Rapid Synthesis

Exploring Models for Health Workforce Planning

16 July 2019

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Rapid Synthesis:
Exploring Models for Health Workforce Planning
30-day response

16 July 2019

McMaster Health Forum

The McMaster Health Forum's goal is to generate action on the pressing health-system issues of our time, based on the best available research evidence and systematically elicited citizen values and stakeholder insights. We aim to strengthen health systems – locally, nationally, and internationally – and get the right programs, services and drugs to the people who need them.

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Timeline

Rapid syntheses can be requested in a three-, 10-, 30-, 60- or 90-business-day timeframe. This synthesis was prepared over a 30-business-day timeframe. An overview of what can be provided and what cannot be provided in each of the different timelines is provided on McMaster Health Forum's Rapid Response program webpage (www.mcmasterforum.org/find-evidence/rapid-response).

Funding

The rapid-response program through which this synthesis was prepared is funded by the British Columbia Ministry of Health The McMaster Health Forum receives both financial and in-kind support from McMaster University. The views expressed in the rapid synthesis are the views of the authors and should not be taken to represent the views of the Ministry of Health or McMaster University.

Conflict of interest

The authors declare that they have no professional or commercial interests relevant to the rapid synthesis. The funder played no role in the identification, selection, assessment, synthesis or presentation of the research evidence profiled in the rapid synthesis.

Merit review

The rapid synthesis was reviewed by a small number of policymakers, stakeholders and researchers in order to ensure its scientific rigour and system relevance.

Acknowledgments

The authors wish to thank Sabrina Lin for assistance with identifying, reviewing and synthesizing literature. We are especially grateful to Stephanie Akers and to an anonymous merit reviewer for their insightful comments and suggestions.

Citation

Waddell K, Wilson MG. Rapid synthesis: Exploring models for health workforce planning. Hamilton: McMaster Health Forum, 16 July 2019.

Product registration numbers

ISSN 2292-7999 (online)

KEY MESSAGES

Questions

- How are health human resource models being used to plan for the health workforce across comparator jurisdictions in Canada and internationally for the next five to 10 years?
- What processes and characteristics are key to establishing successful predictive models?

Why the issue is important

- Ensuring that the right mix of health workers are equipped with the right skills is essential to providing high-quality care when and where people need it.
- However, planning for and managing health human resources requires consideration of the effects of a complex array of factors.
- To overcome these challenges, jurisdictions have increasingly complemented traditional stock-flow models with forecasting and foresight techniques to understand how workforce futures are affected by uncertainty (e.g., introduction of policy reforms, new models of care, changes in labour markets).
- This rapid synthesis examines the health workforce planning models in place across select Canadian provinces and comparator jurisdictions to determine what models, processes and characteristics are important to establishing successful predictive models.

What we found

- We identified three systematic reviews and nine primary studies that related to the questions and complemented these findings with insights from interviews with 11 key informants.
- The literature focused largely on documenting different models for health human resource planning, with a particular focus on supplementing traditional stock-flow estimates with a demand component based on population health needs.
- Variables included in population-health-needs models: demography; epidemiology (e.g., average level and type of sickness in the population); level of service (e.g., planned and historical use of services to respond to the population's health profile); and productivity (e.g., the quantity of service requirements each provider involved in service production must meet).
- One primary study evaluated the use of the health workforce model for general practitioners in the Netherlands and found it to be successful at stabilizing what was previously a volatile labour market.
- Key informants revealed that most systems use a stock-flow model to simulate supply for health workforce, which are often used to predict five to 10 years in the future, but may be regularly updated to ensure they continue to reflect an accurate health-system context.
- Stock-flow models are calculated for each profession and are frequently included as part of broader simulation modelling for demand and supply, including variables to model demand for services (e.g., changes to population demographics, population health status and type of services needed).
- While simulations including variables that account for a range of contextual factors such as changes to scope of practice, models of care, technology or the broader economy may be considered comprehensive, one key informant highlighted that when it comes to simulations, there is an important trade-off between the comprehensiveness of variables included and the accuracy of the estimate.
- In addition to running simulations, many jurisdictions reported undertaking additional activities that inform health workforce planning, including service reviews and horizon scanning.
- Most key informants identified limitations in data available for use in health workforce planning models stressing that the more complex the variable, the more difficult it was to determine exactly what data could be used as a proxy.
- However, key informants identified that these data challenges can be overcome by engaging with professionals to determine whether the estimates produced are reflective of clinical realities.

QUESTIONS

1. How are health human resource models being used to plan for the health workforce across comparator jurisdictions in Canada and internationally for the next five to 10 years?
2. What processes and characteristics are key to establishing successful predictive models?

WHY THE ISSUE IS IMPORTANT

The health of British Columbians has continued to improve over the past decade, with gains in health-adjusted life expectancy and a gradual decrease in the gap between the life expectancy of women and men.(1) These gains in health status have come, in part, as a result of provincial efforts to strengthen health systems and ensure that programs, services and technologies get to those who need them. Essential to these efforts is ensuring that the right mix of health workers are equipped with the right skills to provide British Columbians with high-quality care when and where they need it.

However, planning for and managing health human resources requires consideration of the effects of a complex array of factors. There is no single way to allocate health human resources, as many different combinations of providers can deliver needed services. However, using different combinations of providers may require trade-offs between accessibility, efficiency and effectiveness.

Planning for the future of the health workforce in a given jurisdiction is further complicated by the time period in which it takes place. Adjusting labour markets requires the ability to foresee and act on long-term trends. While there are some short-term adjustments that can be made (e.g., to financial arrangements to incentivize changes in provider behaviour), significant adjustments to the quantity of professionals requires five to 10 years of foresight (depending on the category of provider) before the change is realized in the health system.

To overcome these challenges, jurisdictions have developed models to predict the future supply of health professionals by taking into account the average number of professionals entering and in exiting practice. However, in many cases decision-makers have determined that these considerations alone are insufficient as the basis for long-term decisions. As a response, jurisdictions have complemented these models with additional variables and forecasting and foresight techniques to understand how workforce futures are affected by uncertainty (e.g., introduction of policy reforms, new models of care and changes in labour markets).

