

# Projected patterns of illness in Ontario

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# Executive Summary

## The future of health system burden in Ontario

Ontario's health system is responsible for providing care to all residents, addressing a wide spectrum of conditions from minor acute illnesses to complex chronic diseases across the lifespan. Its role extends beyond treatment, encompassing the prevention and postponement of major illnesses to increase years spent in good health and improve overall quality of life. A thorough understanding of current and future disease burdens is critical to ensuring a resilient and effective healthcare system.

## Our approach

We undertook a detailed study to measure Ontario's current and future burden of chronic disease to estimate the health system needs for the next two decades. Our approach involved three main phases. Firstly, we estimated the current burden of illness in Ontario by capturing historical trends in 18 conditions that account for most hospital care in Ontario. We used diagnoses of these conditions to categorize the Ontario population into three groups using a weighted morbidity score: no illness, some illness and major illness. We measured historical chronic disease and multimorbidity since 2002, which gives us 18 years of data (2002 to 2020) on which to base our projections. Secondly, we captured the projected demographic structure for Ontario up to 2040, using estimated projections provided by the Ontario Ministry of Finance. These projections account for anticipated trends in population aging, mortality, and interprovincial and international migration. Lastly, we combined the age- and sex-specific demographic projections with historical chronic disease trends to model the burden of illness in the population over the next two decades. We present estimates of the expected overall and annual disease burden in the Ontario population up to 2040, including the number of cases and prevalence of each condition and the number of people in each multimorbidity group.

## Main findings

Our analysis finds that there will be an estimated 3.1 million people (239 per 1,000) with major illness in 2040, up from 1.8 million (192 per 1,000) in 2020. Approximately 1 in 4 adults over the age of 30 will be living with a major illness in 2040, requiring significant hospital care, up from approximately 1 in 8 individuals in 2002. In addition to more people living with major illnesses, the number of illnesses any individual will be living with will also increase significantly with the average number of conditions each person lives with. There is also a considerable burden of individuals living with at least one chronic condition, expected to increase by 2 million more individuals with at least one chronic condition compared to currently. The conditions expected to increase the most in number consist of conditions that increase with age, including osteoarthritis, diabetes, and cancer. The aging population contributes significantly to the estimated increases; however, underlying structural and social determinants of health and an increase in chronic disease risk factors also contribute.

## Implications for the health system

Our results highlight the significant burden of illness in the Ontario population and reveal that strain on the system will increase considerably in the next two decades. As more Ontarians will live with more illnesses, significant efforts in chronic disease prevention and management are needed. Many chronic diseases can be managed outside the hospital with appropriate support, and investments in disease prevention, early detection and early and continuous treatment can reduce the subsequent strain on the hospital system. More ambitious chronic disease prevention strategies must be invested in to improve population health, including population-level approaches to prevention alongside tailored individual support. Given longstanding health inequities, chronic disease trends will not be equally felt in the population, necessitating an increased focus on community care and addressing health's social and structural determinants. No single policy approach will address the expected burden of illness; several short- and long-term scenarios are suggested to ensure the health system can continue to care for its citizens.

## Introduction

Canadians are living longer, with life expectancy growing to 81.5 years as of 2020-2022.<sup>1,2</sup> The number of seniors aged 65-84 and 85 and older will reach unprecedented highs in the coming decades as the Baby Boomer cohort ages.<sup>3</sup> This demographic shift coincides with an upward trend in chronic diseases<sup>4</sup>, including diabetes<sup>5</sup>, cancers<sup>6</sup>, and respiratory diseases<sup>7</sup>, which already strained health system capacity and funding.<sup>8,9</sup> Multimorbidity is also rising, which refers to the presence of two or more co-morbid chronic conditions and is a major driver of health services utilization and costs<sup>10</sup>.<sup>10</sup> People living with multimorbidity have unique and complex healthcare needs.

Chronic disease and multimorbidity risk increase with age<sup>10</sup>, but trends of rising chronic illness are not solely the result of aging.<sup>11</sup> They are also the result of changes in the distribution of chronic disease risk factors. Previous research has shown disparities in chronic conditions across key chronic disease risk factors, including smoking, physical activity, and increased body mass index (BMI)<sup>11,12</sup>, and between socioeconomic status (SES) groups.<sup>13-15</sup> In Ontario specifically, multimorbidity is more prevalent among lower SES groups<sup>16</sup>, and the number of chronic diseases accumulated before death is higher among adults from deprived neighbourhoods.<sup>17</sup> The immigrant population, which is expected to account for 86 percent of population growth in Ontario between 2022 and 2046<sup>18</sup>, have unique chronic disease and multimorbidity risks.<sup>19</sup>

The combination of an aging population, high levels of chronic disease risk factors, structural and socioeconomic determinants, and growing chronic disease burdens will place intense pressure on health systems in the coming decades. Planning for a sustainable and equitable health system responsive to the expected demographic changes and the risk factor distribution of our population requires long-term projections of what the chronic disease rates are likely to be in the future. Long-term projections are particularly important for planning capital investments, such as new infrastructure, which are critical for health system sustainability but require decades-long planning.<sup>20</sup>

In this report, we quantify the historical burden and project the future burden of illness in Ontario. We have used comprehensive, linked, population-based data that captures healthcare interactions in the Ontario Health Insurance Program (OHIP)-based population since April 1992. These data allow us to capture chronic condition diagnoses using standardized algorithms that have been validated in the Ontario population. We then combine these historical data with population projections from the Ontario Ministry of Finance. Using established epidemiological techniques, we project how chronic disease is expected to change over the next 20 years in Ontario for the population 30 years and older.

In addition to our study of individual conditions, we apply a new Ontario-specific score to identify groups of multimorbidity based on underlying conditions and their relationship with healthcare utilization and mortality. Based on historical trends in multimorbidity groups and using the same epidemiological methods for individual disease estimates, we present projections of multimorbidity in the adult Ontario population over the coming decades. As chronic disease burden continues to rise in Ontario, policymakers will be faced with challenging decisions about managing healthcare needs. We discuss our findings in the context of potential policy directions, highlighting the implications of our findings for health system planning.

This report represents the most recent large-scale effort to quantify future chronic disease and multimorbidity in Ontario. This work was conducted collaboratively with the Ontario Hospital Association and the Population Health Analytics Lab based out of the Dalla Lana School of Public Health at the University of Toronto. This report aims to increase understanding of how population health and illness may change over the next 20 years in Ontario. We provide a brief overview of plans for future work at the end of this report. Our overall goal is to create robust estimates based on population-wide data to guide current and future efforts to mitigate health system impacts and improve population health outcomes.

