An Integrated Primary Care Workforce Planning Toolkit at the Regional Level (Part 1): Qualitative Tools Compiled for Decision-makers in Toronto, Canada

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Research

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Abstract

Background: A regional health authority in Toronto, Canada identified health workforce planning as an essential input to the implementation of their comprehensive Primary Care Strategy. The goal of this project was to develop an evidence-informed toolkit for integrated, multi-professional, needs-based primary care workforce planning for the region. This article presents the qualitative workforce planning processes included in the toolkit.

Methods: To inform the workforce planning process, we undertook a targeted review of the health workforce planning literature and an assessment of existing planning models. We assessed models based on their alignment with the core needs and key challenges of the health authority: multi-professional, population needs-based, accommodating short-term planning horizons and multiple planning scales, and addressing key challenges including population mobility and changing provider practice patterns. We also assessed the strength of evidence surrounding the models' performance and acceptability.

Results: We developed a fit-for-purpose health workforce planning toolkit, integrating elements from existing models and embedding key features that address the region's specific planning needs and objectives. The toolkit outlines qualitative workforce planning processes, including scenario generation tools that provide opportunities for patient and provider engagement. Tools include PESTLE Analysis, SWOT Analysis, an adaptation of Porter's Five Forces Framework, and Causal Loop Diagrams. These planning processes enable the selection of policy interventions that are robust to uncertainty and that are appropriate and acceptable at the regional level.

Conclusions: The qualitative components informing health workforce planning process are an often overlooked but essential part of an evidence-informed toolkit to support integrated, multi-professional, needs-based primary care workforce planning.

State of Knowledge

State of Knowledge

Because a fit-for-purpose workforce is contextually determined (Campbell et al., 2013), health workforce planning (HWP) must adapt the use of data, methodological approaches, interpretations, and recommendations to the realities and goals of the local system. Mixed methods approaches to HWP mobilize the strengths of both qualitative and quantitative approaches to provide decision-makers with practical recommendations, and to enable corresponding evidence-based action within the health system. Mixed methods approaches: 1) address data and methodological limitations associated with the independent use of either quantitative or qualitative methods; 2) account for the uncertainty that is inherent in health systems; 3) promote engagement with local stakeholders; and 4) foster a planning culture where policy levers are more readily deployed (Martineau & Caffrey, 2008). Planners can then leverage this culture to promote iterative planning with incremental refinement of estimates and course corrections rather than drastic and costly reforms to address a future that may never come to pass.

Inaccuracy and unreliability in health workforce projections often stem from planning exercises that simply project forward the status quo and fail to account for uncertainty and change in population health needs, workforce trends, or the environment within which they interact (Gorman, 2015). In order to account for uncertainty, planners should supplement data modelling and traditional quantitative forecasting with workforce intelligence and qualitative analyses in order to anticipate, and plan for, a system's potential evolution over time (Gorman, 2015; Kinsella & Kiersey, 2016).

Scenario analyses, which contemplate a series of "what if" statements, are increasingly deployed to plan for uncertainty in complex adaptive health systems, assess policy alternatives, and test modelling assumptions. These analyses provide policy-makers with the ability to synthetically 'shock' the system in order to define optimal solutions in the pursuit of system objectives. Scenario analyses also provide an ideal opportunity to explore a range of possible future scenarios that are grounded not only in data but also intelligence informed by the experiences of patients, workers, and planners who are directly engaged with the system at hand, increasing the robustness of HWP exercises.

Stakeholder engagement throughout the workforce planning process can improve the acceptability of planned models of care, encourage buy-in, and facilitate resource mobilization and the implementation of plans (Dal Poz et al., 2010). Health systems are complex, adaptive, and human. Within these systems, workers, employers and system managers are active agents with considerable vested interest in the results of health workforce plans but these aren’t always aligned with one another. Planners can deploy qualitative methods that engage key stakeholders in the design, implementation, and interpretation of HWP models to enhance the political, social, and operational feasibility of workforce plans (Jansen et al., 2014; Fraher, Knapton, & Holmes, 2017; Tomblin Murphy et al., 2016).

