Health Workforce Modelling & Forecasting in Canada

Current State Analysis Report

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Health Workforce Canada | Effectif de la santé Canada

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Executive Summary

Health Workforce Canada (HWC) is an independent organization funded by Health Canada to enhance health workforce (HW) data and planning across the country. HWC's strategic plan includes four areas of focus: convening the networks to collaborate on health workforce priorities; advancing data by innovating and leading to advance access to enhanced health workforce data and information; catalyzing Canada's capacity for health workforce planning, modelling, and implementation; and identifying and sharing innovations and leading practices, supporting evaluation.

In the spring of 2024, HWC commissioned an environmental scan to assess existing HW forecasting models in use or in development among federal, provincial, and territorial (FPT) governments and health regions. Professional associations, consulting firms, and academic researchers and their networks were also consulted. The scan was complemented by a literature review and included over 50 interviews with experts in the field. The findings revealed shared challenges and unique opportunities upon which to focus to optimize HW coordination in Canada.

Common challenges across the country include data and methodological issues, such as inconsistent data sharing and availability, lack of standardized definitions, and difficulty tracking workforce movements like separations and interjurisdictional migration. Although only a handful of pan-Canadian HW prediction models were identified, there was a keen appetite for greater coordination across stakeholders and the possible development of shared datasets, methodologies, and modelling tools. Insufficient focus on needs-based demand and team-based care methodologies and planning was flagged by many.

Subpopulations in modelling and planning were often overlooked. Deficiencies include inadequate attention to equity-deserving populations, like First Nations, Inuit, and Métis communities; insufficient adjustments for gender and age; and persistent issues in the distribution of the workforce in rural and remote areas of Canada. Technological barriers, such as limited access to advanced modelling tools in the territories, and suboptimal adoption of collaborative care models across provinces also pose challenges.

Despite these issues, the environmental scan highlighted significant opportunities to enhance health workforce modelling and forecasting in Canada. These include establishing a Canadian Technical Modelling Working Group (TMWG) to facilitate knowledge exchange and address common technical challenges; pursuing international collaborations focused on health workforce data and modelling; and collaborating with partners such as Health Canada, the Canadian Institute for Health Information (CIHI), Statistics Canada, Employment and Social Development Canada (ESDC), and provincial/territorial modelling teams to develop transparent and accessible pan-Canadian modelling tools.

1.0 Introduction

Health Workforce Canada (HWC) is a new, independent organization, funded by Health Canada and created to strengthen health workforce data and planning across the country. With a mission to benefit Canada's health workforce, patients, and all Canadians through better, broader, and connected data and planning, it works with a broad network of partners to address four strategic priorities:

- **Convening the networks:** Bring partners together to enable a collaborative approach to health workforce priorities
- **Advancing data:** Innovate and lead to advance access to enhanced health workforce data and information
- **Modelling and forecasting:** Catalyze Canada-wide capacity for health workforce planning, modelling, and implementation
- **Sharing what works:** Identify and share innovations and leading practices, and support evaluation

In the spring of 2024, as part of its modelling and forecasting strategic objective, HWC conducted an **environmental scan** of the existing health workforce forecasting models amongst federal, provincial, and territorial (FPT) governments and health regions. Professional associations, researchers, and other specialty contracting firms were also consulted to provide a complete overview of modelling activities currently underway.

The scan was complemented by a **review of grey and peer-reviewed literature** (available upon request) and interviews with **over 50 informed resources across Canada.** It highlighted several common points in health workforce modelling and forecasting, which can be categorized under the following themes: data issues, methodological challenges, operational and functional issues, strategic and policy-related challenges, population-specific considerations, collaborative care models, technological barriers, and ROI measurement challenges. Addressing these shared challenges will require coordinated efforts across jurisdictions, enhancements in data sharing, standardized methodologies, and a stronger focus on needs-based planning and role optimization.

In this Current State Analysis Report, HWC provides an overview of the findings of the environmental scan, summarizes modelling work to date in Canada, and identifies areas in need of immediate solutions through collaborative action.

The sections in this report are structured around the following four questions:

I. How do we define health workforce modelling, predictions, and scenario planning?
II. What is the state of health workforce modelling in Canada?
III. What key challenges and opportunities are common across the modelling and forecasting ecosystem?

IV. Where should we focus to best advance health workforce modelling and forecasting in the country?

The response to this last question leverages insights from the environmental scan, along with the identified challenges and opportunities, to propose three key areas for collaborative action. These areas were selected to align with HWC's strategic objective to catalyze capacity in health workforce planning, modelling, and implementation, laying the groundwork for meaningful progress.

Coordinated Action at the Pan-Canadian Level

While HWC was conducting its environmental scan in the spring and summer of 2024, Health Canada was asked to lead an FPT Education Modelling Study for health professions involved in primary care. This work was initiated based on the FPT ministers' commitment in fall 2023 to a pan-Canadian study to determine the number of education seats that would be required to address shortages in primary care. Though primary care can be defined in many ways, this study focused on family physicians, nurses, occupational therapists, physiotherapists, and pharmacists. Of note, the Health Canada study was supported by the Canadian Institute for Health Information's (CIHI) Physician Resource Planning (PRP) Tool, a tool that emerged from previous pan-Canadian coordinated action on modelling for physicians.