Box 1: Background to the rapid synthesis

This rapid synthesis mobilizes both global and local research evidence about a question submitted to the McMaster Health Forum's Rapid Response program. Whenever possible, the rapid synthesis summarizes research evidence drawn from systematic reviews of the research literature and occasionally from single research studies. A systematic review is a summary of studies addressing a clearly formulated question that uses systematic and explicit methods to identify, select and appraise research studies, and to synthesize data from the included studies. The rapid synthesis does not contain recommendations, which would have required the authors to make judgments based on their personal values and preferences.

Rapid syntheses can be requested in a three-, 10-, 30-, 60- or 90-business-day timeframe. An overview of what can be provided and what cannot be provided in each of these timelines is provided on the McMaster Health Forum's Rapid Response program webpage (www.mcmasterforum.org/find-evidence/rapid-response).

This rapid synthesis was prepared over a 30-business-day timeframe and involved five steps:

1) submission of a question from a policymaker or stakeholder (in this case, the Ministry of Health in British Columbia);
2) identifying, selecting, appraising and synthesizing relevant research evidence about the question;
3) conducting key informant interviews;
4) drafting the rapid synthesis in such a way as to present concisely and in accessible language the research evidence; and
5) finalizing the rapid synthesis based on the input of at least two merit reviewers.

This rapid synthesis was requested by the British Columbia Ministry of Health to examine the health workforce planning models in place across select Canadian provinces and comparator jurisdictions in efforts to determine what models, processes and characteristics are key to establishing successful predictive models.

Box 2: Identification, selection and synthesis of research evidence

We identified research evidence (systematic reviews and primary studies) by searching (in April 2019) Health Systems Evidence (www.healthsystemsevidence.org) and PubMed. In Health Systems Evidence, we used the key words ("health human resource" OR "health workforce") AND (planning OR scenario OR model), along with document type filters for systematic reviews of effects and systematic reviews addressing other questions. In PubMed, we used the key words "health human resource planning" OR "health workforce planning" OR (health workforce AND scenario) along with date filters for the last 10 years.

The results from the searches were assessed by one reviewer for inclusion. A document was included if it fit within the scope of the questions posed for the rapid synthesis.

For each systematic review we included in the synthesis, we documented the focus of the review, key findings, last year the literature was searched (as an indicator of how recently it was conducted), methodological quality using the AMSTAR quality appraisal tool (see the Appendix for more detail), and the proportion of the included studies that were conducted in Canada. For primary research (if included), we documented the focus of the study, methods used, a description of the sample, the jurisdiction(s) studied, key features of the intervention, and key findings. We then used this extracted information to develop a synthesis of the key findings from the included reviews and primary studies.

WHAT WE FOUND

We found three systematic reviews (2-4) and nine primary studies that related to the two questions.(5-13) In addition, we made use of findings from two reports from international organizations (i.e., Organisation for Economic Cooperation and Development and European Commission) and 11 key informant interviews to develop Table 1 and provide insights into the processes and characteristics that are key to establishing predictive models.

Question 1: How are health human resource models being used to plan for the health workforce across comparator jurisdictions in Canada and internationally for the next five to 10 years?

Findings from the literature

We identified three systematic reviews (2-4) and nine primary studies relating to the first question.(5-13) The first review (which was older and medium quality), examined the use of staffing ratios in workforce planning for allied-health professionals.(2) The review found insufficient evidence to draw conclusions about the effectiveness of staffing ratios for workforce planning.(2) However, the review reported that six of the included studies identified appropriate staffing ratios through a consensus process, while another used an outcomes-based approach to guide the number of recruited professionals.(2) The second review (recent and medium quality) examined workforce planning models for rheumatologists and found most high-income countries use a stock-and-flow model to simulate supply alongside additional demand variables.(3) The review found common demand variables include: disease prevalence; rates of referral; clinical visits; and population demographics.(3) Supply variables included in the stock-and-flow model included: post-graduate training; workplace setting; retirement patterns; and influence of medical innovations.(3) Finally, one recent low-quality review examined the history of health workforce planning and compared a range of methodologies, but was unable to identify one as being superior.(4)

The nine primary studies largely focused on documenting different models for health human resource planning. Four primary studies examined the importance of transitioning to a needs-based model.(5; 8; 9; 11) One study compared simulations that included demand variables based on population-health needs in addition to supply-side variables to those that use a stock-and-flow technique to model supply, and found significant shortfalls across 32 high-income countries by 2030 for those jurisdictions using stock-flow alone.(8) Another study highlighted four key variables to adopt as part of a needs-based approach: 1) demography; 2) epidemiology (e.g., average level and type of sickness in the population); 3) level of service (e.g., planned level and mix of services to respond to the population's health profile); and 4) productivity (e.g., the quantity of service requirements each provider involved in service production must meet).(11) Similarly,

an Australian study used data from patient encounters to predict demand for general practitioners(GP).(5) The study examined the predictive power of a range of variables including: the number of chronic conditions; the number of bodily systems involved; patient age and sex; patient characteristics; the number of specific chronic conditions; and the overall severity of patient illness.(5) The study found that the number of chronic conditions was the best predictor of the frequency of GP visits over a 12-month period.(5) Another primary study from Australia documented the use of a supply model and needs-based model to estimate general-practitioner workforce requirements. The supply model included variables for training, existing stock and productivity, while the needs-based model included population size, health needs and service utilization rates.(9) An evaluation of the model found that in validating it retrospectively it provided a reasonable fit to supply and demand.(9)

While needs-based models are becoming increasingly common, one primary study suggested the use of outcome-based planning (in this study focused on services for pregnant women, children and youth). In this approach, an outcome with a clear link to service delivery is used and geographically benchmarked to determine the effect of available resources, taking account of the distribution of professionals and the models of care in which they are working.(12) The study did not provide an evaluation of this type of model.(12)

One case study from the Netherlands provided a description of the model in place for physicians as well as conducting an evaluation of the model 10 years following its implementation.(13) The model is made up of four steps: 1) estimate the existing gap between demand and supply; 2) estimate demand and supply for the target year (including considerations for demography, outflow, professionals trained abroad, and existing training capacity); 3) determine labour-market returns and future capacity; and 4) estimate the gap between what is currently available and projections for the target year.(13) The evaluation of the model found it to be successful at stabilizing what was previously a volatile labour market (e.g., with significant over-supply and under-supply.(13)