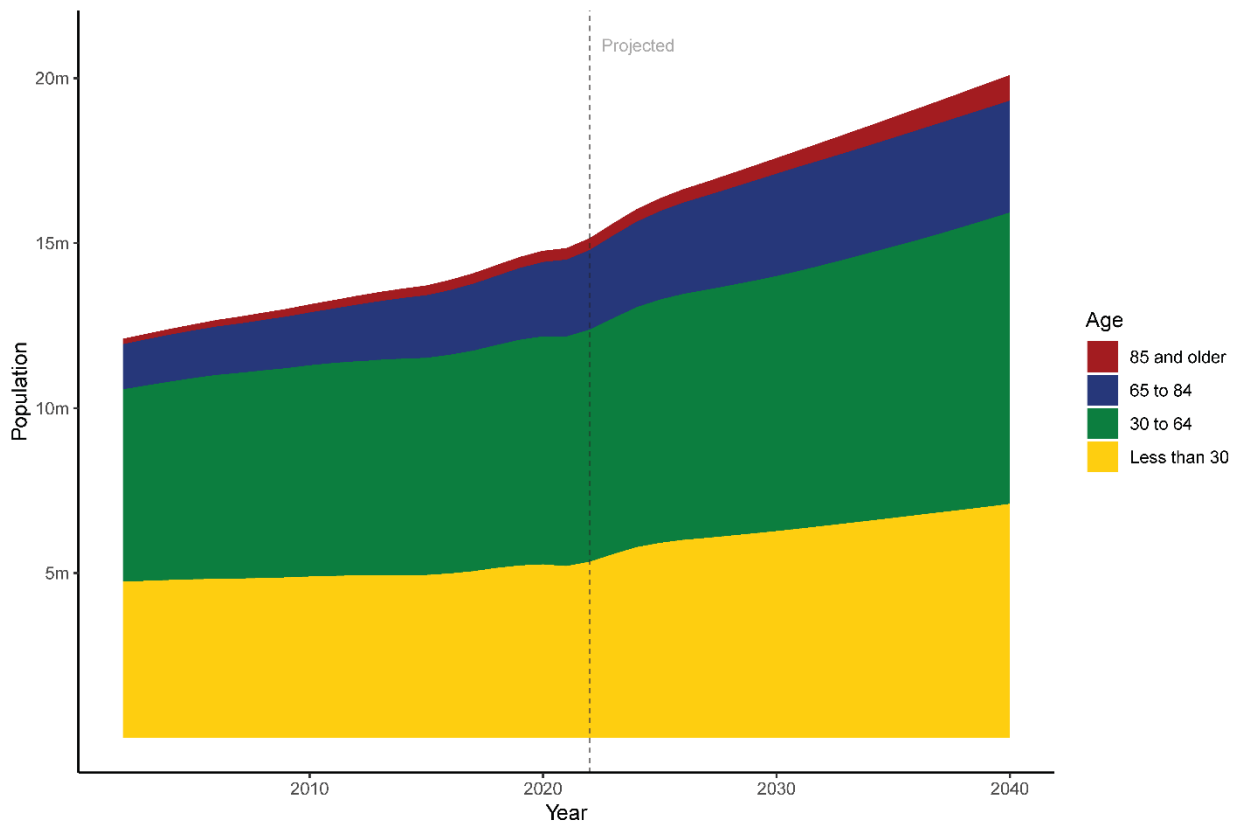
# Background and Approach

## Factors affecting healthcare needs

Trends in population health and healthcare needs result from a complex interplay between demographic transitions, disease trends, and underlying determinants of health. For projections to be useful for health system planning, disease prevention and management, each of these dimensions needs careful consideration. In Ontario, we access multi-linked data sources that capture population dynamics in detail and at scale, which is critical to enabling this work.

### Demographics

Each year, the Ontario Ministry of Finance publishes population projections describing demographic trends over a 25-year period based on Statistics Canada intercensal data for each of Ontario's 49 census divisions.<sup>18</sup> These projections account for expected population trends in fertility, mortality, and migration, including in- and out-migration both nationally and interprovincially. Our analysis is based on the updated 2022-2046 population projections released in summer 2023, which are based on Statistics Canada postcensal estimates for July 1, 2022. Specifically, we use population projections for the reference scenario, or most likely outcome, although the Ministry of Finance also releases high- and low-growth projection scenarios capturing the uncertainty in their projections.



**Figure 1.** Historical population (2000 to 2022) and population projections (2023 to 2040) for the population living in Ontario, by age group ( $n_{2020} = 14.8$  million).

These projections demonstrate that significant changes to the age structure of Ontario will take place over the coming decades (Figure 1). Overall, the population is expected to grow 36 percent in the next 20 years, with large increases to take place in the 65-84 and 85+ age groups. The number of people living in Ontario aged 65 or older will grow from 2.6 million in 2020 to 4.2 million in 2040, an expansion of over 60 percent. In the same time frame, the number of people aged 85 or older will grow from 300,000 to 770,000. The dependency ratio, which describes the relative number of people aged less than 30 or 65+ compared to those aged 30 to 65 (i.e., the traditional workforce), will grow from 1.14 in 2020 to 1.28 in 2040. Each of these factors has important implications for the capacity and sustainability of the Ontario healthcare system.

### *Disease Trends*

Accurate projection of future chronic disease and multimorbidity risk requires a comprehensive assessment of historical trends. We use population-based health administrative data, which capture healthcare interactions, including inpatient stays, emergency department visits, and outpatient physician visits.<sup>21</sup> Datasets were linked using encoded identifiers and analyzed at ICES (formerly the Institute for Clinical Evaluative Sciences), a prescribed entity authorized under provincial legislation to collect personal health information for the purposes of health system policy, planning and evaluation. ICES data captures individuals eligible for OHIP at any time since April 1992. These data are comprehensive and longitudinal, meaning we can assess chronic disease status consistently over a long time span and for the entire Ontario population. We captured chronic disease diagnoses using validated<sup>22-29</sup> and/or standardized<sup>17</sup> algorithms based on diagnostic codes in inpatient, emergency department, and outpatient care settings. The inclusion of outpatient physician visits is a significant advantage over many other health administrative databases in Canada, which often rely on hospital admissions and may miss low-acuity cases or those managed primarily in outpatient care.

### *Determinants of Health*

Chronic disease and multimorbidity risk are sensitive to several underlying determinants of health, such as socioeconomic status<sup>13-15,17</sup>, immigrant status, and health-relevant behaviours.<sup>11,12</sup> While health administrative data do not generally capture these characteristics, linkages with the Canadian Community Health Survey<sup>30</sup> (CCHS) offer a population-representative cohort to enable their study. The CCHS is a bi-annual cross-sectional survey of community-dwelling Canadian residents who answer questions about their sociodemographic characteristics, health status and well-being, health-relevant behaviours, and healthcare utilization and needs. Survey responses between 2000 and 2015 are linked to healthcare outcomes, where we can demonstrate the importance of considering determinants of health and multimorbidity.

## Quantifying the burden of illness in the Ontario population

### *Chronic disease burden, 2000 to 2020*

Our projections are based on historical data capturing chronic disease in the Ontario population aged 30 years and older. Specifically, we measured age- and sex-specific prevalence, for each year between 2000 and 2020, for 18 chronic conditions: acute myocardial infarction, asthma, anxiety and mood disorders, cancer, cardiac arrhythmia, chronic coronary syndrome, chronic obstructive pulmonary disease (COPD), Crohn's or colitis, dementia, diabetes, hypertension, osteoarthritis, osteoporosis, renal failure, rheumatoid arthritis, schizophrenia, substance use disorders, and stroke. These chronic conditions were selected based on previous evidence demonstrating a high health system burden in Ontario.<sup>16,31</sup>

### Measuring multimorbidity

Health outcomes tend to vary based on types of chronic diseases, co-morbid conditions and other patient characteristics.<sup>32</sup> We sought to capture overall health status using a comprehensive measure of the severity of multimorbidity by summarizing a list of conditions into a meaningful indicator of individual and population health. Many multimorbidity measures exist; older approaches (e.g., number of chronic conditions<sup>17</sup>, Charlson index<sup>33</sup>) have used equal or mortality-based weights, while Health system-focused approaches (e.g. Cambridge Multimorbidity Score (CMS)<sup>34</sup>, the Adjusted Clinical Group system<sup>35</sup>) estimate weights based on health care utilization.<sup>36</sup> To best align with the goals of this work, we chose to take the health-system focused approach and developed a multimorbidity measure using Ontario data to develop a weighted equation that measures the severity of multimorbidity as it relates to health outcomes.

