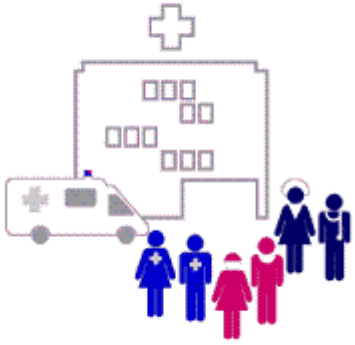
An Inventory of
Health Human Resource Forecasting Models
In Canada
2009



An Abbreviated Report Summary

Cameron Health Strategies Group Limited

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EXECUTIVE SUMMARY

Rationale

With health human resources representing over seventy percent of the health care budget, people remain the greatest asset and the greatest cost of the health care system. The objective of health human resources planning is to equip governments with the information and tools they require to determine how many health professionals are needed to meet the needs of Canadians, both now and in the future. In view of the growing demand for health care services and the expected shortages for health human resources in the near future, it remains critically important that a coordinated, balanced, pan-Canadian health human resources investment strategy be developed and implemented. Its primary aim would be to achieve a stable and optimal health workforce through a cost-effective managed growth strategy.

The capacity to estimate changing population health needs and future gaps in supply and demand in order to be able to develop viable options to improve workforce efficiency and effectiveness is critical to achieving an optimal and stable health workforce. Sound HHR needs-based modelling capacity to forecast HHR requirements is broadly recognized as a priority by provinces, territories and other key stakeholders and is a critical component of effective, evidence-based HHR planning.

In the interests of improving jurisdictions' capacity to plan, the F/P/T Advisory Committee on Health Delivery and Human Resources identified the need to conduct an inventory of forecasting models and tools. This study was commissioned to identify the forecasting needs of provinces and territories, to review current model utilization and to identify gaps and priorities.

Methodology

This review consists of two principal components: a comparative inventory of HHR forecasting models currently being utilized or developed in Canada, and a review of the needs of decision-makers for HHR forecasting models.

For the first component, the main source of data was through an e-mail questionnaire directed to those modellers currently involved in the development and application of HHR forecast models who were willing and able to share their experiences. Inventoried models were compared with respect to their utilization of population health indicators, their methods and sources of collecting and calculating health workforce supply, and, the range of health professions and disciplines for which they were collecting data. The capacity of the various models to do simulations under different planning assumptions was also considered.

The principal source of data for the second component of the study was through personal telephone interviews with decision-makers, i.e. those individuals with responsibilities for HHR and who were in a position to utilize HHR forecast model results to better inform their HHR

management processes. An interview guide was sent to all respondents in advance of the interviews.

Role of Forecasting

Having the right supply, distribution and appropriately deployed health workforce is critical to having an effective and efficient health care delivery system. Policies on licensure, recruitment and retention and education and training, as well as the factors that contribute to labour force participation, employment status, mobility and attrition, all impact on the availability of health workers and the overall stability of the health workforce. The efficiency and effectiveness of health service delivery depends to a large extent on the appropriate use of health personnel.

Given the overall complexity of the health system, it is important that HHR plans and forecasts be updated and assessed regularly. The fiscal capacity of governments to implement health reform initiatives and to respond effectively to emerging health system priorities and trends is of particular importance given the growing inter-jurisdictional competition for limited health human resources.

While it is understood that HHR forecasts are only one component of the complex fiscal and political decision-making processes within governments, the more robust, timely and supportable the forecasts are the more valuable their contribution will be to the overall planning and resource allocation process.

Decision-Maker Survey Findings

All provinces, plus the Canadian Medical Association (CMA) and the Canadian Nurses Association (CNA), use forecasting models (or have done so recently) to assist them with HHR planning. While the majority are projection models, Quebec, Manitoba, NS and the CNA use needs-based planning approaches. Furthermore, Alberta and Ontario are currently developing large-scale needs-based approaches to HHR forecasting. Some jurisdictions currently using projection models generally find them adequate for their purposes because the health needs of the population are difficult to measure and needs-based planning models are often complex and expensive. Nevertheless, there was a high degree of interest in needs-based planning models, particularly that being developed by Alberta. The availability and quality of data, however, remains a major concern and represents a priority area where improvements are being sought by all jurisdictions.

While effective collaboration in HHR planning most often occurred at the Regional level, most respondents viewed pan-Canadian collaboration as being potentially productive. Many respondents supported the federal government's role as facilitator and funder of inter-jurisdictional collaboration, particularly at the analytical and technical level in support of knowledge transfer, however few supported the notion of the federal government providing a leadership role in this regard.