2.0 How Do We Define Health Workforce Modelling, Predictions, and Scenario Planning?

In this section, we define key terms, including modelling, predictions (forecasting and projections), and scenario planning. Definitions for terminology used to describe health workforce statistical activities and outcome measures varied in the literature and appeared to vary during our interviews. To define and standardize terms in this report, we leveraged literature from the Canadian Health Workforce Network (CHWN) and Ontario Health (2024),[1] Hyndman and Athanasopoulos (2021),[2] and Massad et al. (2005).[3]

We define modelling as the process of creating a mathematical or conceptual representation of a real-world system, process, or phenomenon. One of the multiple purposes of modelling is to derive parameters that summarize the relationships between different variables within a system and how they interact based on existing trends and historical data. Sometimes models attempt to explain a situation, while at other times they aim to offer opportunities to make predictions beyond the data that is available. Once there is agreement on a model's key parameters and how it should be built, the model can be used for predictions and scenario testing.

Broadly speaking, prediction activities fall under two approaches: forecasting and projections.[3] At times, these terms are used interchangeably in the literature and across disciplines, and as such, we believe these terms may have been used interchangeably by the participants interviewed as part of our environmental scan. **We define forecasting as an attempt to predict outcomes that *will* happen** if models rely on historical data, current conditions, trends, and fair assumptions about the future. Forecasts are always likely to be at least partly wrong, because predicting the future is based on uncertainties and there are correct answers to forecasts (which are ultimately revealed by history). Alternatively, **projections are predictions about what might happen** based on proposed scenarios about what the future could look like.

A scenario refers to the narrative or set of assumptions about the future that is being hypothesized; it defines relevant conditions, variables, and external factors that could influence a range of outcomes. Scenario-based planning involves generating a

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[1] Canadian Health Workforce Network & Ontario Health. (2024). *How-To Playbook for Health Workforce Planning*. https://www.hhr-rhs.ca/images/PDFs/CHWN-Ontario_Health_Toronto_How-To_Playbook_for_Planning_July2024.pdf

[2] Hyndman, R. J., & Athanasopoulos, G. (2021). *Forecasting: Principles and practice* (3rd ed.). OTexts. OTexts.com/fpp3

[3] Massad, E., Burattini, M. N., Lopez, L. F., & Coutinho, F. A. (2005). Forecasting versus projection models in epidemiology: The case of the SARS epidemics. *Medical Hypotheses*, *65*(1), 17–22. https://doi.org/10.1016/j.mehy.2004.09.029

variety of future-state scenarios, or the “development and elaboration of a range of plausible futures” (CHWN & Ontario Health, 2024). Modelling and projections are used to predict the outcomes of these scenarios. Projections are the numerical outcomes (i.e., how much) that emerge when you apply the assumptions of a scenario (i.e., what if) to a model. In short, projections estimate the quantitative impacts of the scenario. In this text, when we refer to scenarios, we also refer to the projections that may be attached to them.

Health workforce models integrate various data points, such as population demographics, health care utilization patterns, workforce demographics (including retirement rates and attrition), measures of productivity, graduate supply from training institutions, and policy changes affecting health care delivery. By predicting the balance between supply (number and combination of health care workers contributing to the health workforce) and demand (health care needs of the population), these models assist policymakers, health care administrators, and educators in making more informed decisions on workforce planning, resource allocation, and policy development to ensure adequate and efficient health care delivery.

In general, the analytical framework of health workforce prediction models is based on three components: supply-side, demand-side, and gap analyses.[4] A recent systematic review of HW prediction models found eight supply-and-demand frameworks commonly used around the world: population-to-provider ratio, utilization-based, needs-based, skill-mixed, stock-and-flow, agent-based simulation, system dynamic, and budgetary models.[5] While there are a host of statistical approaches used in the frameworks above, we will note two distinct approaches and their strengths: macrosimulation (static, descriptive, or statistical) and microsimulation models. The former relies primarily on historical and current data to predict future trends in HW supply and demand, analyzing factors such as population demographics, health care utilization rates, workforce attrition rates, and educational outputs to estimate future workforce needs. The strength

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[4] Lee, J. T., Crettenden, I., Tran, M., Miller, D., Cormack, M., Cahill, M., Li, J., Sugiura, T., & Xiang, F. (2024). Methods for health workforce projection model: Systematic review and recommended good practice reporting guideline. *Human Resources for Health*, *22*, Article 25. https://doi.org/10.1186/s12960-024-00895-z

[5] A review of the literature and feedback submitted by modellers from around the country highlighted differing definitions and understandings of modelling approaches and terminology. For instance, the eight approaches listed above could also be categorized as empirical vs. mechanistic models. Empirical models, such as a regression analysis, use observed data to uncover patterns, relationships, and trends, rather than theoretical assumptions or mechanistic processes. Empirical models excel when there is a large amount of high-quality data and stable time trends (past trends can predict future outcomes). A mechanistic model is a type of model that represents and simulates the underlying processes, structures, and relationships that govern the behaviour of a system. Unlike data-driven models, which primarily rely on empirical data to identify patterns, mechanistic models are built on theoretical principles and assumptions that describe how different parts of a system interact with each other. They can simulate what-if scenarios, whereas empirical models struggle if such scenarios are not represented in the data. Microsimulation and aggregate models (stock-and-flow, system dynamics) are examples of mechanistic models.

of macrosimulation models is their ability to provide insights based on existing trends and patterns.