Noting the challenges of planning for one category of professional at a time, one study called for the development of multi-professional planning to account for the overlap in professional scope of practice as well as for planning that bridges health and social services.(6) Another primary study documented the development of a minimum standard data set for the behavioural health workforce and found it critical to standardizing health human resource data.(7) However, the primary study found that barriers to its development could include: limited resources to dedicate to data collection; lack of partners to support new data-related policies; and limited incentives in place to support new standards in data collection.(7)

Finally, one primary study from New Zealand examined Work Service Reviews, which detail sets of possible future clinical scenarios generated by subject-matter experts to compliment conventional modelling.(10) The primary study found that while this approach had facilitated shifts in health workforce planning including the integration of service needs into planning models as well as the development of multidisciplinary workforce planning, study participants raised concerns that the energy generated by these reviews was often lost rather than contributing to changes in policy.(10)

Findings from key informant interviews

To complement the findings from the literature included above, we undertook interviews with 11 key informants who provided details on the models used in each of their jurisdictions, which included four Canadian provinces (Alberta, Manitoba, Ontario and Nova Scotia) and four other countries (Australia, New Zealand, the Netherlands and England). General information on the models is provided below, with additional details in Table 1.

The majority of systems use a stock-flow model to simulate the supply of health workers. These are often used to predict five to 10 years in the future, but may be regularly updated to ensure they continue to reflect an accurate health-system context. In the model, the stock refers to the current professionals in the system.

However, many jurisdictions have added dimensions to this estimate to improve its accuracy, including participation (e.g., who is actively practising versus holding a licence), full-time equivalencies, productivity, and in the case of Nova Scotia, clinical focus (e.g., time spent in different sectors or on specific conditions).

The flow refers to the professionals 'flowing' in and out of the system. In-flows refer to those entering the system and often includes variables such as acceptance of relevant training programs, length of training program, and expected graduates of training programs, with distinctions often made between domestic (or within-province graduates) and foreign graduates (either international or elsewhere in Canada). Exit-flows refers to those professionals leaving the system and could include a range of different factors, such as retirement rates, early retirement or career changes, and decreases in hours worked.

Stock-flow models will be calculated for each profession and provide the supply-side estimates. Jurisdictions typically run a 'base case,' which provides an answer to an overarching question, such as whether the system has enough physicians when the context is held relatively constant. From there, those running the model may choose to add different scenarios to determine how changes in the environment or to policies affect the estimates. These simulations will often also include variables to model demand, including changes to population demographics, health status of the population, and level of service (e.g., standard package of care based on health status). Interestingly, Nova Scotia adds an additional variable for division of work for each professional by estimating the proportion of a package of care that each professional would be responsible for providing. Similarly, Alberta has adapted the approach taken in Nova Scotia when planning for physicians and specialists where simulations may be run numerous times to estimate positive or negative changes to a variable to determine a range for the number of professionals who are required over a given period of time. While some jurisdictions have set simulations that they run regularly, other jurisdictions base simulations on a given policy question. Key informants stressed that these simulations can help to overcome contextual changes that may have an impact on health workforce planning. For example, foreign nursing applications to the U.K. dropped by 76% following the vote in 2016 to leave the European Union, resulting in the prediction of a future deficit of nursing professionals and a need to heavily recruit internal candidates and increase available seats in domestic nursing programs.

While simulations that include variables that account for a range of contextual factors (e.g., changes to scope of practice, models of care, technology or the economy) may be tempting to include given their comprehensiveness, one key informant highlighted that in simulations there is an important trade-off between the perceived comprehensiveness of variables and the accuracy of predictions. In particular, they described how many of these broader contextual factors are difficult to predict with relatively little data, such as the role technology will play on productivity (or professional full-time equivalents - FTEs), and as a result reduce the overall accuracy of the prediction. The importance of simple simulations was also highlighted in one primary study described in the section above evaluating physician modelling in the Netherlands.(13)

Alberta employs staffing ratios to plan for health workers in hospitals, including allied health professionals, by breaking down FTE's for each unit within a hospital and comparing it to benchmarks from hospitals of similar sizes across Canada. These estimates are then being used to adjust staffing mixes among large urban hospitals in Edmonton and Calgary.

In addition to running simulations, many jurisdictions undertake activities to inform the variables included in the model. In Nova Scotia and Manitoba these take the shape of service reviews where services provided across the entire system (in the case of Manitoba) or for specific sector or conditions (long-term care and mental health and addictions in the case of Nova Scotia) are reviewed to determine standard packages of care. Categories of professionals and their estimated time required are then mapped to each of these packages of care based on their scope of practice. A similar process is conducted in New Zealand through the use of Work Service Reviews. Similar to the service reviews conducted in Nova Scotia and Manitoba, these are developed with the input of a panel of health professionals. However, contrary to the service reviews which often maintain a degree of status quo, these Work Service Reviews allow for planners to include a vision for how the future ought to be, along with a few relevant alternatives about how it may take shape. Once

constructed, the desirability and likelihood of these scenarios are rated by a panel of experts, with the aim of getting a wide range of opinions. The final scenarios and their likelihood are then used to inform which scenarios are combined with the stock-and-flow model to provide projections for a target year.

Horizon scanning is another approach to inform 'big picture' planning for the health workforce, which has been used in Australia, New Zealand and in the U.K. (conducted by the former Centre for Workforce Insights). Horizon scanning is a complex process that complements and informs the development of likely future scenarios. At a minimum the process includes five key steps: 1) understanding the current and historical context for the health workforce; 2) mapping the present system to determine what factors are currently challenging the system; 3) considering how these factors, or new factors, may interact to create plausible futures; 4) quantifying these factors to consider tangible effects on the health workforce; and 5) assessing the implications for professionals (e.g., what is needed to respond appropriately). Horizon scanning often involves both sophisticated models and algorithms (such as those used by the Centre for Workforce Intelligence Horizon Scanning Hub), as well as considerable engagement with health professionals. Horizon scanning seeks to determine the changes between today and a reference future, but it tends to occur over a long period of time (e.g., 15 to 20 years) and often results in generalizations of future scenarios rather than specific health human resource estimates. In the case of Australia and New Zealand, horizon scanning and the different futures that are derived from this process are used to determine the scenarios and percentage reductions or increases in variables that are built into supply and demand models.