A number of jurisdictions raised the issue of the sustainability of the health care system, noting that currently it was not being adequately addressed. In view of emerging human resource shortages, it was noted that workforce productivity, efficiency, utilization and deployment

needed to be more closely examined. The inability to manage public expectations and the lack of clear health goals were also raised as concerns.

Inventory of HHR Forecasting Models

The number of health professions being modelled has expanded significantly since 2005. As models become more robust and data becomes available, they are being applied more widely to a greater variety of health disciplines.

In both 2005 and 2009 HHR supply models included many of the same variables, including stock, annual additions and attrition, output from educational programs and employment status. Models are currently being strengthened by the recent shift from a fixed to a variable representation of HHR factors. While the majority of jurisdictions used models based on historical data representing global populations, an increasing number were expanding their supply-side population variables by age and sex to also include educational data, immigration and career patterns. There was no consensus however about the range of labour market and government policy variables to include in HHR models.

Similarly with respect to demand factors, most jurisdictions relied on variable rather than fixed assumptions about population demographics, health-care needs and utilization. Only two jurisdictions reported including socio-economic variables in their demand calculations, however, while no jurisdictions included government policy variables.

Most jurisdictions agree that it could be useful to have consistent national standards or guidelines, but some felt that national level forecasting would be insufficiently sensitive to local variations and concerns. Most of the suggestions for federal support concerned greater ease of access to data for researchers and for the creation of a networking mechanism to foster communication, share expertise and facilitate comparative projects between jurisdictions.

While most respondents reported challenges in sharing their models with other jurisdictions because of copyright issues and model specificity, every jurisdiction noted the possible benefits of inter-provincial partnerships, including improved knowledge transfer among forecasting organizations and more consistent and cost-effective inter-jurisdictional data collection. Developmental priorities included more timely and accurate data, more versatile modelling software and improved model simulation and evaluation.

Most jurisdictions noted that there was good uptake of model results, contributing to more effective recruitment and retention strategies and a better alignment between health education programs and health system needs. There were concerns, however, that most HHR research was still conducted in silos. Twenty-five percent of all respondents, however, indicated that lack of cooperation with data providers, lack of resources to exploit available data and the fact that the data was too aggregated, as their most significant data problems.

For the most part, models have not been shared between jurisdictions, although the potential for collaboration was broadly recognized. National modelling initiatives appear to have traditionally

had greater opportunities - and relevance- for sharing results inter-jurisdictionally than have local and provincial modelling activities.
It is noteworthy that none of the forecasting models reviewed at the time of the survey had ever undergone a thorough evaluation. This is a concern to many jurisdictions given the considerable investment that modelling requires in terms of time, expertise and fiscal resources.

Current Challenges in HHR Forecasting

In recent years HHR models have evolved beyond simple supply-side forecasting and utilization analyses. Often they now include dynamic health system-based *simulation* modelling approaches that attempt to combine needs-based population health, health services utilization data and effective-demand measures. Some also include potential efficiencies to be achieved through competency-based staff re-deployment and productivity analyses. No one model of the future can be completely comprehensive, however. To forecast well, one must forecast often, using a variety of approaches, techniques and assumptions. And contingency plans need to be kept at the ready should unanticipated results occur from policy and program actions that have been implemented.

Approaches to HHR planning that have the potential to increase workforce *productivity* or achieve a more stable, effective and efficient health workforce need to be examined. It is critical however, that the full impact of proposed policy decisions be carefully considered and evaluated before action is taken. Staging and prioritizing the implementation process, provides a clearer indication of the kinds and levels of support that are required to achieve the desired outcomes. As many potential unintended consequences and barriers to implementation should be identified as possible *a priori* to ensure that all the necessary supports and critical conditions for success have been identified and put into place to facilitate the viability and long-term sustainability of any proposed policy and program changes.

Needs-based HHR planning involves estimating the health services required to meet the needs of the population and then translating them into the required number of health care providers to deliver these services. It is to be noted, however, that with respect to needs-based planning models (and forecasting models in general), that one size does not fit all. Furthermore, there does not appear to be a clear and consistent understanding of what needs-based planning actually is. A common understanding and working definition of needs-based planning and its components and how they are actually applied to determine overall population needs (including social, political and economic factors) remains a collective challenge.

While needs-based planning continues to gather momentum in various sectors across the country, a major interest now seems to lie in simulation models and productivity analysis. These tools help decision-makers to consider the impact of proposed policy and program initiatives on the efficiency and effectiveness of the health care delivery system. This report recognizes the important contribution of these approaches but also considers a number of challenges that prospective model users should consider. Forecasting is an inexact science and needs are difficult to define. No single model meets everyone's needs, and individual users must balance overall cost and complexity against their respective needs and capacities when making a model selection. Provisional criteria are offered to guide users in this regard. A closer working

relationship between modellers and decision-makers will better align model development and application with emerging health workforce planning priorities.