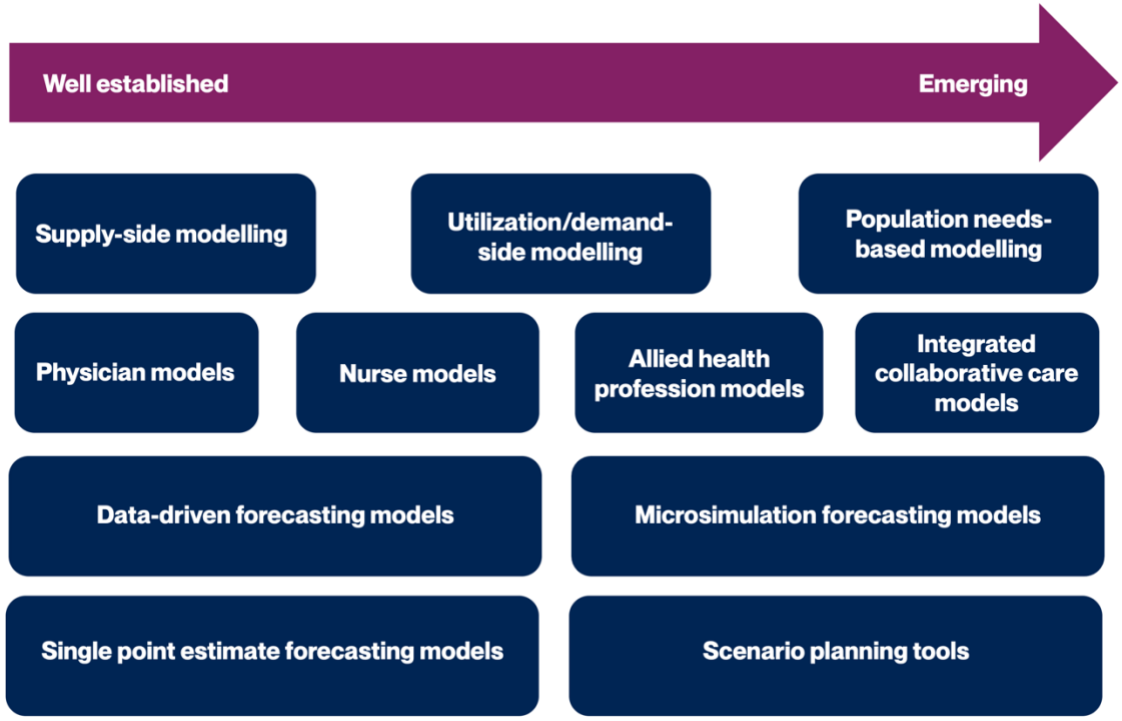
Microsimulation models take a more dynamic approach by simulating the evolving individual-level (agent) behaviour and interactions within the health care workforce across time. Through the development of complex algorithms, these models aim to simulate the life cycle of health care professionals, from education/training to workforce participation to retirement, considering factors like career choices, job mobility, and policy impacts. Microsimulation models are advantageous because of their ability to capture the intricacies of workforce dynamics and simulate the effects of policy changes or interventions with greater accuracy. Both macro- and microsimulation models can inform health care workforce planning through scenario testing, aiding policy decisions by offering complementary insights into future workforce challenges and opportunities.

Governments around the world, including Canada's provincial and territorial governments, are actively engaged in health workforce modelling and predictions to address the complex challenges of health care provision. Internationally, government institutes such as the United States Department of Health and Human Services, the UK's National Health Service (NHS), Australia's National Centre for Health Workforce Studies, New Zealand's Health Workforce Strategic Framework, and the Netherlands Institute for Health Services Research (NIVEL), along with joint initiatives such as the 19-European-country Joint Action on HEalth woRkfOrce to meet health challEngeS (HEROES), have developed strategic HW plans, some of which include sophisticated models that integrate demographic data, health care utilization trends, workforce training outputs, and policy impacts. Health Workforce Canada is working collaboratively with many of these domestic and international partners to advance shared knowledge and coordination in health workforce modelling for the future.

3.0 What Is the State of Health Workforce Modelling in Canada?

As of 2024, Canada has a range of health workforce supply-and-demand modelling programs underway, led by the federal government, provincial and territorial governments, health regions, and independent organizations such as CIHI. A number of independent researchers, professional associations, and consulting companies also produce forecasting models and modelling studies. This environmental scan summary focuses primarily on the work of Canada's FPT governments and health regions.

Figure 1: The Evolution of Health Workforce Modelling and Forecasting



In programs led by federal, provincial, and regional governments, modelling estimates are used as part of larger decision-making processes through a variety of governance mechanisms to determine policy decisions about how to address potential health workforce shortages for the future. It was reported that the model development process itself can bring value by allowing for certain factors to come to light. For example, examining supply could reveal evidence of attrition from an educational program, while examining demand might reveal opportunities to reduce unnecessary laboratory testing.