Specifically, our multimorbidity equation was based on captured health outcomes for the Ontario population in 2021, using chronic disease status assessed at the start of that year. We included the 18 chronic conditions listed above, and added hearing loss, constipation, and epilepsy, as they were found to be meaningful in the CMS, which was developed in the UK. Our equation considers three health outcomes from the CMS – number of primary care visits, unplanned hospital visits, and all-cause mortality. After estimating the equation weights using logistic regression and Poisson models, we defined three multimorbidity classes for the Ontario population based on the continuous multimorbidity score: no illness, some illness, and major illness.



**Figure 2.** Health care costs<sup>1</sup> (2022) for the Ontario population aged 30 and older, grouped into multimorbidity classes using an Ontario-specific multimorbidity equation.

<sup>1</sup>Health care costs are estimated using data capturing healthcare encounters and OHIP billings.<sup>37</sup> Healthcare system users are grouped based on the percentile of their healthcare utilization in 2022 (i.e., ‘Top 5%’ groups contains health care system users in the top 5% of all users that year).



The multimorbidity groups we defined align well with healthcare costs in 2022 (Figure 2). Those with major illness comprise approximately 10 percent of the population, accounting for 38% of the top healthcare expenditure group (top 5% of healthcare users). Those with no illness, who constitute approximately half of Ontarians, accounted for 75% of the low-expenditure group (the lowest 50% of users). There are meaningful differences between the groups; those with major illness are older (mean age 68 compared to 31 for no illness and 46 for some illness) and more likely to have three or more chronic conditions (66% versus 0.5% of those with some illness). The multimorbidity groups are also distinct with respect to their chronic disease profiles; diabetes (41%) and cancer (21%) were more common among those with major illness, while mood disorders (18%) and asthma (29%) were more common among those with some illness (data not shown).

### *Projecting future illness*

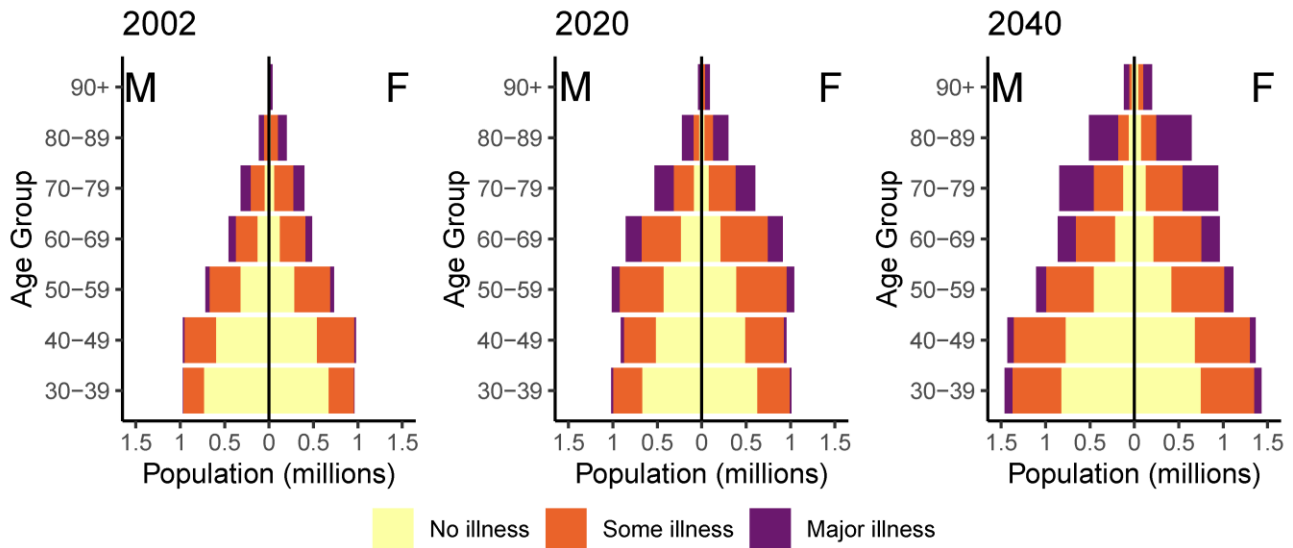
To project future chronic disease and multimorbidity, we combined data on historical disease trends, between 2000 and 2020, with demographic projections from the Ontario Ministry of Finance. To generate our predictions, we fit logistic regression models on the 2000 to 2020 data, including covariates for 5-year age group, sex, and year. For individual disease projections based on binary disease status, we used logistic regression models, and fit separate models by condition. We used a multinomial logistic regression model based on a 3-group classification for multimorbidity group projections. We applied the coefficients from our models to age- and sex-specific demographic projections between 2021 and 2040 to generate annual projections for the number of cases of each condition and the number of people in each multimorbidity group. We also estimated disease prevalence for individual conditions for each year up to 2040.

### *Assumptions*

As with all projections, our approach makes assumptions about the factors influencing chronic disease trends over the coming decades. While our assumptions are based on expert knowledge and scientific evidence, they result in uncertainty in the projected estimates. We describe some key assumptions here to support the transparency and interpretation of our results. The first assumption relates to the data we include in our models. The models we fit are based on inputs capturing historical chronic disease and multimorbidity rates (i.e. disease trends), and demographic projections to 2040 (i.e. population trends). See *Strengths and Limitations* for further discussion of this point. Second, our modelling approach uses regression methods conditional on age and sex and the chronic disease trends observed in 2000 to 2020. We assume the trend observed over this time period will continue until 2040. By extension, we also assume that the influence of underlying risk factors on chronic disease and multimorbidity will also be unchanged from 2000-2020 to 2040. We did not include risk factor covariates in these base projections but plan to do so in future projection efforts, which will provide more detailed estimates (see *Next steps*). Third, our multimorbidity equation assumes that the relationship between chronic disease and health system outcomes (primary care visits, unplanned hospitalizations, and mortality), as captured in historical data, represents the entire 2000-2040 period. This includes the assumption that the disease we chose to include in the multimorbidity equation will continue to be the strongest contributor to Ontario's health system burden over the next 20 years.