Primary health human resource models from the eight jurisdictions that the key informants we interviewed provided insights about are presented in Table 1, below. However, many of the jurisdictions also employ less robust models to estimate the future supply or demand of other professionals for whom relatively less data may be available. One key informant noted that ideally each model would have a complementary process to ensure it is incrementally improved. This should include an evaluation of past projects to determine the extent of the gap between the estimate and reality and the different factors that may account for some of the discrepancy.

Question 2: What processes and characteristics are key to establishing successful predictive models?

Interviews with 11 key informants also shed light on some of the processes and characteristics that were key to establishing successful predictive models and some elements that were frequently mentioned as barriers. Most informants identified limitations in data available to include in health workforce planning models, with the exception of key informants from Alberta who identified their electronic record and central repository of data as a facilitator to effective workforce planning. Those that experienced challenges with data described how some of it was relatively easy to come by, such as payroll data in the U.K. or the number of professionals on college registries in Canadian provinces, gathering other data, such as for the productivity of allied health providers, was more difficult. Key informants stressed that the more complex the variable, the more difficult it was to determine exactly what data could be used as a proxy. For example, one key informant mentioned having been asked to model the effects of technology on the physician workforce, and noted the enormous range of technologies that could be taken into account and their vastly different effects on productivity. While most key informants agreed on a preference for simple simulations, an exception to this was the inclusion of estimates for the cost of employing the projected workforce. One key informant noted that incorporating this information into reports may increase the acceptance and utilization of the results in policy and planning.

Many key informants described making initial estimates based on available data and then involving stakeholders who could provide experiential knowledge about how to adjust the estimates based on clinical realities. For example, in Nova Scotia estimates are brought to a multi-professional panel who are able to comment on whether they are accurate reflections of professional practices (e.g., for productivity and clinical focus variables). Another key informant described the planning process as "an initial estimate to get the conversation going with professionals." Three key informants described stakeholder involvement, while occasionally difficult, as being critical to arrive at a successful model and a shared view of future challenges.

One key informant described how the accuracy of a scenario's prediction is largely reliant on the question being asked (and its specificity). They further highlighted the need to carefully tailor the variables included in a model to meet these requests. Another key informant also noted the importance of maintaining as simple a model as possible, including only the variables necessary to answer the question at hand.

Finally, one key informant described that their biggest challenge was not creating predictive models, but finding ways to ensure it is used to inform policy. They highlighted how the predictions from these models may clash with political agendas. For example, the key informant described how they currently have an oversupply of physicians that is predicted to increase in the coming years and will require scaling back the number of seats in medical schools, a policy decision that is often politically unpopular.

Table 1. Findings from key informant interviews on health human resource models

Jurisdiction		**Project period**	**Coverage**	**Data sources** (where available)	**Scenario(s)**	**Variables** (and assumptions)
Canada	Alberta	5-15 years	Physicians and specialists	Key data sources include, but are not limited to: • Administrative data collected through their single health record	• A base case is run at regular intervals, however no additional scenarios are currently being run	• Supply o Graduates from training programs o Graduates in their first year following training program o Retention rate o Retirement rates o Mix of specialties • Demand o Population demographics o Projected population growth o Levels of chronic disease o Socio-economic variables • Assumption • Adjusted for inflation
	Manitoba	Unknown (in the process of updating)	Multi-professional planning	Key data sources include, but are not limited to: • Payroll data from Regional Health Authority	• Waiting to receive results from clinical-services review and clinical-services plan, which will dictate the scenario's run.	• Current stock of health professionals • Education o Provincial graduation from training programs o External graduates from training programs • Migration (both immigration and emigration) • Productivity
	Ontario	10 years (with data updated every two)	Physicians (general physicians and specialists)	Key data sources include but are not limited to: • Canadian Post-M.D. Education Registry (CAPER) • Ontario Physician Human Resources Data Centre • Canadian Resident Matching Service data • Canadian Institute of Health Information data • Ontario Health Insurance Program billing data • Ad hoc surveys	• A base case for each model is run every two years, with additional scenarios run based on specific policy/planning questions	• **Supply Model (ADIN)** o Predicts physicians from postgraduate training, to practice and through to retirement o Includes in-and-out migration • **Utilization-based Model** o Demand-based model uses physician billing data and population projections to estimate physician service usage into the future • **Needs-based Model** o Predicts both supply and need for physicians into the future, with based on how various risk factors (e.g., smoking) contribute to the incidence and prevalence of health conditions in the future (e.g., lung cancer)
	Ontario	10 years (reassessment schedule has not yet been set)	Registered practical nurses (RPNs) and registered nurses (RNs)	Key data sources include but are not limited to: • Ontario Health Professions Database	• Base case has just been run for the first time this year	• Model is comprised of three sub-models: supply, need and labour-market demand • Results of each sub-model are compared to determine gaps/surpluses. • Labour-market demand

Jurisdiction		Project period	Coverage	Data sources (where available)	Scenario(s)	Variables (and assumptions)
				• Canadian Institute of Health Information • College of Nurses of Ontario • Canadian Community Health Survey • Ontario Public Accounts • Discharge Abstract Database • National Ambulatory Care Reporting System • Client Profile Database		○ provincial healthcare spending to estimate how many RNs and RPNs the system can hire • Need ○ data regarding population demographics/growth ○ the prevalence of health conditions ○ levels of service use to estimate future health-service requirements • Results are provided by sector (acute, long-term care, home care, community care and other)
	Nova Scotia	10 years (with an annual data update)	Multi-professional planning and physician-specific planning	Key data sources include but are not limited to: • Collected through billing data, diagnostic codes for select conditions, and registry data then verified with a multi-professional panel to determine accuracy of assumptions	• Base case is run annually with positive and negative scenarios run for supply variables • economic and financial variables as well as models of care are assumed constant	• Education ○ Expected number of new graduates (within province) ○ Expected external graduates (out of province) • Practising professionals (providing direct care) • Working time (in FTE) • Productivity • Clinical focus of professionals • Population demographics • Health status of the population • Level of service (standard service-delivery model)
Australia		15 years (2010-2025)	Physicians, nurses and midwives	Key data sources include but are not limited to: • Medical, nursing and midwifery labour-force survey	• 5% productivity gain • 2% lowered demand • 50% reduction in international graduates • 95% reduction in international graduates • High demand due to changing expectations • Undersupply of 5% in the initial year of projection • Capped working hours to 50 hours per week	• Education ○ Number of graduates ▪ Medical graduates: planned increase up to 2015 of medical graduates and held constant there after ▪ Nurses/midwives: growth until 2012 and held constant thereafter – enrolled nurses held constant at 2009 level ○ International graduates • Number of health workers for each category of professional • Working time (in FTE) • Exit rates ○ Physicians: the 2007-2009 existing rates, constant over projection period ○ Nurses/midwives: the 2007-2009 existing rates apply from 2010-2012 then revert back to 2001-2006 rates • Population

