biomarker testing is a barrier to diagnosing MCI due to AD will depend on investment decisions in PET and CSF biomarkers.

Expanding PET capacity in Canada in time to meet the expected demand if an AD–modifying therapy is approved is challenging for two reasons. First, the installed base of PET scanners is lower in Canada than in countries of comparable wealth, implying a greater need to expand. According to OECD Health Statistics, 1.4 PET scanners were installed in Canada per 1 million population in 2017, compared with 2.2 in France, 4.3 (in 2014) in Japan, 5.1 (in 2015) in the United States, and 7.3 in Denmark (OECD, 2018).

Second, installing new PET scanners in public facilities takes time. The required funding must
be requested and approved by a provincial ministry of health, building and operating permits must be secured, and additional staff positions must be approved and filled. Several experts suggested that the process could take years, and one expert shared that four years had elapsed from an initial request until a PET scanner was operational in that expert’s facility.

Private imaging facilities exist in many Canadian provinces, and they are able to expand capacity faster than public facilities. However, medical services obtained in private facilities are not usually covered by public insurance—i.e., patients have to pay out of pocket (Bercovici and Bell, 2008). Moreover, it may be illegal under the Canada Health Act (Government of Canada, 1984) for privately run facilities to bill patients for medically necessary services that are offered by public facilities. There are, however, exceptions, if wait times for appointments in public facilities are perceived as unacceptably long, even if this results in a conflict with the stipulations of the Canada Health Act. Quebec allows radiologists to work in both the public and private systems, and to bill patients for scans conducted in a private clinic, in large part due to long wait times for public MRIs (Derfel, 2015; Pinker, 2000). Saskatchewan had allowed privately paid MRIs, if clinics provided an equivalent number of scans for patients on the public wait list (Grant, 2016). In British Columbia, the government had contracted out MRIs to private facilities and permitted privately paid MRIs while ramping up capacity (Mason, 2015; Shore, 2018).

Thus, expansion of PET capacity to accommodate the expected demand in case of the approval of an Alzheimer’s treatment is likely to rely on a combination of public and private facilities. However, the expansion of PET capacity may not be rapid enough to meet the need, given the large population of people with MCI.

Another option to expand biomarker testing more rapidly would be to increase capacity for CSF measurement. Currently, about 20 percent of clinicians use CSF tests, and there is limited laboratory infrastructure for CSF assays in Canada (Laforce et al., 2016). This would be particularly important for patients living in remote areas, for whom getting

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**Box 1. The Emergence of Primary Care–Led Memory Clinics in Ontario**

The movement to establish primary care–led memory clinics started in Kitchener, Ontario, at the Centre for Family Medicine Family Health Team from a realization that patients with memory complaints needed faster access to evaluation and advice. A second objective was to increase familiarity of family physicians with memory disorders (Lee et al., 2010).

The defining characteristic of this model is the reliance on an interdisciplinary care team consisting of a family physician, two to three nurses, a social worker, and potentially a pharmacist and an occupational therapist. Services include assessment of cognitive decline with a screening test, neurocognitive testing (in some clinics), evaluation for reversible causes of dementia, referral to social services, and coordination with the patient’s primary care physician. The care team will handle most cases and refer only the most complex cases to an affiliated geriatric specialist, who is also available by phone or email for consultation. Indeed, an evaluation has shown a decline in referral rates to specialists of 8–10 percent of cases (Lee et al., 2014).

After promising evaluation results, the model was codified into an accredited Memory Clinic Training Program in collaboration with the Ontario College of Family Physicians (Lee, Kasperski, and Weston, 2011). Today, approximately 85 clinics accredited under this program operate in urban and rural settings in Ontario (Council of Academic Hospitals of Ontario, undated).