Health Workforce Planning at the Regional Level: The Case of the Toronto Central Local Health Integration Network

Within the Canadian context, the organization, administration, and delivery of healthcare services falls under provincial jurisdiction. In the province of Ontario, until a health system transformation was initiated in 2019, 14 regional health authorities, called Local Health Integration Networks (LHINs) were responsible for coordinating, integrating, and funding health services at a local level. The Toronto Central Local Health Integration Network (TC LHIN) administered health care services for the 1.15 million individuals living in the core of Toronto, Canada's largest city. The TC LHIN encompassed a highly urbanized metropolitan area that bordered four other LHINs. Many non-residents who worked in central Toronto or traveled to access specialized services, also utilized the primary care services available within the TC LHIN.
Rapidly changing demographics and disparities in access to integrated primary care between sub-regions within the TC LHIN underlined the need for a more robust local-level planning process. Accordingly, the TC LHIN developed, with provider input, a comprehensive Primary Care Strategy which aimed to improve patient access to care, service integration, and system efficiency. The TC LHIN identified HWP as an essential input to the implementation of this Strategy and to improving access to primary care by adequately planning for current and future population health needs in the TC LHIN.

Accordingly, the TC LHIN contracted our team at the Canadian Health Workforce Network (CHWN) to develop an evidence-informed HWP toolkit. In support of this objective, we conducted a targeted review of existing methods and models in HWP to leverage leading practices in the development of a workforce planning toolkit that acknowledged and addressed key challenges in workforce planning and was tailored to local planning needs. For an overview of our collaborative approach to toolkit development, please refer to [Bourgeault, Chamberland-Rowe & Simkin, SUBMITTED COMMENTARY].

**Methods**

We undertook a targeted review of health workforce planning literature and an assessment of existing planning models. We assessed models based on their alignment with a list of guiding principles that outlined the core needs and key challenges faced by the TC LHIN. We also assessed the strength of evidence surrounding the models’ performance and acceptability. This review was complemented by a parallel scan of available quantitative datasets to inform the development of a quantitative model [Simkin, Chamberland-Rowe & Bourgeault, SUBMITTED PART 2 PAPER]. Based on the results of these two exercises, we developed a fit-for-purpose planning toolkit, including qualitative HWP processes and a quantitative HWP model, for integrated, multi-professional, need-based primary care workforce planning.

**Identification of Models for Assessment**

Our targeted search strategy was designed to identify models for assessment and involved a total of twelve specific searches to allow for a comprehensive review of HWP approaches as they relate to the parameters set forth by our regional partners (see Additional Document 1). We implemented all search strategies in PubMed, Web of Science, and SCOPUS. We exported the resulting citations to EndNote X8. We confined the search to articles published between 1997 and 2017, in English and French. In the event that searches rendered a high volume of citations, we reviewed the first 500 citations, filtered by relevance or “best match”. As is depicted in the Fig. 1, the twelve search strategies rendered 2461 unique citations in PubMed, 1095 unique citations in SCOPUS, and 757 unique citations in Web of Science. Following the removal of duplicates, we proceeded with a title screening of 3852 citations. Following the initial title screening, we deemed that 640 citations were eligible for abstract screening. After abstract review, 118 citations met inclusion criteria. We included articles if they presented a model for HWP that accounted for alignment between supply of and demand for health human resources, regardless of how these components were defined.

To supplement our search of academic literature, we conducted a search of grey literature on HWP. This search was particularly important given the role of public sector and multilateral organizations in HWP. We also consulted the bibliographies of existing reviews of HWP models to ensure that all relevant sources were included in our review. Our search strategy and inclusion criteria reflected an explicit focus on Canadian content, while acknowledging the opportunity to learn from leading practices in both high-income and low- and middle-income countries internationally.

**Model Assessment**

In order to develop a ‘fit-for-purpose’ HWP toolkit for our regional partners, we used a list of guiding principles to help assess fit, based on the capacity of models to:

1. project demand as a function of population need rather than simple service utilization;
2. project alignment at the neighbourhood, sub-region, whole-LHIN, and supra-LHIN (Greater Toronto Area) levels;
3. support multi-professional or service-based, rather than uni-professional, planning, given the TC LHIN’s focus on integrated primary care;
4. provide accurate projections for short planning horizons, in light of the TC LHIN 1–5 year planning cycles;
5. support scenario analyses to assess the impact of changing population and provider profiles, policy interventions and modeling assumptions;
6. engage primary care workers in the co-design of health workforce plans, in line with the TC LHIN’s efforts to empower and engage the primary care workforce and stakeholders in the planning process; and
7. account for key challenges in the TC LHIN, such as changing provider practice patterns and population mobility.