Jurisdiction		Project period	Coverage	**Data sources** (where available)	Scenario(s)	**Variables** (and assumptions)
						○ Population projection estimated by bureau of statistics ○ Utilization ▪ Based on the growth in activity over the period 2006-2009
New Zealand		Five to 15-year plans (with two-to-three year updates and quarterly reviews)	Multi-professional planning	Key data sources include but are not limited to: • Annual practising certificate data, district health boards and other employers, New Zealand Census, Workforce Service Forecasts commissioned by Health Workforce New Zealand, as well as Medical Schools Outcomes	• Expert deliberation following Work Service Reviews determine scenarios for each clinical area.	• Inflow ○ Active workforce ○ Number of graduates ○ International medical graduates ○ Movements from inactive to active status • Outflow ○ Emigration ○ Retirement ○ Deaths ○ Movements from active to inactive (early retirements)
Netherlands		Between 10-20 years (2010-2028)	Multi-professional as well as some technical professions who work alongside medicine (e.g., pharmacologists, chemists working in hospital)	Key data sources include but are not limited to: • Combination of data sets (e.g., registration • Population projections • Administrative data on work status, calculations, surveys of health professionals, and expert estimations	Four scenarios are run, each with two additional estimates whereby the added variable trends to stop in 2020 or continue to 2028: • Basic variant (addition of demography variable) • Low variant combination (addition of socio-cultural and epidemiology) • Low variant (addition of vertical substitution) • High variant (addition of vertical substitution)	• Number of health workers • Working time (FTE calculation) • Education ○ Students entering medical education ○ Graduation rates • Labour-market entry ○ New registrants ○ Number completed training • Immigration • Exit rate (professionals who will leave profession for a range of reasons) • Changes in population structure • Changes in disease incidence, prevalence and risk factors • Under-use or unmet care needs (socio-cultural factor) • Horizontal or vertical substitution of professionals
United Kingdom	England	29 years (2011-2040)	Physicians (general practitioners and trained hospital doctors); other professions are planned for using similar models	Key data sources include but are not limited to: • Collected through a human resource and payroll system, however data on general practitioners and some practice staff who are not directly employed by the NHS are collected separately	Supply and demand scenarios • Compression of morbidity in a high-resource environment • Compression of morbidity in a low-resource environment • Expansion of morbidity in a high-resource environment • Expansion of morbidity in a low-resource environment	• Education ○ Medical school intake (held constant) ○ Drop-out rates (held constant at 5%) ○ Time spent in medical school (held constant) • Postgraduate training ○ Postgraduate intake ○ Drop-out rates ○ Time spent in different training modules • Number of health workers

Jurisdiction		**Project period**	**Coverage**	**Data sources** (where available)	**Scenario(s)**	**Variables** (and assumptions)
					Funding scenarios • Public spending on health grows in line with GDP • Public spending on health exceeds GDP growth but by a smaller margin than in the past • Public spending on health grows in line with the long-run average of around 4% per year	• Working time (in FTE) • Exit rates o GP early leavers o Trained hospital doctors early leavers (2% per year below the age of 54) o Age-specific retirement based on historical data

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APPENDICES

The following tables provide detailed information about the systematic reviews and primary studies identified in the rapid synthesis. The ensuing information was extracted from the following sources:

- systematic reviews - the focus of the review, key findings, last year the literature was searched, and the proportion of studies conducted in Canada; and
- primary studies - the focus of the study, methods used, study sample, jurisdiction studied, key features of the intervention and the study findings (based on the outcomes reported in the study).

For the appendix table providing details about the systematic reviews, the fourth column presents a rating of the overall quality of each review. The quality of each review has been assessed using AMSTAR (A MeaSurement Tool to Assess Reviews), which rates overall quality on a scale of 0 to 11, where 11/11 represents a review of the highest quality. It is important to note that the AMSTAR tool was developed to assess reviews focused on clinical interventions, so not all criteria apply to systematic reviews pertaining to delivery, financial or governance arrangements within health systems. Where the denominator is not 11, an aspect of the tool was considered not relevant by the raters. In comparing ratings, it is therefore important to keep both parts of the score (i.e., the numerator and denominator) in mind. For example, a review that scores 8/8 is generally of comparable quality to a review scoring 11/11; both ratings are considered "high scores." A high score signals that readers of the review can have a high level of confidence in its findings. A low score, on the other hand, does not mean that the review should be discarded, merely that less confidence can be placed in its findings and that the review needs to be examined closely to identify its limitations. (Lewin S, Oxman AD, Lavis JN, Fretheim A. SUPPORT Tools for evidence-informed health Policymaking (STP): 8. Deciding how much confidence to place in a systematic review. *Health Research Policy and Systems* 2009; 7 (Suppl1):S8).

All of the information provided in the appendix tables was taken into account by the authors in describing the findings in the rapid synthesis.