A similar model was implemented by the Kawartha Centre in rural Ontario (Kawartha Centre, 2018) to improve access to quality dementia care in the less populated part of the province. These care models are currently being evaluated with funding from the Canadian Consortium on Neurodegeneration in Aging to identify shared elements, success factors, and potential for scaling (Canadian Consortium on Neurodegeneration in Aging, 2018).
to an urban center with a PET scanner could be a considerable journey. Although a lumbar puncture is an established procedure with low risk for the general population (Duits et al., 2016), one concern for some of the population being evaluated for Alzheimer’s disease is the ability to safely perform the procedure in potentially elderly, medical frail patients, although some of these patients may not be eligible for a disease-modifying therapy for other reasons, related to comorbidities or contraindications. Clinical guidelines could standardize protocols for diagnostic lumbar punctures and identify circumstances in which PET would be the preferred modality. Although CSF biomarkers for AD have been shown to be comparable to amyloid PET imaging for early diagnosis, there has been historical variability in accuracy and thresholds used across laboratories (Bjerke and Engelborghs, 2018). In Canada, laboratory networks following best practices and guidelines would be needed to support early Alzheimer’s diagnosis. Based on our analysis, expanding CSF capacity to handle 50 percent of the diagnosis caseload would eliminate waiting periods for biomarker testing.

Expanding Infusion Services Through Clinics and Home Infusion

In Canada, infusions outside of oncology are often administered and paid for through manufacturer-sponsored infusion clinics (Patented Medicine Prices Review Board, 2016). These infusion clinics are privately operated and may be freestanding or share space with physician offices or pharmacies. The existing network of infusion clinics includes...
several organizations operating clinics and some offering home infusion services (BioScript Solutions, 2018; AmerisourceBergen, 2017; McKesson Canada, 2018; Bayshore HealthCare, 2018). Given the role of privately operated clinics in Canada, the expansion of infusion capacity could be rapid but would depend on the reimbursement levels. Unlike PET scanners, infusion clinics do not require substantial capital investment. However, a limiting factor could be an adequate nursing workforce to staff the clinics.

Home infusion services may be a desirable option to accommodate the large number of prevalent MCI cases in the initial years, which would help avoid building fixed clinic infrastructure that may be underused for incident MCI cases in later years. Expanding home infusion services may be more feasible in urban areas that have denser populations, but it may also be useful in areas serviced by remote consults.

Box 3. Rural and Remote Memory Clinics Use Telehealth to Increase Access in Saskatchewan

Saskatchewan is a province with a population of about 1 million people spread over an area the size of France. It serves as an example of both how challenging geographic access to health care can be in many parts of Canada and how technology can help overcome those challenges. Saskatchewan’s population is largely rural and spread widely across the province, with two urban centers, in Regina and Saskatoon. Outside these urban centers, geographic access to care—including for AD—is a challenge. Saskatchewan has only one geriatrician in the entire province, with a rate of 0.1/100,000 population versus 0.8/100,000 in the rest of Canada (Hill, 2018). Instead, diagnosis and treatment for AD is likely to be driven by neurologists, of which there are around 40. Even if a patient can get to a specialist to be seen, diagnosis is complicated by the fact that the province has only one PET scanner (Sinclair et al., 2018).

In an attempt to improve access, Saskatchewan has the Rural and Remote Memory Clinics program, which was first funded by the Canadian Institutes of Health Research (RaDAR: Rural Dementia Action Research, 2018; Morgan et al., 2009). These multidisciplinary clinics were started in 2004 and were the first of their kind. Individuals who live more than 100 kilometers away from either Saskatoon or Regina are eligible and come once in person to start care. At that time, they undergo neuropsychological testing, have a computed tomography (CT) or MRI scan if needed, and see other therapists and specialists, such as dieticians. Once a diagnosis and care plan are established, patients do not need to return in person unless imaging is required. Subsequent care can be provided by telehealth (or in person, if that is preferred by the patient) (Gateway to Rural International Initiatives in Dementia, 2018). The clinics are now funded by the Saskatchewan Ministry of Health to provide clinical services to residents of the province.

Efforts to Coordinate and Standardize Strategies in Canada

Investments to increase specialist, biomarker testing, and infusion capacity in Canada are one aspect of improving diagnosis and care for people with AD. Joint efforts are needed to ensure that people at all points of the Alzheimer’s continuum receive timely and necessary care. Canada is currently working to establish a national dementia strategy (see Box 4). Future assessments of the cost implications of an AD-modifying therapy will also help guide strategies. Coverage and clinical guidance from Canadian health agencies will have implications for the availability of physicians, biomarker testing infrastructure, and infusion delivery infrastructure to support the delivery of a new Alzheimer’s therapy (see Box 5).