# Projected patterns of illness

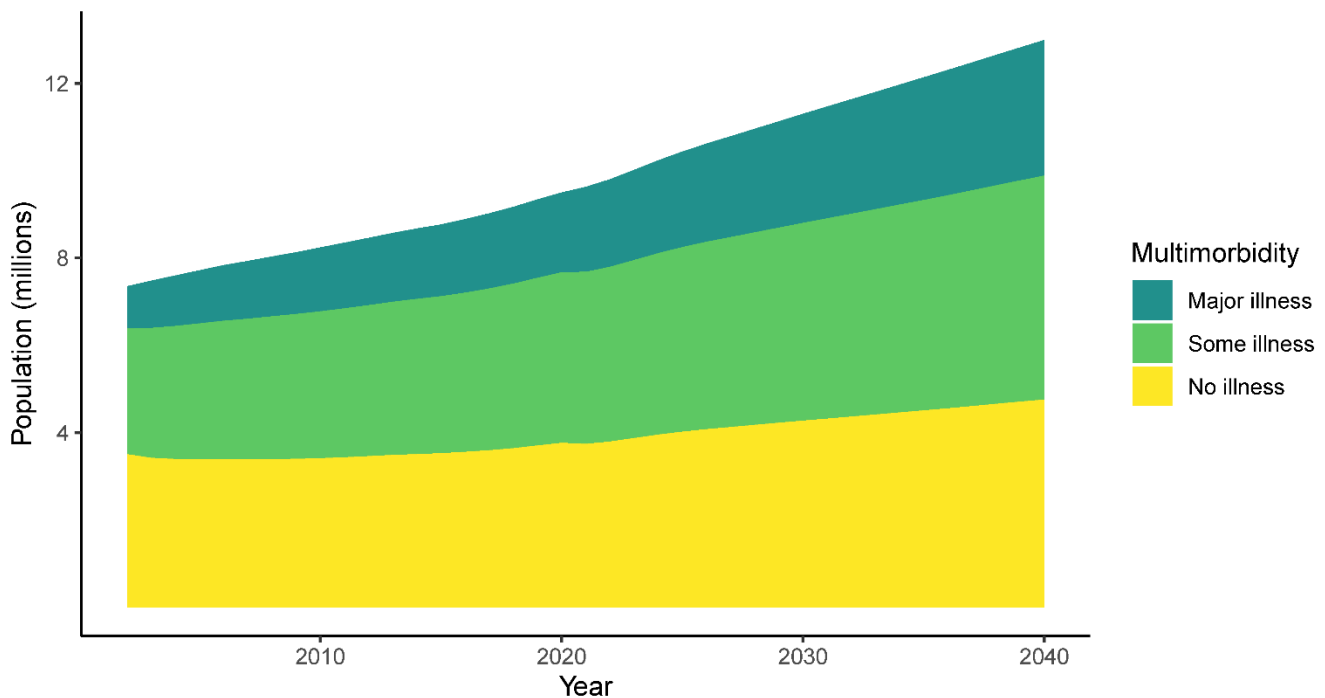
## Multimorbidity



**Figure 3.** Ontario population aged 30 and older, 2002, 2020, and 2040 (projected), by age, sex, and multimorbidity<sup>1</sup> category ( $n_{2020} = 9.5$  million).

<sup>1</sup>Chronic conditions included in the multimorbidity categorization: acute myocardial infarction, asthma, anxiety and mood disorders, cancer, cardiac arrhythmia, chronic coronary syndrome, chronic obstructive pulmonary disease, Crohn's or colitis, dementia, diabetes, hypertension, osteoarthritis, osteoporosis, renal failure, rheumatoid arthritis, schizophrenia, substance use disorders, and stroke.

The Ontario population has grown considerably over the past 20 years and will continue to do so in the coming decades (Figures 1 and 3). As the population ages, the age structure of the population also transitions (Figure 3). The Baby Boomer cohort, born between 1946 and 1964, will all reach age 65 by 2030, and will reach age 85 between 2031 and 2050. This population transition will come with significant challenges. In the age 65 and older population, 53% are expected to live with major illness as of 2040, up from 41% in 2002 and 46% in 2020. This finding is partially due to age, as multimorbidity increases between the ages of 40 and 90. It is also due to underlying trends in chronic disease risk, which have increased in Canada.<sup>4,38,39</sup> Notably, major illness will increase substantially in the working age (age 30 to 64) population, from 5.7% in 2002 to 9.2% in 2020 to 10.2% in 2040. These increases may take place disproportionately among individuals with key risk factors and low socioeconomic status.<sup>39,40</sup>



**Figure 4.** Historical population (2000 to 2020) and population projections (2021 to 2040) for the population aged 30 and older living in Ontario ( $n_{2020} = 9.5$  million), by multimorbidity<sup>1</sup> category.

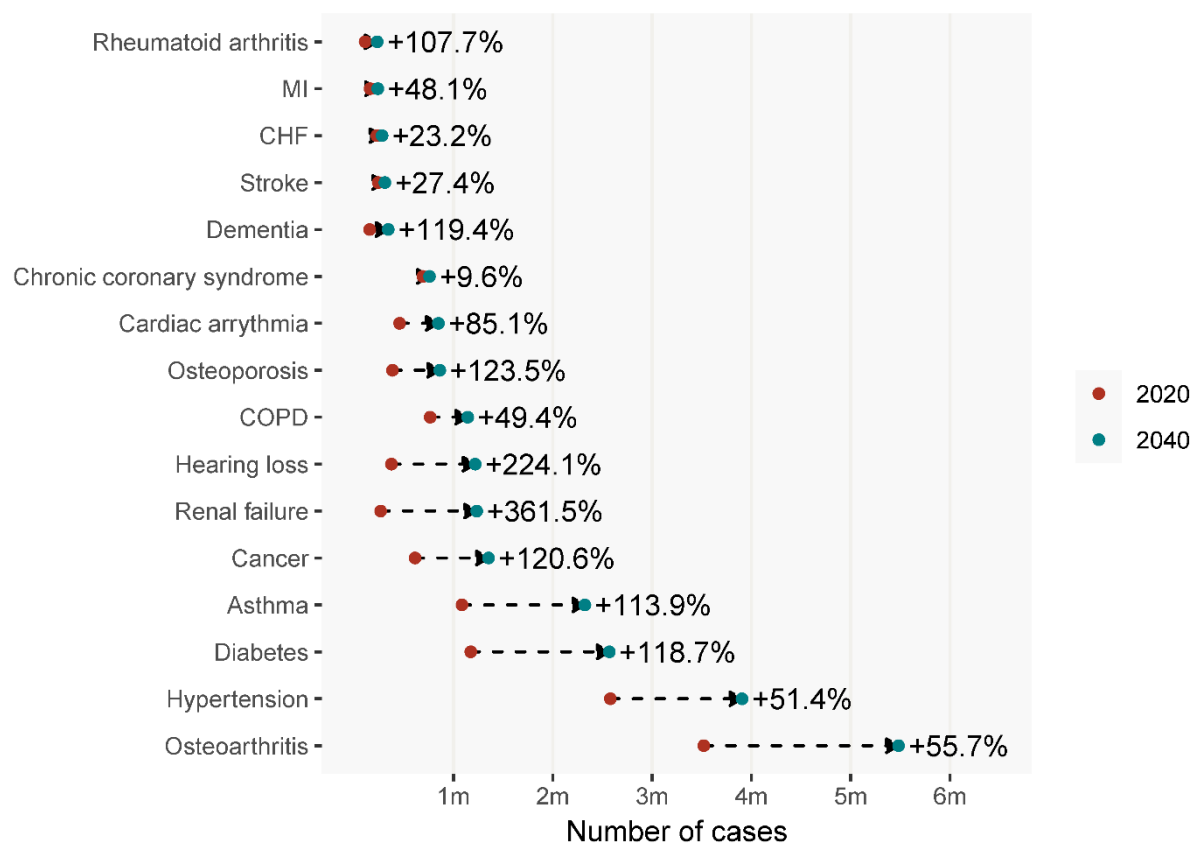
<sup>1</sup>Chronic conditions included in the multimorbidity categorization: acute myocardial infarction, asthma, anxiety and mood disorders, cancer, cardiac arrhythmia, chronic coronary syndrome, chronic obstructive pulmonary disease, Crohn’s or colitis, dementia, diabetes, hypertension, osteoarthritis, osteoporosis, renal failure, rheumatoid arthritis, schizophrenia, substance use disorders, and stroke.