In all the provinces for which we received input, modelling work is underway at the provincial ministries of health, with additional initiatives taking place within the health regions. Currently, neither the models generated by provincial/territorial (P/T)

governments nor their forecasting estimates are typically shared beyond P/T borders. No known health workforce forecasting models developed by territorial ministries of health were identified at the time of the study, although all territorial representatives indicated a desire to pursue such development in the future. At the pan-Canadian level, several notable modelling and forecasting programs of work are ongoing. These include the Canadian Institute for Health Information's Physician Resource Planning (PRP) Tool, an interactive data-driven supply-and-demand model for all physician specialties that forecasts up to 20 years in the future and is accessible to the modelling community. Alternatively, labour market projections for all National Occupation Classification (NOC) occupations, including health professions, can be estimated using Employment and Social Development Canada's (ESDC) Canadian Occupational Projection System (COPS) to better understand potential shortages in the future. Statistics Canada leads the development of several microsimulation models to produce current and future population and chronic disease estimates, essential tools to assess the demand for care. The national statistical agency also works in concert with the Canadian Partnership Against Cancer (CPAC) to continuously upgrade and improve OncoSim, an online modelling tool that provides population projections for cancer and anticipated health service needs, based on the information needs of provinces and territories that leverage this pan-Canadian resource. Each of these organizations plays a critical role in shaping the data and standards that are relevant to the pan-Canadian modelling work being done across the country.

Given the extensive work on health workforce modelling and forecasting in Canada, many of those interviewed suggested that certain concepts relevant to modelling, including methodologies, standard definitions, and their operationalization, would have some level of portability between jurisdictions.[6] In other words, challenges related to defining and coding model parameters (e.g., full-time equivalencies) may be common across jurisdictions. Solutions to data problems may have been identified by some and not by others, and this presents an opportunity for collaboration to yield mutual value across the health workforce modelling community.

Population needs-based planning approaches are centred on estimating "workforce requirements to meet the unique needs of patients based on their demographic and epidemiological profiles, and an established level of service."[7] These approaches are

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[6] Organizations such as Statistics Canada, CIHI, and ESDC play a standardization role. CIHI developed health (care) classifications (including terminology), indicators/standards, datasets, and methodologies (e.g., case mix groupings, Health Human Resources Minimum Data Set [HHR MDS]) in support of health information, statistics, evidence, and data interoperability. The National Occupational Classification (NOC) is another example. Co-developed and updated by StatCan and ESDC, it is Canada's national system for describing occupations. In addition, standard development work, including pan-Canadian engagement, funded by the Canadian Institutes of Health Research and led by the Canadian Health Workforce Network, fills much-needed gaps in our capacity to assemble the high-quality data needed for HW modelling, forecasting, and planning.

[7] Simkin, S., Chamberland-Rowe, C., & Bourgeault, I. L. (2024). Key considerations in health workforce planning. In McDermott, A. M., Hyde, P., Avgar, A. C., & L. FitzGerald (Eds.), *Research handbook on contemporary human resource management for health care* (pp. 181–199). Edward Elgar Publishing. https://doi.org/10.4337/9781802205718

being pursued across the country, although each government organization is at a different stage of advancement. Despite variability across the country, the supply-side of health workforce modelling is better established (at least for physicians), while demand-side modelling is less well developed.

Traditionally, modelling work has focused on producing estimates for single professions, with physician forecasting models being the most advanced, followed by nursing and then other extended health professions. Much less common are forecasting models that account for collaborative team-based care, although there is a strong sentiment that these are the next iterations of future models, which makes them important for advancing planning in the country.

Government organizations, whether at the ministry level or within health regions, create HW forecasting models based on the data they have. When certain datasets are missing, they make key assumptions to fill in the gaps. These assumptions, tailored to specific contexts, are critical for forming the basic parameters of the resulting estimates and, to an even greater degree, for accurately interpreting the results. A complementary challenge that was highlighted was the need to reconcile the complexity of the models used to produce estimates with the necessity to communicate these estimates in such a way that the audience understands the general methodology, basic assumptions, and overall conclusions.

However, data sharing between regions and ministries of health is not always seamless. The data accessible at the ministry level is not always available to health regions, and vice versa. This means that different organizations within the provinces engaged in modelling may rely on different datasets and assumptions, leading to variations in their forecasting models and estimates. Understanding these context-specific assumptions is essential for interpreting and comparing results across different jurisdictions. The context described above may suggest that the centralization of, and shared access to, key common definitions and methodologies and/or data points, or anonymized aggregates of data points, would support greater alignment in model estimates.

While much of health workforce modelling continues to focus on producing point estimates, it is widely recognized that using more advanced forecasting models that include scenario planning capabilities is a better approach. With such tools, different policy scenarios can be played out through the numbers before being applied to real-world populations. It is commonly understood within the modelling community that there is no single estimate that will predict future health workforce requirements in absolute terms. Scenario planning tools can use both macrosimulation and microsimulation modelling techniques to estimate the potential impacts of a broad range of what-if scenarios that range from changes in disease prevalence trends to variations in population demographic projections. Microsimulation is just emerging as an approach amongst provincial government modelling teams to complement data-driven models.