Several provinces have also developed dementia strategies and plans. For example, Ontario’s dementia strategy includes supporting people with dementia; accessing services; coordinating care; supporting care partners; training the dementia workforce; and addressing awareness, stigma, and brain health policies.
Box 4. Canada’s National Dementia Strategy

Canada became the 30th country to call for the development of a national dementia strategy when the Canadian Parliament passed the National Strategy for Alzheimer’s Disease and Other Dementias Act (Bill C-233) in June 2017 (Parliament of Canada, 2017). Key measures of the act include:

- development of national objectives to improve patient situation and decrease the burden on Canadian society
- greater investment in research, including biomedical, clinical, and health services and systems
- international coordination in the fight against Alzheimer’s and increased Canadian contribution
- assisting the provinces in developing and disseminating treatment guidelines and information on the prevention and management of early intervention
- making recommendations on national guidelines for standards of care based on evidence-based best practices.

Box 5. Alignment of Quebec’s Drug Review Body with Federal Bodies May Decrease Delays and Increase Access

Coverage of an AD-modifying therapy in Canada would be determined by several agencies. Once a drug has been approved for use by Health Canada, it undergoes review by the Canadian Agency for Drugs and Technologies in Health (CADTH) through the Common Drug Review (CDR) process to decide whether it will be eligible for public reimbursement (CADTH, 2018a). The CDR process was introduced by health ministers in 2003 to replace the 18 independent review processes that existed in different jurisdictions in Canada. Once a drug is submitted for review, CADTH reviews the available clinical effectiveness, safety, and cost-effectiveness evidence and makes a recommendation about whether the drug should be covered—and, if so, at what price. Once this recommendation has been made, the provinces negotiate price together through the pan-Canadian Pharmaceutical Alliance (pCPA) (Canada’s Premiers, 2018). The pCPA leverages the combined purchasing and negotiating power of drug plans across multiple provinces and territories, including Quebec.

However, Quebec is unique in that it has its own special body that reviews available evidence for new drugs and gives guidance to government directly, called the Institut National d’Excellence en Santé et en Services Sociaux (INESSS) (INESSS, 2018). INESSS not only issues recommendations for the adoption, use, and coverage of new drugs but also develops clinical guidance to ensure their optimal use.

In June 2018, Health Canada, CADTH, and INESSS announced an initiative to align review timelines for health technology assessments and regulatory drug submissions to reduce the time between market authorization and reimbursement recommendations for public drug plans (CADTH, 2018c). In an effort to reduce delays, CADTH had already announced an operational change in March 2018 by accepting drug submissions up to six months prior to anticipated receipt of Health Canada’s approval (CADTH, 2018b). Based on results of a 2017 pilot that considered oncology drugs, manufacturers with qualifying drug submissions can choose to participate in an aligned review between Health Canada, CADTH (through its Common Drug Review and pan-Canadian Oncology Drug Review programs), and INESSS.
(Ontario Government, 2016). Although most strategies focus on support of people with dementia and their care partners, actions to improve coordination, develop the workforce, and increase awareness will benefit people in both dementia and predementia stages. The goals of British Columbia’s Dementia Action Plan are to support prevention and early intervention (including care planning for people with MCI), ensure quality person-centered dementia care, and strengthen system capacity and accountability (British Columbia Ministry of Health, 2012). See Box 6 for more on decisionmaking in British Columbia.

**Conclusions**

There is cautious optimism that a disease-modifying therapy for AD will be available in the near future. Many countries do not have sufficient infrastructure to deliver such a therapy to a large population of people with early-stage AD, and Canada is no exception. Without efforts to expand capacity, we estimate that projected wait times for access to treatment could peak at 28 months, which is longer than in the United States and six European countries, because of the comparatively low density of dementia specialists and the small installed base of PET scanners and limited infrastructure for CSF testing. In addition, Canada faces the challenge of large geographic areas with sparse populations and limited access to specialty care. At the same time, the historical challenge of servicing remote areas has led to creative delivery models that use telemedicine and preceptorship approaches to enable primary care–led memory clinics. These models could serve as a blueprint to reduce wait times for specialist appointments, not just in rural areas but in urban centers and other countries.