Appendix 1: Summary of findings from systematic reviews about health workforce planning

Type of review	Focus of systematic review	Key findings	Year of last search/ publication date	AMSTAR (quality) rating	Proportion of studies that were conducted in Canada
Systematic review	Evaluation of workforce ratios in health professions (2)	As healthcare is a complex and expensive industry, healthcare service providers must be able to provide effective and efficient services under fixed budget constraints. Service overlaps should be minimized, and staff allocation should be evidence-based and target population needs. This study aims to identify workforce ratios in allied health professions (AHPs) in hopes of determining appropriate levels of staffing for workforce planning. This review included 12 papers that provided workforce ratios of AHPs to the number of patients or beds. The included studies had varied research methodologies and study quality. Six papers used consensus to derive the ratios, though with considerable variability. One experimental trial derived a recommended AHP ratio based on outcomes from increased level of interventions. Current clinical dietitians and psychologists collected surveys, which reported insufficient staffing ratio and high levels of stress incurred by heavy caseload. Only one paper was found to report the link between staffing ratio and clinical outcomes, which suggested a statistically insignificant effect of increased staff levels on reducing length of stay and hospital bed usage. Due to limited findings, there is insufficient evidence for the use of staffing ratios in the realm of medicine and nursing. However, such information can be very useful for healthcare-service planning and delivery.	2008	6/9	1/12
Systematic review	Reviewing workforce planning models for rheumatology from Western countries (3)	Rheumatic diseases are increasing in prevalence due to a range of factors including higher life expectancy in Western countries. The current supply of practitioners is insufficient for the expected demand. The systematic review included 14 studies to compare different health workforce projection models for rheumatology. There was a range of estimates for rheumatologists needed per 100,000 people with 0.7 in the U.K. for 1988 to 3.5 in Spain for 2021. The median was about two rheumatologists per 100,000 adults. These projections were based on a supply-based approach for three studies and a needs-based approach by six studies. Factors that influence the needs or demand for rheumatology services included: disease prevalence; patients' rate of referral to rheumatologists; clinical visits per patient per year; and population development. In regards to supply, variables that models commonly included were: factors influencing performance of rheumatologists such as workplace setting; retirement patterns; and influence of medical innovations.	2016	4/10 (AMSTAR rating rom McMaster Health Forum)	4/14

Type of review	Focus of systematic review	Key findings	Year of last search/ publication date	AMSTAR (quality) rating	Proportion of studies that were conducted in Canada
		Studies on projection models were varied in their methodology, variables considered, time span for estimates, and selection of rheumatic conditions included. The authors of the review suggest a need for more standard methods for workforce calculations.			
Systematic review	Examining the chronological and historical evolution of healthcare workforce planning (4)	Healthcare human resources planning is a crucial component of a health system that effectively meets the needs of the population. Understanding of the planning process is key to success. The review examined 75 publications from over 60 years in order to examine the chronological and historical evolution of health human resources planning. The review classified findings into three main sections: 1) an introduction of principles characterizing the healthcare market; 2) the evolution of the field; and 3) a discussion of current trends in the area. Healthcare human resources planning is increasing in demand and importance as the field of healthcare expands. Adequate models of supply are intrinsic to a workforce plan, as balance must be found between worker supply and population demand. A number of methodologies have been identified, including measurements of training, productivity, skill mix and worker-to-population ratios. Models of demand are also crucial, and centre around measurements of potential demand, effective demand and service targets. Human resources planning in healthcare has evolved significantly over the course of its history. The first phase of this planning began with health workers being seen as production factors, with emphasis on needs- and demand-based approaches. The second phase focuses on workforce planning as an economic process, broadening the scope of analysis and integrating the supply and demand relationship. The third phase focused on the health workforce as a necessary resource, continuing the second phase with increased emphasis on modelling key demand and supply inputs. After five decades of work in human resources planning, this field of research is essential to the healthcare workforce. The importance of an integrated approach to workforce planning is stressed, as dynamic planning is necessary to respond to an ever-changing field. This approach incorporates data for projections, supply and demand, economic factors, organizational changes, and the evolution of health needs over time. The review examined publications from over 60 years in order to observe the evolution of health human resources planning. None of the observed methodologies emerged as superior, and there remains room for improvement in this area of research. Workforce planning demands integration and flexibility, with consideration for supply, demand, skill mix and productivity.	2013	1/9 (AMSTAR rating from McMaster Health Forum)	Not reported in detail

Appendix 2: Summary of findings from primary studies about health workforce planning

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
Examining patient use of general practice services in Australia (5)	*Publication date:* 2019 *Jurisdiction studied:* Australia *Methods used:* Data analysis	1,449 randomly selected Australian general practitioners (GPs)	A total of 1,449 randomly selected Australian GPs recorded GP-patient encounter details for 43,501 patients. Collated data included patient characteristics, diagnosed chronic conditions per patient, and the number of GP visits for each patient in previous 12 months.	Study authors developed a parsimonious model that predicts patient visit rate to GPs by examining the predictive power of: the number of chronic conditions; the number of body systems involved; patient age and sex; patient characteristics; the presence of specific chronic conditions; and the overall severity of patient illness. From the study sample, it was found that GP visit rates significantly increased with the number of chronic conditions per patient, from 5.0 visits for those with no chronic conditions to 22 visits for those with 10 or more. GP visit rates also increased with the number of body systems, from 5.0 visits for patients with no chronic conditions to 20.1 visits for those with at least one condition in eight or more different body systems. Female patients were found to have a significantly higher GP visit rate than male patients. Among females, the visit rate increased significantly with age, especially among those 70 and over. Overall, it was found that the number of chronic conditions was the best predictor of GP visit rate in the previous 12 months, much better than the age and sex of the patient combined.
Examining a patient-centred approach to workforce planning (6)	*Publication date:* 2019 *Jurisdiction studied:* New Zealand *Methods used:* Qualitative proposal	n/a	Authors examined the current model of health workforce planning in New Zealand and proposed a more holistic, patient-centred approach.	This primary study is based on the belief that traditional workforce planning methodologies and interprofessional education approaches will not be capable of adequately addressing growing health-systems challenges worldwide. To mitigate this, researchers proposed a series of paradigm shifts to reframe health workforce planning to center around patient populations. Specifically, authors recommended a shift away from a focus on shortages toward assessing how to more effectively deploy and retrain the existing workforce. They called for workforce planners to turn away from silo-based workforce projection models toward methodologies that recognize professions' overlapping scopes of practice. Finally, they advised a shift away from a focus on traditional health professions toward including both health and social-care workers. In terms of training, the authors' proposal centres around the idea that new models of learning must be delivered in the context of practice. This model will necessitate a shift away from the current model's focus on preparing collaboration-ready students to designing clinical practice environments that support continuous learning. The reframing of this model is expected to benefit not only learners, but patients, populations, and providers as well.