In their review of Health Workforce projection models deployed in OECD countries, Ono et al. (2013) stated that models should be evaluated based on the process of model development, which encompasses the model’s underlying conceptual framework and variables, the performance and predictive accuracy of the model, and the acceptability and impact of the model. These criteria also informed our assessment of HWP models.

We created a literature extraction tool in Excel to capture information relevant to our assessment. The tool included a row for each of the identified models, enabling the comparison of their potential contribution to HWP in the TC LHIN based on a defined list of content areas (columns). These content areas included:

- the conceptual framework employed (if any);
- the methods, variables, and data requirements for both the supply and demand components of the model;
• the model’s alignment with the key features guiding our assessment (short planning horizon, small-area planning, multi-professional planning, scenario analysis, provider engagement, practice patterns, and population mobility);
• the evidence surrounding the model’s performance and acceptability; and
• our evaluation of the strengths, weaknesses, and unique features of the model in question.

Based on the comparative analysis of the information captured in this literature extraction tool, we identified a short-list of models that were used to inform specific components of a fit-for-purpose HWP model for primary care within the TC LHIN.

Results

Tables 1-3 present a synthesis of the models shortlisted to inform our health workforce planning process (Table 1), our service requirement and capacity projections, and our allocation of service requirements across cadres (Table 3), respectively. These synthesis tables also describe the shortlisted models’ alignment with the needs of the TC LHIN.

Based on the findings of our model assessment, we developed a hybrid HWP toolkit for primary care services. Because no single model identified through our search strategy fully accommodated the TC LHIN’s needs, we integrated key features from a number of existing approaches to develop a fit-for-purpose HWP process that aligns with the specific planning needs and objectives of the TC LHIN.

The overarching HWP process that we recommended to the TC LHIN combines promising elements from three distinct HWP frameworks. England’s Robust Workforce Planning Framework (Centre for Workforce Intelligence, 2014) informed the recommended process for health workforce planning and scenario development. Australia’s Health Workforce Planning Tool (Health Workforce Australia, 2014) informed the recommended process for stakeholder and workforce engagement. Finally, our recommended workforce planning process integrates a number of environmental scanning tools presented by New Zealand’s Workforce Intelligence and Planning Framework (National DHB General Managers Human Resources & Health Workforce New Zealand, 2014).

These promising practices in HWP nest quantitative HWP models within broader health workforce and health system planning processes that are both iterative and interactive in nature. The toolkit we proposed (depicted in Figure 2) outlines a qualitative workforce planning process that provides opportunities for primary care workforce, stakeholder, and patient engagement and facilitates the evaluation and selection of policy interventions that are robust to uncertainty across a range of possible futures.

Horizon Scanning

The cyclical workforce planning process presented in England’s Robust Workforce Planning Framework (CfWI, 2014) begins with a horizon scanning exercise to map the driving forces present within the system. Within the context of the TC LHIN, we have recommended that an internal planning group engage in a one-day horizon scanning workshop using the environmental scanning tools presented by Health Workforce New Zealand (National DHB General Managers Human Resources & Health Workforce New Zealand, 2014) to identify driving forces that could influence workforce and population health trends over the defined planning period.

Planners can use PESTLE analyses (political, economic, sociological, technological, legal, and environmental) and SWOT analyses (strengths, weaknesses, opportunities and threats) to engage in the identification of factors that can affect the ability of a system to achieve optimal or appropriate alignment between service requirements (population health needs) and service capacity (workforce supply).

First, planners can use PESTLE analysis to identify macro-level contextual factors that merit consideration in the HWP process due to their potential impact on the health workforce or on population health and demography within a particular region. As a means of enriching discussions surrounding these six categories of factors, we encourage planners to refer to a systems framework for HWP, and we employed an example specific to the Canadian context (Bourgeault, Demers, & Bray, 2015). This framework, and its applications in this exercise, are more fully described in [Bourgeault, Chamberland-Rowe & Simkin, SUBMITTED COMMENTARY]. By consulting such a framework, planners can ensure that their discussions account for the complex network of system-level inputs and policy levers that must be mobilized in order to allow for population health needs to serve as the drivers of health workforce planning and deployment.