The consequence of simultaneous rising multimorbidity and population growth is that increasing numbers of Ontarians are expected to live with some or major illness over time (Figure 4). The number of people living with major illnesses has nearly doubled in the past 20 years, from approximately 960,000 in 2002 to 1.8 million in 2020. We expect this trend to continue, reaching a high of 3.1 million people living with major illness by 2040. An additional 5.1 million people will be living with some illness in 2040, up from 2.9 million in 2002 and 3.9 million in 2020.

The “major illness” category, which we defined based on historical patterns of healthcare utilization, includes patients with at least one high-acuity condition (e.g., dementia), or a combination of several lower-acuity conditions (e.g., diabetes, hypertension, osteoarthritis). As a result, as major illness rises we expect the number of people living with multiple chronic conditions to grow as well. Illustrating this point, we find that the average number of conditions per person aged 30+ living in Ontario will grow from 1.2 in 2002, to 1.5 in 2020 to 1.9 in 2040 (data not shown). The complexity of the care needs of the Ontario population will increase in parallel to this trend.

These trends result from many factors, including population growth and aging, increased incidence and earlier onset of chronic disease, and improved survival across all multimorbidity groups. While multimorbidity increases the risk of death,<sup>41-43</sup> accumulation of chronic diseases over the lifespan is a hallmark of expanding life expectancies.<sup>44,45</sup> The onset of chronic disease is typically earlier, and time spent with chronic disease is longer, for low-SES individuals and those with key risk factors such as smoking, hypertension and obesity.<sup>46,47</sup>

## Specific conditions

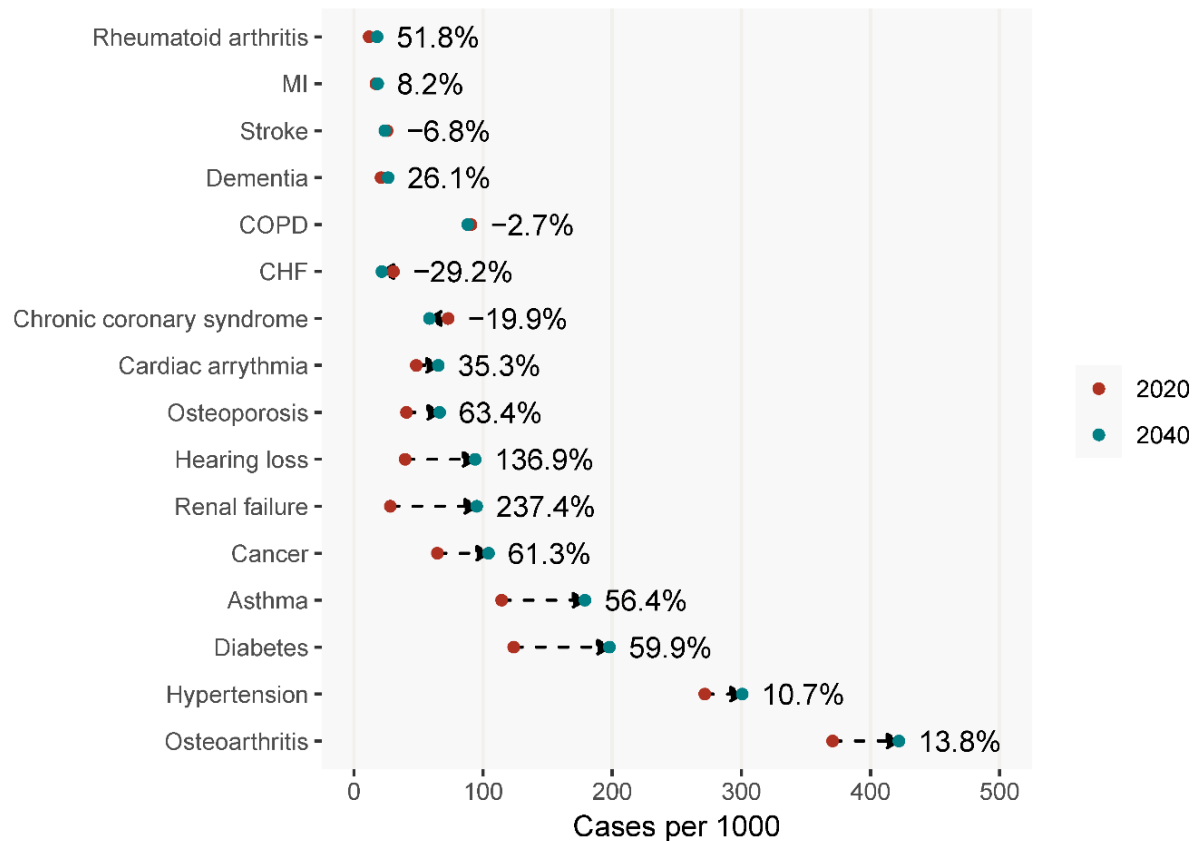


**Figure 5.** Number of cases (2020) and number of projected cases (2040) for 16 chronic conditions<sup>1</sup> in the Ontario population aged 30 and older ( $n_{2020} = 9.5$  million).

<sup>1</sup>MI: myocardial infarction; CHF: congestive heart failure; COPD: chronic obstructive pulmonary disease.

The number of people living with a chronic condition is expected to grow over the next 20 years (Figure 5). There are several reasons for these trends. Some of the conditions expected to experience large growth in the number of cases are those typically associated with aging, such as dementia<sup>48</sup>, hearing loss<sup>49</sup>, and stroke<sup>50</sup>, which will increase as the population ages even without changes to disease prevalence within age groups. Other chronic illnesses, such as diabetes<sup>51</sup> and renal failure<sup>52</sup>, will increase both as a function of age and as the result of the rising age-standardized prevalence of these conditions.

The total number of cases for any condition results from a combination of factors: the size of the population, the number of new cases, the number of cases entering remission, and the longevity of people living with the disease. For most of the conditions we study, remission is not possible, and people will live with the disease until their death. In some cases, such as for chronic obstructive pulmonary disease<sup>7</sup> (COPD) or diabetes, increases in the prevalence or total number of cases are, in part, the result of disease management strategies which have been successful in reducing mortality rates among patients. For diseases where remission is possible, such as hypertension and type 2 diabetes, the number of cases may decrease as a result of improved treatment and behavioural interventions.<sup>53,54</sup> This is also true for mood and anxiety disorders and substance use disorders, which are major contributors to the chronic disease burden in younger Canadians (disease trends not shown).<sup>55</sup> However, unmet mental health care need<sup>56</sup> and first-contact psychiatric emergency department visits<sup>57</sup> are both high in Canada.