It is also generally recognized that there may never be a single model for Canada that meets all the information needs of its jurisdictions. P/T governments, health regions,

and others will continue to develop targeted models that meet the specific needs of their local contexts.

Results from HWC's environmental scan highlighted that access to centralized pan-Canadian forecasting tools, able to produce a wide range of health workforce estimates and scenario-testing capabilities, would be of value for validating a range of policy-relevant options. Such tools would not be expected to replace existing P/T data, modelling, and forecasting activities, but they would provide opportunities to test alternative scenarios based on different sets of assumptions. A centralized pan-Canadian forecasting model that aims to account for a broad range of health provider types, as well as team-based models of care delivery, does not currently exist. There are therefore ample opportunities to learn from the experimentation and implementation lessons of HW modelling, forecasting, and planning across the country.

A key consideration that was identified during the environmental scan was the possibility that HW estimates/findings coming from different tools (e.g., pan-Canadian versus P/T versus regional) could differ and lead to confusion, misuse, and erosion of trust in findings and methodology for any of the contributors. This points to the need for strong collaboration and coordinated communications by all parties to ensure alignment on the data and methodological sources contributing to the differences.

Modelling and Forecasting Across Canada

The following section is a tabulation of health workforce modelling at FPT government levels (including health regions). There are strengths as well as opportunities for improvement associated with each model, and all are subject to change over time.

Although not reported here, some professional associations, like those representing physicians, nurses, pharmacists, and oral health professions, are undertaking their own profession-specific modelling studies or have done so in the past. There are also a range of academic pursuits in health workforce supply-and-demand modelling in Canada, where specific areas of focus, professional specializations, geographical coverage, and methodological underpinnings are varied.

Table 1: Health Workforce Modelling, Prediction, and Planning Tools

Level	Organization	Current State
Canada	Health Canada (HC)	Recently conducted an education, training, and distribution study of a range of health care professions including physicians, nurses (various types), occupational therapists, pharmacists, and physiotherapists. The health workforce supply and demand modelling component of the study employed profession-specific models with annual projections from 2023 to 2040 (models could go further out but with less reliability). The supply and demand models focused on family physicians, nurses (nurse practitioners, licensed practical nurses, registered and registered psychiatric nurses), occupational therapists, pharmacists, and physiotherapists. Projections are pan-Canadian, specifically making projections at the national level, but underneath it is a bottom-up approach (i.e., national is based on roll-up of results for each province/territory). Workforce supply and demand (and supply-demand gaps) were further reported by rural/remote and urban geographic areas. Combination of data-driven models (e.g., for physicians, leveraging CIHI's PRP Tool) and microsimulation modelling for other health professions. Projections include a base case (status quo) analysis and various scenario to assess alternative results in the case of increasing demand (e.g., increase in population size, disease prevalence) or decreasing supply (e.g., early retirement).
Canada	Employment and Social Development Canada (ESDC)	The Canadian Occupational Projection System (COPS) is a labour market projection tool for all National Occupation Classification (NOC) occupations, including health professions.

Level	Organization	Current State
		The main objective of COPS is identification of overall labour shortages over the next 10 years. Audience is general Canadian—COPS cannot be used for workforce planning in the health sector at a very detailed level. COPS uses the manpower approach, which is the employment level needed to reach a level of production given a certain productivity level. From that perspective, COPS can be used for workforce planning. However, it does not provide enough detail at the occupational level for what is required in this project. COPS is a set of time series models that leverage labour market survey data, adjusted based on input from stakeholder consultations.
Canada	Statistics Canada (StatCan)	Population and chronic disease microsimulation models, leveraging the extensive survey datasets available at Statistics Canada Not explicitly focused on health workforce forecasts Population projections to 2068 Partner with other organizations to provide modelling expertise and access to data (e.g., see Canadian Partnership Against Cancer, CPAC)
Canada	Canadian Institute for Health Information (CIHI)	Manages the Physician Resource Planning (PRP) Tool, a scenario-based data-driven supply-and-demand tool for approximately 30 physician specialties, forecasting up to 20 years in the future The PRP tool was informed by FPT work and models; can be stratified at the P/T level. Available as fully modifiable PRP Tool calculator, or a dashboard-style Viewer for ease of use, to all FPT ministries / departments of health and select non-governmental organizations. Designed for estimating population demand and unmet need for care while accounting for population demographics, the Population Grouping

Level	Organization	Current State
		Methodology (POP Grouper) considers disease prevalence and service utilization to estimate health care costs and health services use.
Canada	Canadian Partnership Against Cancer (CPAC)	Houses OncoSim, an online modelling tool that provides population projections for cancer and future health service requirements (model development by Statistics Canada). OncoSim is a microsimulation model. OncoLocate was a geo-mapping tool for cancer health human resources, but it has been sunsetted. Leverages StatCan population and simulates what-if scenarios (e.g., what if smoking prevalence decreases to 5% in 2030? How would that affect lung cancer incidence in the year 2050?)
Territories	Yukon	No known health workforce forecasting models were available at the time of this study.
	NWT	No known health workforce forecasting models were available at the time of this study.
	NU	No known health workforce forecasting models were available at the time of this study.
Provinces	BC	Both provincial and regional governments do some forecasting, and modelling estimates are used to help inform decision-making. Time series and predictive separation with historical weighting and algorithms looking at retention rates. Essentially physician data without patient-level records for nurses and allied health professions. Focused on adding more geographic detail. Population health modelling through simulation.