Second, SWOT analyses allow planners to categorize external (contextual) and internal (organizational) factors as either favourable or unfavourable to the desired system outcome (e.g., a balance of population health needs and health workforce supply and capacity), and to the ability of planners to achieve this outcome through targeted planning and intervention. As an initial step for SWOT analysis, planners can categorize the contextual factors identified through the PESTLE Analysis as either opportunities or threats. Planners can then identify internal organizational factors that should be considered in the workforce planning process and categorize them as either strengths or weaknesses.

These analytical tools allow planners to account for their sphere of influence and the policy levers at their disposal to control the factors identified. Internal factors are within the planners’ sphere of influence, and so these factors are more readily reinforced or remedied, whereas planners must develop strategies to leverage external opportunities and mitigate external threats that are beyond their sphere of influence. We have recommended that planners synthesize the outputs of this horizon scanning workshop into a brief report that can serve to frame a broader consultative process.
Planners can use environmental scanning tools in the horizon scanning phase of workforce planning to explore the breadth of factors that interact within the health region as a complex adaptive system. In subsequent stages of scenario generation and policy analysis, planners can use these same tools to delve deeper into particular issues of concern in the delivery of primary care within the region. Furthermore, all of the included environmental scanning tools can be used for both internal brainstorming and external consultation and engagement throughout the HWP process.

**Scenario Generation**

Scenario generation allows planners to elicit, develop, and focus on HWP scenarios that are relevant to their communities. The scenario generation process is also critically important to inform the ultimate data requirements for quantitative modelling. We recommended that planners conduct scenario generation workshops at the sub-region level as well as at the full-LHIN regional level, ensuring that both local and region-wide workforce issues can be addressed. These one-day workshops are designed to bring together a broad range of stakeholders to augment the list of factors generated by the horizon scanning exercise, and develop narrative scenarios shaped by the uncertainties that may influence the future state of the system (CFWI, 2014).

Stakeholder consultation promotes the modelling process and reinforces the relevance of its outputs (Kinsella & Kiersey, 2016). Furthermore, stakeholder engagement can foster buy-in and facilitate the acceptance of projections as a trusted evidence-base for policy action (Crettenden et al., 2014). To supplement the work conducted internally by the TC LHIN and infuse the scenario generation process with local workforce intelligence, we have recommended that planners invite clinical leads from each concerned primary care cadre, patient advisors, and other relevant experts to participate in scenario generation workshops.

During these workshops, participants develop narrative scenarios that describe a reference future, which is considered to be the most probable and reasonable baseline future given current trends, as well as alternative futures that reflect the potential effects of the driving forces identified during the horizon scanning workshop. In addition to the environmental scanning tools described in the previous section, planners can use causal loop diagrams during scenario generation workshops to map the complex web of interactions between factors and system components. Once the causal loop diagram has been drawn, participants are asked to elaborate on a series of narrative scenarios that describe its interactions, and their potential impact on service requirements and capacity. Causal loop diagrams can assist workshop participants in gaining a more holistic understanding of the challenge, allow them to elaborate consistent and valid narrative scenarios, and enable them to identify the quantitative variables that require manipulation to simulate this scenario using the HWP model.

The toolkit then bridges qualitative and quantitative approaches by employing the elicitation methods described by England's Centre for Workforce Intelligence (2015) - including traditional Delphi Processes, the EFSA Delphi approach, and the Sheffield Elicitation Framework - to gain expert consensus on the estimated quantitative input parameters of narrative scenarios. These inputs reflect the potential influence of these driving forces on service requirements and capacity. We recommended that the TC LHIN host an elicitation workshop to define the parameters of the reference future using the Sheffield elicitation framework, and that the parameters for alternative scenarios be elicited remotely using the EFSA Delphi Approach. Both of these approaches allow planners to define probability distributions for each elicited parameter, including upper and lower bounds of the plausible range of values, a median value, and upper and lower quartiles.

**Workforce Modelling**

Embedded within the proposed HWP process is a quantitative HWP model. This model begins with the development of population health and workforce profiles that inform service requirement and service capacity projections, respectively. Planners then conduct an initial assessment of alignment between service capacity and service requirements which is supplemented by a descriptive allocation process designed to explore workforce capacity to meet population health needs under alternative models of care (optimizing the distribution of service requirements across the full spectrum of cadres contributing to integrated primary care).