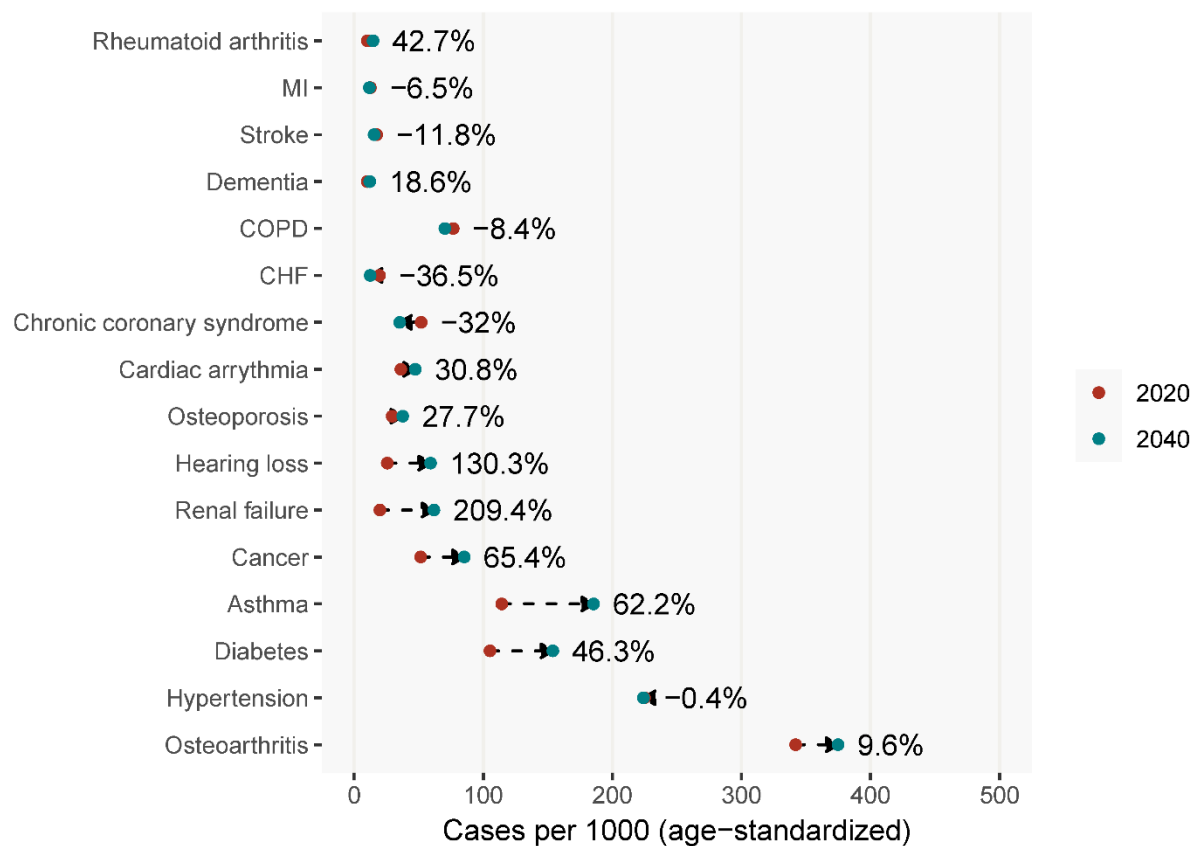


**Figure 6.** Population prevalence (cases per 1000) for 16 chronic conditions<sup>1</sup> in the Ontario population aged 30 and older ( $n_{2020} = 9.5$  million), 2020 and 2040 (projected).

<sup>1</sup>MI: myocardial infarction; CHF: congestive heart failure; COPD: chronic obstructive pulmonary disease.

The number of cases for some conditions will increase simply because of the growing Ontario population, surpassing 20 million in 2040. Disease prevalence estimates, which we estimate as cases per 1000, show anticipated changes in chronic illness independent of population growth (Figure 6). Prevalence estimates demonstrate that for stroke, chronic coronary syndrome, and CHF (congestive heart failure), primary prevention efforts, including smoking cessation, hypertension control, and lipid management, have been successful at reducing the disease burden.<sup>58</sup> While overall disease trends are promising, heart disease and cardiovascular risk factors have increased substantially among low-income Canadians in recent years,<sup>59,60</sup> and population trends may reverse as socioeconomic inequalities widen.<sup>61</sup>

It is worth noting that for some chronic diseases, including asthma and cancer, we assume formal disease remission is not possible even though some patients may live symptom-free. For both of these conditions, disease prevalence is expected to increase as the result of key risk factors (e.g., environmental exposures, smoking, obesity) and survival rates in the aging population.<sup>62-64</sup> As healthcare costs are greatest in the initial or acute care phase, health system impacts may be mitigated by improved treatment and continuing care.<sup>65,66</sup>



**Figure 7.** Age-standardized<sup>1</sup> population prevalence (cases per 1000) for 16 chronic conditions<sup>2</sup> in the Ontario population aged and older ( $n_{2020} = 9.5$  million), 2020 and 2040 (projected).

<sup>1</sup>Age-standardized to the 2020 Ontario population.

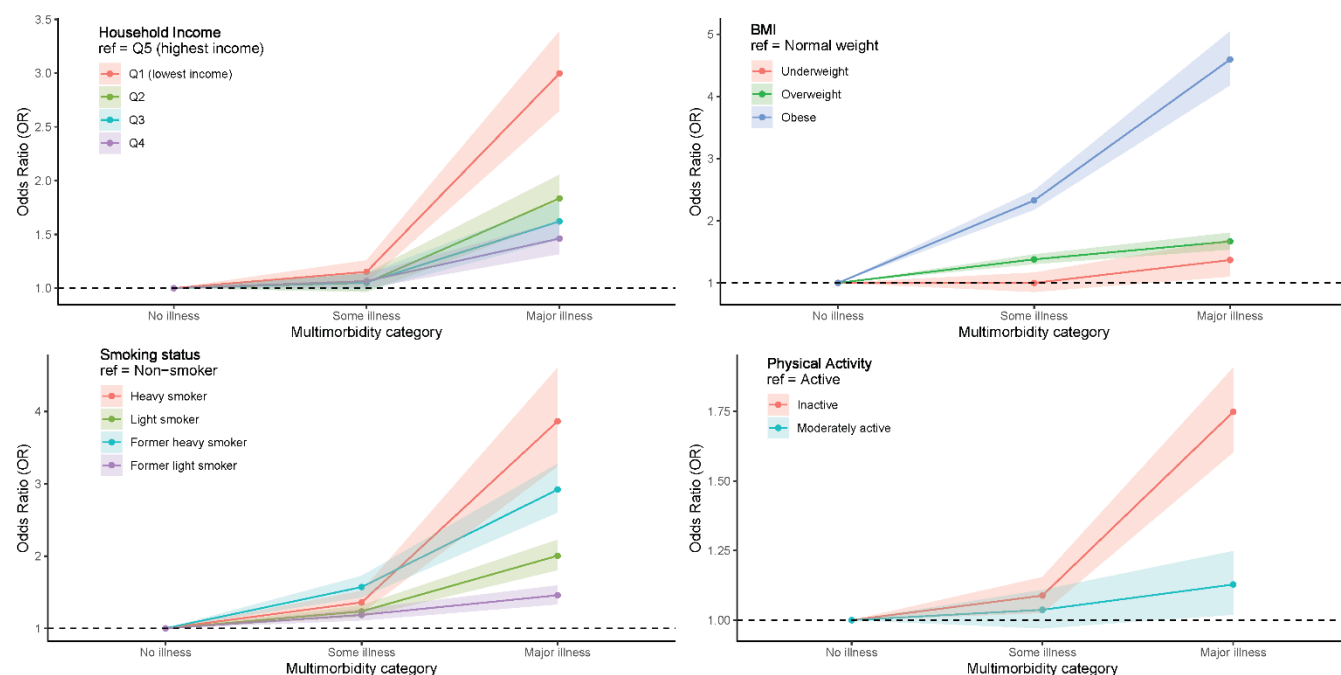
<sup>2</sup>MI: myocardial infarction; CHF: congestive heart failure; COPD: chronic obstructive pulmonary disease.