Conclusions

Health human resources are critical to the effective and efficient delivery of health care services. As such, the importance of health human resources planning and the capacity to predict future gaps in supply and demand, are well recognized. Models that can estimate changing population health needs, and which can simulate the impact of proposed new policy and program changes, are valuable planning tools. Most jurisdictions engage in some form of HHR forecasting, the majority of these being supply-side projection models. While needs-based planning models are sometimes viewed as too complex, data intensive and expensive, there is general agreement that it remains a good idea in principle and that a close watch needs to be kept on developments in this area across jurisdictions.

Effective planning models are needed that can assist decision-makers in identifying policy options, that if implemented, provide a reasonable expectation of improving program efficiencies, further stabilizing the health workforce and achieving a more sustainable health delivery system. A common understanding of the overall capacities and limitations of models to support both short and long-term HHR policy and planning initiatives may be a place to begin. Given that HHR modelling is an emerging science, there is benefit to encouraging and supporting competition, innovation and diversity in HHR model development and application.

Recommendations

While this review focused primarily on the details of forecasting models, the scope of these recommendations include the identification of the critical conditions necessary to enable their continued development and support. Improvements in data development, the strengthening of individual jurisdictional capacity and the broadening of partnerships remain central to advancing this enterprise.

- With respect to *Partnerships and Collaboration* it is recommended that the F/P/T Working Group on HHR Modelling and Data Development be reactivated; that CIHI's role be reviewed and strengthened in support of modelling; that opportunities be created to formally bring modellers, employers and decision-makers together to better align priorities; that the new HHR models being developed by the CNA, Alberta and Ontario be nationally show-cased when completed; and, that a virtual Observatory be established to integrate forecast modelling with HHR data development and to further promote and facilitate pan-Canadian knowledge exchange.
- Regarding *Modeller Capacity Development,* it is suggested that a network of modellers be established to enhance communications and information sharing at a technical level through regular workshops aimed at achieving a common understanding of the concepts, scope and range of modelling options available.
- *Data Development* recommendations include a minimum data set for HHR performance indicators on workforce productivity and stability to better measure the success of new policies and programs. An HHR data inventory would identify information gaps and

development priorities, while a unique identifier for health professionals would improve the capacity of HHR planners to track them inter-jurisdictionally throughout their lifecycles.

- With respect to *Research,* it is also recommended that the HHR research agenda be expanded to include some of the contextual issues (social, economic) that impact on HHR to enhance its relevance to decision-makers; that a synthesis of current HHR research be conducted to better understand the impact of recent changes to health care delivery systems and workforce deployment on health system efficiency and effectiveness; and, that some of the challenges to modelling identified in this report be explored more fully in order to make forecasting models more comprehensive and useful.
- Although HHR planning and forecasting models have been evolving for the past two decades, very few have been thoroughly evaluated in terms of their scope, viability, costs, output and overall capacity to inform government decision-making processes. As such, it is recommended that *Evaluation* criteria be developed to both assess the overall utility of forecasting models as well as to assist new, prospective model-users in selecting appropriate models to meet their respective needs, capacities and budgets.

In terms of *next steps*, it is suggested that the development of common HHR performance indicators on population health needs and workforce stability and efficiency, as well as the development of evaluation criteria to assess forecasting models, would be high priorities. Showcasing the needs-based planning initiatives soon to be completed by Ontario, Alberta and the CNA would be a highly relevant and important place to begin. The establishment of a virtual HHR Observatory to oversee the integration of forecast modelling with other HHR data development, planning and evaluation activities would promote and strengthen inter-jurisdictional knowledge creation and exchange.

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1.0 INTRODUCTION

1.1 Background and Rationale

In 2004, the First Ministers renewed their commitment to the objectives described in the 2003 *Accord on Health Care Renewal*, including developing collaborative strategies to strengthen the evidence base for pan-Canadian health human resource planning to ensure an adequate supply of health care professionals in Canada.

Recognizing health human resources as a *national* resource, federal/provincial/territorial governments agreed to increase the supply of health professionals, based on an assessment of the gaps in supply and demand in the health workforce, through increasing professional training and enhanced recruitment and retention strategies. In view of the growing demand for health services and the expected shortages for health human resources in the near future, it has remained critically important that a coordinated, balanced, pan-Canadian health human resource investment strategy be developed and implemented in order to achieve a stable and optimal health workforce through a cost-effective, managed growth strategy.