Three models informed our initial assessment of alignment between service capacity and service requirements in the TC LHIN: the Canadian Institutes for Health Information Population Grouping Methodology (CIHI, 2017), the Needs-Based Health Human Resource Planning Framework (Birch et al., 2007), and Manitoba's Needs-Based Planning for Generalist Physicians (Roos et al., 1997). The descriptive allocation process outlined in the toolkit is inspired by adjusted service target-based planning approaches (Dreesch et al., 2005; Guerra Arias et al., 2017; ten Hoope Bender et al. 2017; Jansen et al., 2014). Simkin et al. (SUBMITTED PART 2 PAPER) present the development and output of the quantitative service requirement and capacity projection models included in this toolkit.

The quantitative scenario parameters identified through the elicitation processes can be used as inputs for the modelling stage. The HWP model should be run using the reference future scenario, as well as all scenarios defined in the previous step of the workforce planning process. Planners can introduce scenarios to assess the impact of alternative population health and workforce profiles, and of alternative allocations of services across cadres with relevant scopes of practice.

**Policy Analysis**

Finally, planners can hold structured workshops to explore potential policy interventions that could be conducive to remedying any misalignments highlighted by the model's gap analysis.
We have recommended that the TC LHIN invite the expert participants who were engaged in scenario generation, and a broader range of primary care workers and patients to participate in these discussions.

Planners can develop the narrative description and quantitative input parameters for identified policy scenarios using the tools prescribed for scenario generation. The influence of potential policy interventions can then be measured against all identified scenarios, which represent a number of potential futures. Policies are therefore considered "robust" to uncertainty if they produce favourable workforce outcomes against a high proportion of potential futures (CFWI, 2014).

As an additional layer of robustness, Porter's Five Forces Framework can be used to identify key forces with the potential to influence the implementation of proposed workforce policies and interventions. Planners are encouraged to assess whether the implementation of an intervention could be influenced by the bargaining power of suppliers and buyers, or pose a threat to the existing workforce through the introduction of new entrants or substitutes. This framework is particularly amenable to the identification of dynamic interactions between actors and interests within health systems that could influence the implementation of proposed workforce policies and interventions. These considerations are salient given the social and political context within which HWP occurs. In developing scenarios, and interpreting health workforce projections, planners must take into account the whole picture, acknowledging that political and social contexts can influence the levers at their disposal and their capacity to act upon the evidence generated by these models in order to achieve desired outcomes.

Discussion

Strengths & contribution within the context of existing research

This workforce planning toolkit pulls from extant evidence to provide planners with a fit-for-purpose approach that in this instance is tailored to the primary care planning needs of a regional health authority, but with a number of features that are transferrable to other settings. By acknowledging and leveraging the strengths of both qualitative and quantitative approaches to workforce planning, this toolkit presents health workforce policy decision-makers with the most comprehensive and rigorous approaches to HWP. The toolkit is designed to inform evidence-based decision-making, allowing policy-makers to account for uncertainty and the potential impact of interventions across a range of possible futures. Furthermore, the toolkit describes an iterative and interactive workforce planning process designed to engage key stakeholders in the elaboration and validation of scenarios, embed a planning culture into the local health system, and facilitate stakeholder buy-in and mobilization of available policy levers.

Limitations

HWP models, and particularly qualitative planning tools, do not produce conclusive predictions. Planners should treat workforce projections as an estimate of alignment between service requirements and capacity in the event that all assumptions outlined in a given scenario are fulfilled.

Changing political landscapes can impede the operationalization of health workforce planning processes, and the scale-up of these resource-intensive innovations. In the Ontario context, since the development of the toolkit, a new provincial government has taken office and is undertaking system-wide reforms. At the time of publication, a proposal to dissolve the LHINs and centralize the funding, planning, and integration of health services has been implemented. Despite these transformations, the TC LHIN, in partnership with the City of Toronto (the municipal level governing body), has chosen to proceed with a first cycle of HWP, which is currently underway.

Finally, this toolkit was designed for and tailored to the needs of a metropolitan regional health authority. As a result, adaptation would be required to allow for full transferability to other regional jurisdictions. While the principles and processes we have recommended for health workforce planning are highly relevant across jurisdictions both domestically and internationally, the technical assumptions integrated into the quantitative model are context-dependent and would require revision to reflect the unique stocks, flows, and policy levers present within different systems.