We can further demonstrate the interplay between population aging and chronic disease trends by age-standardizing prevalence estimates to the 2020 Ontario population (Figure 7). Age-standardization removes the influence of population aging from our prevalence estimates and presents chronic disease rates in a *hypothetical* scenario where the population age-sex structure is unchanged between 2020 and 2040. These estimates show that for some chronic diseases, such as myocardial infarction, increases in cases (Figure 5) and population prevalence (Figure 7) can be fully accounted for by removing the effects of population growth and aging. For other conditions, including some – such as hearing loss – typically considered age-related illnesses, predicted increases over the next 20 years cannot be fully attributed to the aging population. While they are useful for understanding the factors that contribute to the trends we describe, it is important to note that these age-standardized prevalence estimates are not representative of the real-world population. The scenarios presented in Figures 5 and 6 better reflect the burden and distribution of disease that the Ontario health system must prepare for.

## The importance of a population health approach to health systems

To address the growing chronic disease burden in Ontario, it is imperative to improve the overall health of the population by addressing a wide range of factors that influence health outcomes, including social, economic, environmental, and behavioural determinants.<sup>67</sup> This approach differs from a focus on individual patient care and acute health issues. To address the worrying trends already observed and projected for

Ontario, chronic disease prevention and early detection, not only management, must be a priority, with a strong focus on health equity.<sup>68</sup>



**Figure 8.** Risk of multimorbidity associated with household income, body mass index (BMI), smoking status, and physical activity in the Ontario Canadian Community Health Survey population, 2000 to 2014 (unweighted n = 233,969).

Upstream determinants of health are important considerations for health system planning and disease prevention. These risk factors play an important role in determining the future risk of chronic illness and multimorbidity, and cut across many diseases.<sup>69-72</sup> In Ontario, the relationship between determinants of health and chronic disease outcomes is well-established.<sup>11,12</sup> Analyses using survey data show that the risk of multimorbidity increases with lower household income, overweight and obesity, smoking, and physical inactivity (Figure 8). These are illustrative findings to emphasize the importance of considering these broader factors.

Net migration accounts for 72 percent of population growth since 2010 and will account for 86 percent of growth between 2022 and 2046.<sup>18,73</sup> Ontario’s immigrant population has unique health needs. Previous studies have shown that immigrants generally have lower mortality compared to Canadian-born residents.<sup>74,75</sup> However, this finding is weaker with a longer duration in Canada, in later life, and for chronic disease morbidity.<sup>75</sup> For example, many immigrant communities in Ontario are at increased risk of diabetes relative to the Canadian-born population<sup>76,77</sup> and face several other barriers to accessing healthcare.

While we do not account for individual-level risk factors or immigration status in our projections, the effects of underlying trends in population are clear. As an example, smoking rates have decreased steadily since the mid-20<sup>th</sup> century<sup>78</sup>, as well as improvements in cardiovascular screening and treatment. Those positive health impacts are apparent in the long-term projections of associated cardiovascular disease (Figures 5 and 6). Conversely, diabetes is expected to increase significantly over the next 20 years, which reflects rising obesity rates, reduced opportunity for physical activity and growing health inequities.<sup>79</sup> Chronic disease prevention efforts must carefully consider the underlying determinants of health to ensure that interventions and approaches address these complexities.

# Summary and conclusions

## Key Findings

This report presents chronic disease and multimorbidity projections for the Ontario population up to 2040. Our projections suggest that more Ontarians will be living with major illness, and the number of cases will rise for many chronic conditions. These findings are the result of several dynamic trends, including a growing and aging population, improved survival of chronic disease patients, and rising rates of illness across all age groups. The millions more people expected to be living with chronic illness will pose a significant challenge to Ontario's health system capacity and sustainability.

We project that 3.1 million people will be living with major illness by 2040. This is driven by large increases in the number of people living with diabetes, cancer, and osteoarthritis, among other conditions. Chronic disease will rise as a result of population growth and aging and from the amplification of underlying health disparities across chronic disease risk factors. The growing immigrant population, which will account for most population expansion over the next 20 years, has unique healthcare needs.

The Ontario health system is responsible for managing and mitigating population health risks. Past successes, including reductions in smoking and improved primary care management of cardiovascular health, have had demonstrable impacts on population health, as demonstrated by our projections. Moving forward, efforts will need to focus on the prevention, early detection, and continuous management of chronic disease in high-risk populations to ensure the sustainability and equity of the health system.

## Strengths and Limitations

As with all disease projections, the assumptions inherent in our methodological choices (see *Assumptions*) result in interpretive cautions. We would like to highlight two key limitations that relate directly to these assumptions.

First, in using health administrative data to capture chronic disease diagnoses, we rely on the assumption that people who have been diagnosed with a given condition are receiving care in the Ontario health system, identifiable using health billings and diagnostic codes. This may not be true for all conditions; for example, many patients with hearing loss do not pursue treatment via hearing assistive devices,<sup>80</sup> and would be considered hearing loss-free in our analysis. Using health administrative data to capture chronic disease diagnoses likely results in underestimating several conditions. In that sense, our projections can be seen as conservative estimates.

Second, our modelling approach assumes that trends over the next 20 years will reflect historical trends in chronic disease. This means that our findings do not reflect the effects of recent or not yet-realized developments in treatment, such as new medications. Some diseases may experience improvement relative to their historical trajectory, although a complete reversal is unlikely.

This is the most recent population-wide, long-term chronic disease projections for the Ontario adult population. We integrated data capturing decades of health system interactions and population demographic projections to produce robust estimates of chronic disease and multimorbidity over the next 20 years. The data show that concerning trends in chronic disease and major illness are expected in the coming years, which may exceed the Ontario health system's current capacity. Despite any limitations of our approach, we feel that these results are important and raise important considerations for health system planning in the province.