Level	Organization	Current State
	AB	Both provincial and regional governments do some forecasting, and modelling estimates are used to help inform decision-making. Most extensive modelling is on physicians due to richness of data. Other professions include nurses, PSWs, paramedics; plans for other professions, such as PT sonographers, MRTs, and MLTs. They model, in some cases, up to 5 years into the future. Some health profession models are advanced, while others are rudimentary, leveraging the provincial data they have access to (e.g., regulatory, payroll/employment, service utilization, and education data.) Focused on profession-specific models for now, but building a team to make advancements in team-based care models.
	SK	Both provincial and regional governments do some forecasting, and modelling estimates are used to help inform decision-making. They have a physician model, and they produce models for roughly 40 other professions. For physicians they typically model up to 10 years in the future, but they are looking at the best time frame for prediction to ensure accurate estimates. They produce profession-specific models but do not yet model team-based care, though they want to in the future. They use data they have access to, employment (payroll) data, some regulatory data, some StatCan data (labour force survey, population projections, education, etc.).

Level	Organization	Current State
	MB	Both provincial and regional governments do some forecasting, and modelling estimates are used to help inform decision-making. Manitoba employs both data-driven models (relying on historical data) and microsimulation models (simulating individual-level behaviours and interactions within the workforce, providing more dynamic and complex insights to predict future trends) as part of its supply-based forecasting and service utilization modelling approaches to workforce planning. Provincial modelling on physician supply is in development. Significant work has occurred on supply-based modelling and forecasting for various health professions, including PSWs, nurses, emergency response paramedics, diagnostic imaging (numerous positions), and OTs/PTs/audiologists/pharmacists. They use data they have access to, employment (payroll) data, some regulatory data, service utilization data, education data, etc. Preliminary work is occurring on physician workload management modelling using both qualitative and quantitative approaches that build in clinical input.
	ON	Both provincial and regional governments do some forecasting, and modelling estimates are used to help inform decision-making. They have fairly robust modelling for physicians and nurses but are less advanced when it comes to other professions. Working towards advancements in professions such as OTs, PTs, pharmacists, MLTs, MRTs, and PSWs, where the data can be made available. They use data they have access to, province-level regulatory data for many health professions as well

Level	Organization	Current State
		as physician data, payroll/employment data, education data, etc. Models project up to 10 years in the future in some cases. Strong interest in primary care and home care modelling, with some work planned to advance in this area. Mostly profession-specific modelling, with a goal to move toward collaborative care models in the future.
	QC	Information not available at this time.
	NB	Both provincial and regional governments do some forecasting, and modelling estimates are used to help inform decision-making. Physician models are still the predominant forecasts, but they aspire to advance modelling for nurses and other key health professions. Work is just getting underway to expand modelling beyond physicians. Particular interest and focus on primary care and modelling for family physicians; working through related data and methodological complexities.
	NS	Both provincial and regional governments do some forecasting, and modelling estimates are used to help inform decision-making. Physician modelling available as well as modelling for other health professions, including nurses, paramedics, continuing care assistants (CCAs), medical laboratory technologists, medical radiation technologists, respiratory therapists, pharmacists, pharmacy technicians, dietitians, occupational therapists, and physiotherapists, with a future focus on mental health and addictions (psychologists, social workers, counselling therapists) and oral health (dentists, DH, DA, denturists, etc.).

Level	Organization	Current State
		They generally model up to 15 years but are looking at optimal projection time frames that are useful and produce reliable estimates. They use data they can access, including regulatory data, employer data, physician billing, and vacancy rates.
	NL	Profession-specific health workforce models have been developed over the last 10 years. Reports are available online. Occupations include registered nurses, licensed practical nurses, dietitians, medical laboratory technologists, and social workers. Models used a stock-and-flow approach, with some allowance for changing demand. Models were developed under stakeholder guidance and expertise. Deloitte has been contracted to undertake workforce modelling for 47 distinct health occupations, including physicians. This work is nearing completion and used a combination of stock-and-flow and utilization-based modelling.
	PEI	Both provincial and regional governments do some forecasting, and modelling estimates are used to help inform decision-making. Started with only physician forecasting models but have recently established data-driven supply-and-demand models for over 20 different health professions. Models were developed using qualitative and quantitative approaches, including clinical inputs, to contemplate both profession-specific and collaborative team-based care projections. The 2024 adjusted population needs-based model is now in the hands of an Implementation Committee, with a three-year plan to have “One island – one system.”