Canada is also unusual in that, under the assumptions of historical capacity projected forward, substantial wait times for biomarker testing would persist beyond 2050. Given the long lead time for adding PET scanners in public facilities, two options to reduce wait times are to contract scans out to private facilities and to increase capacity for CSF

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**Box 6. British Columbia: Regional Devolution of Decisionmaking and Delivery**

Uniquely within Canada, decisions about health care services in British Columbia are partly made at the provincial and at the regional level. The Provincial Health Services Authority (PHSA) (PHSA, 2018) is responsible for the provision of selected specialized health services, such as cancer care, transplantation, and dialysis, whereas five regional health authorities organize and deliver most health care services independently but subject to a provincial framework.

Today, care of memory disorders is mostly handled in regional centers of excellence, such as the Djavad Mowafaghian Centre for Brain Health in Vancouver (Djavad Mowafaghian Centre for Brain Health, 2018) and the Neil and Susan Manning Cognitive Health Initiative in Victoria (Victoria Hospitals Foundation, 2016). These clinics serve as referral centers for their respective regions, as sites for clinical trials and Alzheimer’s research, and as training facilities for dementia specialists.

Given the devolved structure, an expansion of the infrastructure to deliver a disease-modifying therapy for Alzheimer’s disease could take two paths. Regional authorities could expand services building on their centers of excellence, or Alzheimer’s treatment could become one of the specialized services under the auspices of the PHSA. Either way, decisions about insurance coverage of Alzheimer’s treatments and associated services would more likely happen at the provincial level.

British Columbia participates in the CDR process, as explained in Box 5, and uses a provincial Drug Benefit Council (Government of British Columbia, 2019a) to make final recommendations about inclusion of a treatment in the provincial PharmaCare formulary, as well as requirements for treatment eligibility. Given the complexity of a disease-modifying therapy, it is likely that physicians will have to obtain prior authorization from the Special Authority Unit (Government of British Columbia, 2019b) for each patient.
testing. Conversely, a robust network of infusion clinics provides a solid base for expansion of infusion delivery services.

The changes necessary to expand capacity will not happen without the concerted and coordinated effort of multiple stakeholders, given the need for increased awareness, capital investment, care model innovation, and changes to regulation and reimbursement. Without these changes, we estimate that an additional 166,000 to 485,000 Canadians will progress from MCI to manifest Alzheimer’s dementia while waiting for treatment between 2021 and 2050. With a disease-modifying therapy for Alzheimer’s potentially being available within a few years, precious little time remains for stakeholders to take action. It may be difficult to dedicate resources before a therapy is available; however, actions may focus on strategies that are synergistic with improving dementia care and awareness for people currently affected by dementia and cognitive impairment. The capacity for the diagnoses of MCI due to AD will be the most pressing issue to address and will take time to build. Waiting until a therapy is available will likely result in hundreds of thousands of Alzheimer’s dementia cases that could be avoided.

Online Appendix Available

For more information about our data, please see this report’s technical appendix at https://www.rand.org/pubs/research_reports/RR2744.html.

Notes

1 Our U.S. and European analyses (Liu et al., 2017; Hlávka, Mattke, and Liu, 2018) assumed that a therapy would become available in 2020.

2 Our U.S. and European analyses assumed that the age eligibility would be 55 and older. For this analysis, we lowered the age to 50, as the later-stage clinical trials tend to target younger age groups and some trials targeting older age groups have been terminated (e.g., U.S. National Library of Medicine, 2018f).

3 This assumption differs from our prior analysis in the United States, where a PET scan is currently the only U.S. Food and Drug Administration–approved modality for clinical use. In our analyses of European countries, we assumed that 90 percent of biomarker testing would be performed by CSF biomarker testing, and only 10 percent would be PET imaging, for patients with contraindications to lumbar puncture.

4 Fluorodeoxyglucose, or FDG, ¹⁸F has a half-life of 110 minutes (International Atomic Energy Agency, 2012).

5 Florbetapir ¹⁸F and flutemetamol ¹⁸F are approved for investigational use in Canada (DrugBank, 2018b; DrugBank 2018c).

6 For example, the top-selling disease-modifying antirheumatic therapy, Remicade, is delivered in manufacturer-sponsored infusion centers in Canada (Patented Medicine Prices Review Board, 2016).
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About This Report

This report illustrates the magnitude of health care system infrastructure challenges in the diagnosis and treatment of early-stage Alzheimer’s disease with a future potential disease-modifying therapy in Canada.

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