Conclusions

By integrating a targeted review of HWP literature into the toolkit development process, we sought to highlight and address key health workforce planning challenges for a regional health authority. This toolkit presents a regional planning process that mobilizes available tools to allow for integrated, multi-professional, needs-based primary care workforce planning. Furthermore, the prescribed process enables engagement with patients, stakeholders, workers, and planners who are active within the system in the generation of locally-relevant scenarios and solutions. Qualitative components informing health workforce planning process are an often overlooked but essential part of an evidence-informed toolkit to support integrated, multi-professional, needs-based primary care workforce planning.

List Of Abbreviations

CHWN: Canadian Health Workforce Network

HWP: Health Workforce Planning

TC LHIN: Toronto Central Local Health Integration Network
Declarations

Ethics approval and consent to participate: Not applicable.

Consent for publication: Not applicable.

Availability of data and material: Data sharing is not applicable to this article as no datasets were generated or analysed.

Competing interests: The authors declare that they have no competing interests.

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Authors’ contributions: CCR conducted the assessment of existing HWP models. CCR developed the prescribed HWP process and the descriptive allocation process. SS identified and assessed available datasets. SS developed the quantitative HWP model. IB supervised the development of all presented tools. IB, CCR, and SS prepared the manuscript. All authors read and approved the final manuscript.

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| Models Identified | Capacity for Needs-Based Projections of Service Requirement | Capacity for Local-Level Planning | Capacity to Accommodate Short Planning Horizons | Capacity for Multi-professional Planning | Capacity to conduct Scenario Analyses | Capacity to Engage the Workforce | Capacity to Account for Changing Practice Patterns | Capacity to Account for Population Mobility |
|-------------------|------------------------------------------------------------|----------------------------------|-----------------------------------------------|-----------------------------------------|-------------------------------------|--------------------------------------|-----------------------------------------------|---------------------------------------------|
| England's Robust Workforce Planning Framework (CfWI, 2014) | Uses Birch et al. (2007) Needs-Based Health Human Resource Planning Framework to project service requirements | Scale defined in horizon scanning process | 30-year planning horizon in 5-year increments | Uses scenarios to account for uncertainty that is inherent to health systems and uses sensitivity analysis to test impact of data variations | Elicitation of expert opinion to define sources of uncertainty, generate narrative scenarios, quantify scenario parameters, and assess the impact of policies | Not Addressed |
| New Zealand's Workforce Intelligence and Planning Framework (National DHB General Managers Human Resources & Health Workforce New Zealand, 2014) | Integrates demographics and demand by first conducting a health needs assessment, followed by defining appropriate model of care | Can be used to inform local, regional or national-level planning | 2-3 year planning horizons feed into 5-15 year plans | Amenable to multi-professional planning | Capacity for scenario analysis | Clinician and expert engagement in the environmental scanning process | Accounts for internal flows between geographic locales, institutions, sectors, and specialties | Not Addressed |
| Australia's Health Workforce Planning Tool (Health Workforce Australia, 2014) | Utilization-Based Projections | Defines a common national approach to prioritize coherence and consistency at the national level | Plans through 2025 | Conducts separate exercises for doctors, nurses, and midwives using the same modelling methodology | Allows for scenario analysis to assess the impact of policy options and conduct sensitivity analysis | Consults with expert reference groups, workforce participants, clinical leads throughout the planning process | Attributes exit rates to each 5-year age and gender cohort | Not Addressed |
### TABLE 2: SERVICE REQUIREMENT AND CAPACITY PROJECTIONS