# Implications for Health System Capacity

## Impacts

### *Increasing healthcare needs*

The burden of illness and subsequent strain on Ontario's health system will grow considerably over the next two decades. Currently, the healthcare system is largely designed around acute care and single conditions; as a result, people with multimorbidity are likely to receive care from multiple healthcare providers.<sup>81</sup> Fragmentation and unnecessary care, such as alternative level of care (ALC) days and hyper-polypharmacy, lead to inefficient use of health care resources and poorer patient experience.<sup>82-84</sup> Taken together, the result is that health care utilization, patient costs, and health system resource demand all increase with older age and greater multimorbidity.<sup>4,9,85</sup>

### *Ontarians are living longer with more illness*

Multimorbidity will increase in all age groups over the coming years. Ontarians will spend more years with major illness, and the complexity of healthcare needs will grow.<sup>32,86,87</sup> This means that in addition to a greater volume of patients and health care utilization, the health system will need to care for more patients with multiple chronic conditions over a longer time period. Existing challenges in delivery and continuity of care will be exacerbated by increasing levels of multimorbidity, which will have implications for health system burden and health outcomes. Among patients with chronic disease, progression of multimorbidity<sup>88</sup> and multimorbidity-driven hospitalizations<sup>89</sup> will both increase with poorer continuity of care. Quality primary health care and ambulatory care coordination will be critical to manage this burden and preserve acute care capacity.<sup>90-92</sup> In addition, expansion of palliative care, including improving palliative care competency across all health care professionals, will help to meet the needs of patients in a variety of care settings.<sup>93,94</sup>

### *Opportunities for prevention and postponement of chronic conditions*

The current trajectory of population health in Ontario is the *expansion of morbidity*, the idea that more and earlier time will be spent in poor health.<sup>95</sup> The alternative, *compression of morbidity*, requires that onset of chronic disease is delayed into later life. To achieve compression of morbidity, illness must be prevented and postponed at a population scale. This means people spend the fewest years as possible in poor health.

Many chronic diseases, including hypertension, diabetes, and COPD, are preventable through early and appropriate intervention on disease risk factors.<sup>72</sup> Effective and equitable disease prevention requires careful consideration of the upstream structural and social determinants of health, such as SES, housing, race, and immigration status.<sup>96</sup> Stronger partnerships between public health and healthcare sectors, which for various reasons have been siloed, would strengthen disease prevention efforts and improve equity.<sup>68,97,98</sup> In terms of the onset of chronic disease, postponement can be achieved through many of the same approaches as disease prevention. From a health system perspective, postponement in terms of disability and need for acute care is equally important; chronic disease management is thus central to this goal.<sup>90,99</sup> A focus on integrated person-centred care, including social care support, should be a priority.<sup>100</sup> Furthermore, trusted partnership with community organizations, residents, patients, family and caregivers is essential to ensure meaningful impact.

## Potential Policy Options

No single policy approach meets the challenges described in this report. The projected growth in major illness in just over 15 years would tax the health system in multiple ways. However, combinations of different policies may help temper the growth in major illness and help increase the ability of our health system to respond to the remaining growth in illness.

There are short-term options around improving **primary and secondary prevention**, including redoubled efforts on health promotion and addressing chronic disease risk factors and social determinants, whether through major infrastructure and policy investments or care system options.<sup>101</sup> There are also ongoing opportunities around increasing access to breakthrough drugs and treatments. However, none of these options will likely be sufficient on their own, and most will require new investment.

Short-term options to increase **health system capacity** include a broadened scope of practice, increased use of different care models, and more community-led outreach programming to help prevent disease progression and enable early detection in community settings, particularly for those with lower access. Innovations in care delivery and greater introduction of technology that increases access options and improves quality will also support the capacity of the system to respond and reduce access barriers.<sup>102</sup> Long-term solutions will need to confront the challenge of capital. There will likely need to be substantial new investments in physical infrastructure to support changes in practice and new builds to support high-quality community care. New partnerships and investment opportunities might be needed, including but not limited to, cross-sector collaborations anchored by transparency and rigorous oversight.

Short- and long-term options exist for more effective and integrated **health system organization**. Integration will result in substantial long-term benefits, but challenging as disparate parts of the system will need to be brought together in a way that has not yet been done in Canada but is more common in other jurisdictions.<sup>103,104</sup> Without integration, health systems will likely continue to under-invest in prevention and early intervention and over-invest in acute and chronic care. Efforts to reduce healthcare utilization will result in outsized returns because of inequities in the distribution of disease. Other shifts, such as greater patient, family, and caregiver engagement and empowerment,<sup>105</sup> are likely to lead to better system performance and outcomes. Comprehensive integration also includes social services as well as healthcare. Integration may be designed in the short term, but it will need new funding and accountability as well as commitment over the long term for meaningful impact.

None of these options will meet all the challenges in this report, nor will they be a quick fix. There are well-studied cases of how communities have reduced the burden of morbidity through prevention, increased the effectiveness of early intervention through integration, and increased the capacity of systems. New treatments and technologies, such as next-generation pharmaceuticals, digital innovations, and virtual care, show remarkable promise; however, relying on isolated treatments, interventions, and technology will not fully address the issue. While we continue to learn more about integration and effective health system organization, we are also aware that none of these potential solutions will change the growth rate in a short period, and almost all will require continued policy and management attention. Policy tools that maintain attention on critical issues such as report cards<sup>106</sup>, the deliverology approaches,<sup>107</sup> and other accountability and monitoring strategies should accompany any set of policy interventions to ensure attention to long-term success. The greater the transparency, the more they are publicly released, and the more effective these instruments will be to inform needed policy change.

Further policy-oriented analyses could consider the regional and community-specific impacts to guide capacity development strategies. The rank ordering of the impact of different interventions, such as the widespread use of specific treatments and prevention approaches, would also help prioritize investments for impact.

## Next steps

This report represents the most recent large-scale effort to project chronic disease and multimorbidity in the Ontario population. Our findings raise considerable questions about the future of chronic illness in the province, which we plan to investigate further.

The next steps of this project include fully integrating data on sociodemographic factors and health behaviours into our projections by differentially accounting for risk and summarizing by different population sub-groups. This will allow us to account more fully for the distribution of chronic disease burden among specific population groups and inform the subsequent strategy implications. We also plan to produce stratified projections to determine how future chronic disease and multimorbidity risks vary by social and demographic groups and quantify anticipated health system inequities. In addition, we will generate region-specific projections for health regions within Ontario. Regional projections will provide locally relevant insights to further support health system planning.

The results in this report apply to the Ontario population aged 30 and older. We chose to focus on this age group as the burden of chronic disease and multimorbidity is higher in older ages, and because the chronic diseases we highlight have been identified as a priority for Ontario health system planning. Patterns of illness among children and young adults are markedly different, and this population's health status and needs over the next 20 years are unlikely to align with the adult population. Furthermore, early age prevention is a critical component of a comprehensive population disease strategy. Our future work plans include investigating parallel childhood and adolescent chronic disease trends and risk factors, including the impact of early intervention. This work requires distinct methodological and expert input.

## Summary

The findings have crucial implications for Ontario's health system. The growing burden of illness will strain the system significantly in the next two decades. More Ontarians will live with chronic diseases, necessitating stronger prevention, early treatment and management strategies. Prevention strategies, including population-level approaches, are essential to improving health and postponing illnesses. Collaboration across sectors is needed to address social and environmental factors. Longstanding health inequities mean these challenges will not be equally distributed and may significantly increase health disparities. Early detection and management of chronic conditions can be managed outside hospitals, reducing hospital strain. Addressing this burden will require focusing on community care and addressing the determinants of health to sustain system capacity. Understanding the future healthcare burden enables health policymakers and system operators to make informed strategic decisions and plan effectively.

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