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
Examining the usage of methods of foresight for health workforce planning (14)	*Publication date:* 2018 *Jurisdiction studied:* New Zealand *Methods used:* Actor analysis, scenario development, policy Delphi	Respondents for the study were identified as time-poor senior doctors, nurses, executives and experts based in New Zealand	This study employed semi-structured interviews for actor analysis data collection and iterative online Delphi panel surveys for the collection of expert opinions. The findings from this primary data collection were supported by data from a Rapid Evidence Review of New Zealand workforce documents.	This study is centred around an augmented scenario method of health workforce modelling, which joins scenario and policy development through the application of the policy Delphi. The study provides insight to workforce planners and policymakers on how actor-focused foresight data is able to complement conventional workforce forecasting approaches and help overcome some of its limitations. Fifteen strategic issues were derived from the inductive content analysis of workforce documents and interviews, which completed the actor analysis data sets. Notably, it was found that across all sets, the consumer actor had little or no influence in the system, which is troubling considering that current efforts for workforce planning are centred around community-based self-care service configurations. The augmented scenario method is expected to improve upon the limitations of traditional workforce planning methodologies by developing scenarios as narrative descriptions of future situations. In doing so, planners are able to see how services are configured and which actors' roles experience an impact. This enables planners to look past the numbers and to gain insight into future workforce structures, relationships, and leadership capabilities that are necessary for service transformations. Despite its proposed benefits, this model should be considered in the context of its limitations. Firstly, the approach applied in this method focuses principally on the planning based upon policy recommendations. This approach could be seen as limited and lacking in deeper critical perspectives. Secondly, the policy Delphi might not be the best method to identify and prioritize policy proposals, as the method could be affected by panellist withdrawal and poor round completions.
Examining data for improving behavioural health workforce planning (7)	*Publication date:* 2018 *Jurisdiction studied:* U.S.A. *Methods used:* Descriptive analysis	n/a	Authors explored the implications of developing a workforce minimum data set (MDS) for behavioural health.	An MDS is a collection of data elements that can improve the modelling and estimation of current and future worker supply and demand on a national, regional and state level. It can also assess the comprehensiveness of existing workforce data sets. According to study authors, the development of a behavioral health workforce MDS is a foundational step in standardizing collection of workforce data. In terms of limitations, resource and statutory barriers must be overcome before wide adoption of the MDS is possible, especially at the state level. State licensing boards could potentially be an important user of the MDS, but often lack the human resources needed to engage in this type of data collection. Widespread MDS implementation may also require cultivation of partnerships and development of new policies. State and federal government agencies and policymakers can advocate for the adoption of standards in data collection for

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
				human resources planning, as well as provide incentives for implementing ongoing data collection. According to researchers, efforts to adopt standardized data elements can substantively benefit the field by better informing policymakers and health workforce planners about staffing patterns and workforce needs.
Examining the future supply of and requirements for human resources for health in high-income OECD countries (8)	*Publication date:* 2016 *Jurisdiction studied:* OECD countries *Methods used:* Predictive modelling	Data for 32 high-income member countries from the OECD's online database, up to 2030	This study employed a model combining a stock-and-flow approach to simulate the future supply of each profession in each country, along with a needs-based approach to simulate future human resources for health (HRH) requirements. Values were adjusted according to levels of HRH participation and activity.	In this paper, a simulation of future HRH supply in terms of head counts was calculated using a stock-and-flow approach, which involves adjusting current HRH stocks according to expected flows in (e.g., new graduates, inward migration) and out (e.g., retirements, attrition to other sectors, outward migration) of each country's stock. These head counts are then adjusted according to levels of participation (providing direct patient care) and activity (proportion of full-time hours spent providing direct patient care) for different types of HRH. To inform the process of estimating HRH requirements, a review of the objectives of each country's healthcare system was conducted. Limitations of this modelling method include: potential inaccuracy of included data due to its collection by secondary source; and lack of distinction between health delivery from public and private sectors.
Improving the planning of the GP workforce in Australia (9)	*Publication date:* 2016 *Jurisdiction studied:* Australia *Methods used:* Simulation modelling	Data to populate the model was sourced from a range of organizations in Australia, including General Practice Education and Training Ltd., the Australian Institute of Health and Welfare, and the Australian Government Department of Health, among others	A stock-and-flow approach was used to estimate the future GP headcount based on existing numbers of GPs working in clinical care.	In this study, a simulation model was developed with two sub-models: a supply sub-model and a need sub-model. While the supply sub-model comprised three components (training, supply and productivity), the need sub-model described population size, health needs, service utilization rates, and productivity. A state transition cohort model was used to estimate the future supply of GPs, accounting for entries and exits from the workforce and changes in location and work status. The model used incidence and prevalence data to estimate the required number of GPs, combining age, gender and condition-specific utilization rates. The model was run under various assumptions, reflecting potential changes in need and utilization rates over time. It was found that the results from the supply sub-model provided a reasonable fit to the observed data for the stock of GPs, though the difference between the observed and predicted number of GPs and consultations varied for the need sub-model depending on the assumption made. In terms of limitations, the model did not accommodate for variations in GP service utilization, which may have affected its accuracy. Further limitations relate to the quality or lack of data for both the supply and need sub-models.
Examining New Zealand's iterative workforce service reviews (10)	*Publication date:* 2013	The 16 interview participants were recruited from Health Workforce New	Phase 1 involved the development of a program logic model (a visual representation of	The WSR process is based on the theory that a clinician-led think-tank inductive process is essential to developing innovative new service configurations and workforce models. Key informant interviews indicated that while the WSR