| Models Identified                                      | Capacity for Needs-Based Projections of Service Requirement | Capacity for Local-Level Planning | Capacity to Accommodate Short Planning Horizons | Capacity for Multi-professional Planning | Capacity to conduct Scenario Analyses | Capacity to Engage the Workforce | Capacity to Account for Changing Practice Patterns | Capacity to Account for Population Mobility |
|-------------------------------------------------------|-------------------------------------------------------------|-----------------------------------|-----------------------------------------------|------------------------------------------|--------------------------------------|-----------------------------------|------------------------------------------------------------------|---------------------------------------------|
| **Canadian Institutes for Health Information Population Grouping Methodology (CIHI, 2017)** | Service requirements predicted as a function of demographic and clinical profiles of individual patients | Data outputs are at the level of the individual, and can be aggregated to a variety of planning levels/regions | Single year projection that can be run as a time series to project further | Projects service requirements for primary care physician visits | Not addressed | Not addressed | Not Addressed | Not Addressed |
| **Needs-Based Health Human Resource Planning Framework (Birch et al., 2007)** | Projects need as a function of a population's demographic and epidemiological profile, a determined level of service, and a productivity function | Has been applied at provincial and national levels, but authors claim that it can be applied to any jurisdiction | Yearly projections over a determined period | Can produce separate estimates for any provider group | Allows for scenario analysis of policy options, as well as sensitivity analysis | Not Addressed | Incorporates activity and participation rates that can vary over time for each and sex cohort | Not Addressed |
| **Service and Competency-Based Health Workforce Planning (Tomblin Murphy et al., 2013)** | Projects need as a function of a population's demographic and epidemiological profile, a determined level of service, and a productivity function | Used at the regional level | Describes current alignment | Accounts for all professions involved in the provision of identified competencies and/or services | Uses scenarios to assess gaps based on differing rates of prevalence | Workshops to validate competency list, identify relevant scopes of practice, and determine proportion of patients requiring each competency | Incorporates activity and participation rates | Not Addressed |
| **Manitoba’s Needs-Based Planning for Generalist Physicians (Roos et al., 1997)** | Compares actual utilization rates with number of visits needed, which is projected as a function of age, sex, health-related indicators, and socioeconomic characteristics | Data collected for 54 service areas and aggregated into 4 regions | Describes current alignment | Output is an aggregate of required physician visits, which encompasses General Practitioners, General Internist, and General Pediatrician, | Not Addressed | Not Addressed | Accounts for variation in average visit workload across regions | Produces an estimate of visit requirements generated by residents and non-residents who access care within a region while accounting for the proportion of care that each of these populations seek elsewhere | Not Addressed |
| Models Identified | Capacity for Needs-Based Projections of Service Requirement | Capacity for Local-Level Planning | Capacity to Accommodate Short Planning Horizons | Capacity for Multi-professional Planning | Capacity to conduct Scenario Analyses | Capacity to Engage the Workforce | Capacity to Account for Changing Practice Patterns | Capacity to Account for Population Mobility |
|------------------|----------------------------------------------------------|---------------------------------|-----------------------------------------------|------------------------------------------|------------------------------------|----------------------------------|-------------------------------------------|---------------------------------------------|
| Adjusted Service Target-Based Planning (Dreesch et al., 2005) | Identifies the need for services based on the incidence and prevalence of health problems, demographic characteristics of the population, and service targets | Can be conducted at all levels | Can describe current alignment or use population projections to project future service requirements | Designed for multi-professional planning, projects for all professions with relevant scopes of practice that are involved in the provision of the targeted package of services | Can be run using a baseline “status quo” scenario and alternative scenarios to assess the potential impact of labor market interventions | Engagement with workers and experts to develop the planning methodology, define time allocated to each task, and to account for contextual factors in the process of allocation | Addresses overlap between scopes of practice and can account for proportion of time dedicated to non-clinical and alternative clinical activities | Not Addressed |
| Plasticity Matrices (Holmes et al., 2013) | Utilization-Based | Can be conducted at multiple geographic levels (including local) | Can describe current alignment or produce prospective estimates | Designed for multi-specialty physician planning and can be applied for multi-professional planning, uses the concepts of within specialty, and between specialty plasticity | Projects under a variety of scenarios and incorporates visualization features to assess impact of policy scenarios | Clinical advisory board and technical experts provide input throughout model development | Concept of plasticity predicates that individual physicians within the same specialty may provide different scopes of service, while the scope of service of physicians in different specialties may overlap | Not Addressed |
| Linear Programming (Gallagher, Lim & Harper, 2013) | Combines oral health needs and utilization | Conducted in one regional health authority that comprises 5 subregional authorities; projections of need are produced at the level of the subregion and amalgamated to the regional level | Produces 5-year projection, but can be used descriptively | Use of linear programming to explore optimization of skill mix between dentists, dental nurses, dental therapists, and dental hygienists | Explores future scenarios for the use of skills within a dental team to inform dental therapy training | Consults an expert steering committee to define scenarios and assess the maximum proportion of care that could be undertaken by dental therapists rather than dentists | Incorporates the prevalence of part-time work in the dental therapist workforce into scenarios | Not Addressed |

**Figures**
Figure 1

Search Strategy Flow Chart

Figure 2

Cyclical Health Workforce Planning Process