4.0 What Key Challenges and Opportunities Are Common Across the Modelling and Forecasting Ecosystem?

A review of modelling and forecasting activities in Canada highlighted common challenges faced by modelling teams. Likewise, several overlapping themes and emerging considerations were highlighted by those engaged in ongoing forecasting efforts. The following table provides a quick summary of challenges commonly reported by participants in the environmental scan. It is followed by a more detailed description of the current state in Canada.

Challenges

Health workforce supply-and-demand modelling has evolved in Canada over the last 10 years, with most provinces making meaningful advances. Many of the modelling teams are relatively small, with between three and seven members per modelling unit. The Canadian territories do not yet have health workforce forecasting models, but all have expressed the desire to develop them. While progress has been made, almost all modelling teams have signaled a consistent set of challenges (Figure 2). While these issues are common, the modelling network in Canada is not well connected, and teams currently lack the ability to work together to find solutions.

Table 2: Themes and Common Challenges

Theme	Categories and Descriptions
Data and Methodology	**Acquisition and sharing:** Inconsistent data sharing and acquisition across jurisdictions and sectors. Inconsistencies in data quality and availability vary between health provider types. In some instances, where high-quality, nationally representative health provider counts exist (e.g., the National Occupational Classification [NOC]), certain health provider categories are pooled and cannot be stratified. **Definitions and sources:** Lack of standardized definitions and sources complicates data integration. Concepts such as vacancy, overtime, variants of demand, FTE[8], attrition (both from the graduate pool and upon entry into the workforce by profession), education and upskilling, productivity, scope of practice and models of care, and measures of demand and unmet need were of common interest. Standardized definitions could facilitate the development of centralized national datasets where there is general agreement and will to normalize data collection and management (possibly on the topic of vacancies, for instance). This would improve timeliness of data reporting while enabling jurisdictions to get a sense of the situation in other provinces and territories. **Inadequate separation data**: Difficulty in tracking movement and separation (sick leave, maternity leave, retirement) within the workforce. **Modelling and forecasting approaches**: Diverse and uncoordinated approaches across jurisdictions; lack of a unified model. Coordination tables that include the Committee on Health Workforce and its sub-committees also drive better coordination and information sharing. Needs-based vs. utilization-based planning:[9] Insufficient focus on needs-based planning, often overshadowed by demand-based (utilization-based) approaches.

[8] Some provinces leverage CIHI's FTE methodology. Having a better understanding of why other FTE methodologies are in use could help determine what factors could limit universal adoption.

[9] In utilization-based approaches, "planners apply observed health care utilization rates in various population subgroups to projected population profiles to estimate future demand for health services, and corresponding workforce requirements." In needs-based approaches, "planners estimate workforce requirements to meet the unique needs of patients based on their demographic and epidemiological profiles, and an established level of service." Definitions taken from Simkin et al. (2024).

Theme	Categories and Descriptions
	Qualitative vs. quantitative data: An imbalance between quantitative metrics and qualitative assessments, with the latter receiving less attention. **Team-based care:** Challenges in establishing effective and "clinically appropriate" assumptions and indicators reflecting team-based care models; inconsistent definitions and applications. **Functional specialties:** Difficulty addressing and forecasting for functional specialties amongst physicians.
Operational and Functional Issues	**Workforce vacancies:** Growing number of job vacancies and inadequate responses to workforce shortages. **Role optimization:** Slow progress in optimizing roles within the health care workforce.
Strategy, Planning, and Policy	**Varied uptake**: Different levels of adoption and maturity in collaborative care models across provinces. **Evidence-based decision-making:** Differing use of modelling estimates in evidence-based decision-making governance approaches **Funding models:** Lack of a satisfactory and consistent funding model for collaborative care initiatives. **Collaboration across jurisdictions:** Limited sharing and coordination between provinces, territories, and other organizations. **Needs assessment:** Weak or non-existent needs assessments; reliance on insufficient proxies for unmet need. **Simulation models:** Simulation models offer promise but are underutilized and need further development. **Upfront costs vs. downstream savings:** Challenges in justifying upfront costs for anticipated long-term savings and quality improvements.
Subpopulations	**Equity-deserving populations:** Inadequate attention to modelling and forecasting for equity-deserving populations, including Indigenous communities. **Gender and age adjustments:** Insufficient adjustments for gender and age in workforce models. Includes the impact of an aging population.

Theme	Categories and Descriptions
	Remote and rural issues: Persistent problems in addressing rural and remote health care workforce needs.
Technological and Innovation Barriers	**Different levels of adoption:** Different levels of adoption of collaborative care models across provinces. **Access to advanced tools:** Limited access to advanced modelling and forecasting tools

Opportunities

Despite the range of challenges explored, many in the modelling community flagged opportunities to help improve modelling and forecasting across the country. The following opportunities emerged as solutions to help strengthen Canada's health workforce modelling for the future:

- Scenario planning using modelling could be used to help policymakers explore possible policy interventions (i.e., what-if scenarios) before policies are applied in the population.
- Collaborative and integrated team-based care is the centrepiece of the future delivery of care, and while existing profession-specific/-centric modelling can provide a strong foundation, novel forecasting techniques that can account for coordinated care should be explored.
- Population needs-based planning is a goal shared by many, but more work is needed to establish common approaches to defining and measuring "needs."
- Multiple data sources (particularly for regulatory, payment, and education data) will continue to contribute to modelling and forecasting. Work to evolve data sharing and the conditions that facilitate the utility of shared data sources should continue. For instance, efforts by CIHI (and CHWN) to define and advance a Health Human Resources Minimum Data Set (HHR MDS) data standard fulfills this ideal by providing a blueprint for alignment in concepts, values, and data collection practices across health care provider groups in Canada. Further, agreement amongst stakeholders on high-value and currently (un)available datasets should be tracked (e.g., inventoried) to prioritize data acquisitions. These activities should be coupled with centralized data collection and management, as well as data governance enabling shared access.
- The concept of developing a unique national identifier that is profession- and data source–agnostic to track a broad array of health care trainees and provider types across time and geography was identified as an aspirational goal whose achievement would provide unprecedented opportunities in HW modelling and planning.
- While governments will continue to create forecasting models to meet their own information needs, pan-Canadian modelling could be used to triangulate results, assess workforce planning across all of Canada, and serve as a common reference tool. Making such tools available is particularly relevant for HW planners with limited or no modelling resources of their own.

5.0 Where Should We Focus to Best Advance Health Workforce Modelling and Forecasting in the Country?

Evidence-based decision-making is recognized as critical for effective policy development for health care systems around the world. While many policymakers consider facts when making decisions, evidence-based decision-making is a deliberate process that considers multiple data inputs, both quantitative and qualitative, reviews historical trends, and invites discussions about future goals.

Health workforce supply-and-demand forecasting is critical to evidence-based decision-making for health workforce planning. Decision-makers benefit from modelling and forecasting tools by making the best use of the data available, with forecast estimates serving as guideposts for potential future goals for the health care system. While forecasted estimates are not the only input required to support decision-making (there being myriad other factors, such as political priorities and financial trade-offs), they are integral to early and purposeful decision-making and health system optimization.

Drawing from the results of this environmental scan and the challenges and opportunities identified, **Health Workforce Canada proposes three initial areas of collaborative action to catalyze capacity for health workforce planning, modelling, and implementation:**

1. Establish a Canadian **Technical Modelling Working Group (TMWG)** to create and reinforce connections within the modelling community.

   An active, engaged, and representative TMWG would serve as an aggregator for the modelling and forecasting community to identify and discuss common technical challenges, support improvements in data standardization and methodology, and to generally support knowledge exchange across the country. In particular, the TMWG would set a priority agenda based on the key modelling challenges, several of which are mentioned in this report, and would allow other topics to surface as needed. Priority themes could include, but are not limited to, data issues, methodological challenges, and subpopulation considerations identified in Table 2. Here are a few examples:

   a) Advancing team-based care modelling
   b) Standardizing (defining and operationalizing) key concepts such as unmet needs, vacancies, and functional specialties
   c) Identifying priority missing datasets, proxies, and indicators (e.g., regulatory, payment, education)
   d) Establishing best practices to guide work at the interface of forecasting, scenario planning, and decision-making/policy-setting

2. Continue to advance the **international collaboration agenda on health workforce modelling and forecasting** to support ongoing learning and knowledge sharing on the world stage.

   The health workforce crisis is not a challenge that Canada is facing alone. Many countries around the world are experiencing similar shortages, distribution challenges, and worker burnout; at the same time, they are faced with the growing needs of an aging population. These health workforce issues have been present for years, but they were exacerbated by COVID-19. Several countries have made significant advances in health workforce modelling and forecasting, in areas identified in this report.

   By establishing ongoing commitments to collaboration internationally, Canada's opportunities to continue to be a strong leader and learner in health workforce planning will be enhanced, and it will be more fully able to meet its commitments to self-sufficiency as part of the World Health Organization's Ethical Recruitment Framework.

3. **Collaborate with key partners to advance pan-Canadian modelling, forecasting, and scenario-based planning efforts.** While P/T governments will likely always create forecasting models to meet their own information needs, the development of novel and complementary pan-Canadian modelling, forecasting, and scenario-based planning tools could support the broader HW community (e.g., by providing a shared reference). To get there, two parallel tracks could be pursued through engagement with HW stakeholders:

   a) Understanding the range of relevant HW future-state scenarios: Engage stakeholders to gain a comprehensive understanding of the future populations and health workforce scenarios under consideration. These insights will inform the development of tools that align with decision-making needs both today and tomorrow, ensuring that our data ecosystem and the models that rely on it will have the necessary capabilities to address evolving challenges and opportunities surrounding the health workforce.
   b) Identifying priority HW analytical tools: Engage stakeholders to identify useful HW tools and rank them based on their value proposition for health workforce planning at both the national and regional (P/T) levels. These tools could range from relatively simple solutions to more complex methods that leverage microsimulation, machine-learning algorithms, AI, or other advanced techniques. These should aim to complement or go beyond existing supply-and-demand models—that is, to avoid duplicating what has already been built.

      The three areas of action proposed above would be led with support from and through continued collaboration with HWC's data partners, including Health Canada, the Committee on Health Workforce (CHW), CIHI, Statistics Canada, ESDC, FPT governments, and other key stakeholders.