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
	Jurisdiction studied: New Zealand *Methods used:* Realist evaluation approach	Zealand (HWNZ) and the four Workforce Service Reviews (WSRs)	the assumptions or theories underpinning how the WSRs were supposed to work) using literature and WSR documentation. Phase 2 involved semi-structured interviews with key informants from Health Workforce New Zealand HWNZ and members of the four WSRs.	process was a successful way to facilitate new ways of thinking and working, there was often confusion about what its tangible outcomes were meant to be. Additionally, participants raised concerns about ways to sustain the creative energy generated by the WSRs, how the ownership of the generated models would be allocated, and how the HWNZ would transition the WSR visions into policy decisions. To date, the WSR process has facilitated several paradigm shifts in New Zealand's conceptualization of health workforce planning. It has advocated for a move from workforce planning based solely on matching supply and demand to using service needs to inform future models of care: from duo-disciplinary (e.g., general practitioner, nurse-centric approaches) to inter- and multidisciplinary (e.g., general practitioner, nurse, allied health, specialists, consumers, etc.) approaches to workforce planning; from a reliance on broad-brush consultative processes to unique and creative clinician-led think-tank processes; and from solution-based, siloed methods of workforce planning to collaborative problem-solving approaches.
Creating a needs-based approach for physician planning (11)	*Publication date:* 2013 *Jurisdiction studied:* United Kingdom *Methods used:* Conceptual essay, with some projection modelling	General practitioners in the United Kingdom	Replacement of a typical stock-and-flow planning model with a needs-based model that incorporates variables for: demographics; epidemiology; level of service; and productivity.	Resource planning has not typically focused on the needs, but rather has been based on incremental increases to resources to reflect aging populations, trends in technology and patient expectations. Given this discrepancy, the article provides an overview of a needs-based model for health workforce planning. The article posits that there has been relatively little response to the changing needs of the population or the workloads of professionals. Similarly, typical stock-and-flow models for planning assume a constant relationship between provider requirements and need for care. Health workforce planning should expand to recognize the importance of including population health and not only the size of the population. Provider requirements should be determined by four variables demography; epidemiology (e.g., average level and type of sickness in the population); level of service (e.g., planned level and mix of services to respond to the population's health profile; and productivity (the quantity of service requirements each provider involved in service production must meet). To be successful though, planning must include temporal changes for each variable, given that productivity and level of service can be influenced through policy decisions. Authors note that this model is subject to some data challenges, particularly around the productivity variable where data sets are reliant on self-reported data, however this can be supplemented with administrative data on service quantity and provider hours.

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
Considering outcomes-based health human resource models for maternal and child health (12)	*Publication date:* 2009 *Jurisdiction studied:* Canada *Methods used:* Conceptual essay	Health services for pregnant women, children and youth	The article considers the replacement of a typical stock-flow model with an outcomes-based approach to health human resource planning.	The primary study details the limitations of a typical needs-based approach and describes more comprehensive planning for health human resources for pregnant women, children and youth. Outcomes-based planning requires a clear understanding of a the outcomes desires for a certain population, as well as readily available data defining healthcare needs and existing outcomes. Thus far, for data on pregnant women, mothers and children, data sets are usually based on hospitalization discharge abstracts and physician billing claims. However, these also have significant limitations given there is no validated case definitions for many diseases, and considerations such as functional status are left out. The first step in developing an outcomes-based health human resource planning model is to begin by agreeing on the most meaningful outcome measures. These should have evidence that links them to service delivery and reflect what families and those receiving care consider to be of the highest value. Second, data sets are needed that cross government sectors. For example, among children, educational attainment and health status. Once outcomes and data are defined, it is critical to compare outcomes across regions using a benchmarking approach, including considerations for places that are better resourced than others. Recent evidence shows that it is not just the supply of a health professional that is important, but rather the distribution of providers as well. Taking into account the model of care that providers are operating in is critical to planning, especially in Canada given the large jurisdictions. The different models used in urban and rural areas may call for different involvement of providers.
Evaluation of general practitioner planning in the Netherlands (13)	*Publication date:* 2012 *Jurisdiction studied:* Netherlands *Methods used:* Case study	Dutch general practitioners	Development and implementation of a simulation model and use of scenarios to alter inflow predictions for general practitioners	Workforce planning is critical for controlling the shortage or oversupply of providers. Case study provides details from a simulation model used from 2000 to 2010 in the Netherlands. The model calculated the future required inflow in medical specialized training, but it could be used for other professions. The simulation model was developed in 2000, to estimate the yearly number of health professionals in training required to meet the estimated demand. The model was made up of 26 elements taken through a combination of data sets, calculations and expert estimations. The model can be separated into three different stages. The first is calculating the current situation. This includes the total available full-time equivalent (FTE) of supply, while the gap between supply and demand is estimated by experts. There are a number of challenges reported including getting accurate information about the number of active health professionals, given that not all registered practitioners are active. Another challenge is obtaining information

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
				about the average percentage of FTE that health professionals work, as well as in estimates about unmet need which are largely reliant on experts who can make subjective interpretations. Further, mix-methods are often needed to validate expert estimations. The second step is to estimate supply and demand for the target year. This calculation includes considerations for: demographic developments; outflow; health professionals trained abroad; and training. Finally, the third step includes determining labour market returns and future capacity, and calculating the gap between what is currently available and what will be needed in the target year. A number of extended scenarios have been developed to account for additional changes that may take shape between the baseline and target year. The first scenario adds the influence of epidemiological (e.g., prevalence and incidence of disease) and socio-cultural developments (e.g., patient empowerment or differences between ethnic groups with respect to healthcare demands), as well as any developments regarding the profession, technical developments and developments in efficiency and in horizontal substitution. The second scenario adds the change in working ours per FTE to the projection of the future demand. The third and last scenario is based on developments regarding vertical substitution (e.g., the shift of professionals between professional levels). In using the scenarios, the results showed that they tended to increase numbers as more variables were considered, with vertical substitution as an exception. The study lays out that the results of the scenario are just one input into a larger decision-making process through the Ministry of Health, Welfare and Sport. After the Ministry and national government decide the total budget for training health professionals, this budget steers the numbers used to advise training facilities. The study has found the simulation to be successful in maintaining demand and supply, however the model was not always faithfully followed. Yearly projections were adapted based on health-system contexts. The model that has been implemented for the last 10 years has been generally successful at stabilizing the labour market for physicians and has been found to have significant policy value.

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