Over the past five years the *Pan-Canadian HHR Planning Framework* has provided actions and strategies to enhance the collaborative capacity of provinces and territories to better plan and manage health human resources by supporting HHR data development, exploratory research, needs assessment, forecasting, program development and evaluation and dissemination of best practices. This approach complements and supplements jurisdictional HHR strategies by strengthening planning capacity at both local and pan-Canadian levels to ensure, as far as practicable, that an appropriate, well-distributed, adaptable, well-managed and sustainable national workforce is achieved and maintained. Sound HHR needs-based modelling for the forecasting of HHR requirements is broadly recognized by provinces, territories and other key stakeholders as an important component of effective, evidence-based HHR planning and is expected to remain a priority.

1.2 Recent Actions and Initiatives

A Pan-Canadian Inventory, Assessment and Gap Analysis of HHR Forecasting Models

In 2004, *Vestimetra International Incorporated* was commissioned to establish baseline information on HHR models in Canada, to assess their respective capacities and to identify gaps with respect to the forecasting needs of the provinces and territories.

The review recommended that modellers strengthen their connections to policy makers, that they work more closely with universities and that they share their work with other modellers. It was noted that models at local levels, rather than national, tend to have more utility and impact. It was suggested that those provinces with the more complete models (Ontario and Quebec) should be emulated and the greatest emphasis should be placed on physicians and nurses. Health Canada was seen as having a continuing role in providing resources to those provinces which are without models or are just beginning to develop them. It was suggested that forecast modelling

receive the continued support of the federal HHR strategy as an important component of provincial and territorial HHR planning infrastructure and capacity development.

Data and Modelling Workshop (2007)

The general purpose of the Workshop was to foster collaboration and partnerships among the players in HHR research, modelling and data development in order to achieve a common understanding and approach to the HHR modelling process and support to analytical capacity development.

Within the broad pan-Canadian planning framework, key questions remain: Are the current plans for the supply of health care providers adequate to meet our future needs? What is the effectiveness of different policy approaches to meet these needs? The ongoing challenges for HHR modelling within a needs-based planning context are for better information, evidence and data, as well as improved research capacity, knowledge translation, infrastructure development and stronger linkages of HHR to key health system issues. Broad partnership support and strong leadership are needed to move the approach forward.

Participants identified a number of priority areas where immediate action was required, particularly in the areas of data development, capacity building and partnerships to support the overall modelling process. The Workshop acknowledged that it was particularly important that the dialogue between researcher-modellers and decision-makers be developed and strengthened. It was recommended that a general planning workshop be held every two years.

Workshop on Data and Modelling for Effective HHR Planning (2009)

This Data and Modelling Workshop focused on the most recent data and modelling projects in Canada to identify their successes and to propose realistic actionable solutions to address any gaps identified. A broad range of presentations were made by modellers, decision-makers and employers covering activities and perspectives from Manitoba, British Columbia, Nova Scotia, New Brunswick and Newfoundland and Labrador. In addition, British Columbia and Ontario shared their state of the art models. A number of provinces were planning to invest in needs-based planning approaches to HHR. Significant interest was expressed in simulation models that emphasized a range of health delivery models that utilized health professionals to their full competency levels to improve workforce productivity.

Participants focused on developing over a dozen project proposals to address the HHR planning gaps and problems which had been identified. The top four priorities included: a needs-based planning approach for minority populations with identified needs; expanding the national HHR database to include additional health professions beyond the seven which are now covered; a rapid response modelling toolkit to promote knowledge exchange on forecast modelling; and establishing a pan-Canadian health human resources Observatory to monitor, coordinate and promote collaborative HHR initiatives and knowledge exchange.

1.3 Objectives

Guided by the objectives of the Pan-Canadian Planning Framework, and building upon the survey work completed by *Vestimetra International Incorporated* in 2004-05 and the results of the 2007 Vancouver Data and Modelling Workshop, the objectives of this current project were to:

i) Update the inventory of HHR forecasting models across Canada;
ii) Review and assess model utilization;
iii) Identify forecasting needs of provinces and territories;
iv) Assess the gaps between capacities and needs in the forecasting abilities of jurisdictions across Canada; and,
v) Identify issues and challenges and to recommend next steps.

2.0 APPROACH AND METHODOLOGY

2.1 General Approach

In recognition of the need to have reliable modelling and forecasting tools to support provincial, territorial and national HHR planning initiatives, this updated inventory, analysis and assessment of current forecast modelling activities identifies some of the strengths and limitations of various approaches, as well as opportunities to support and enhance evidence-based HHR planning.

In light of the challenges that persist around the broad, long-term goals for HHR forecast modelling outlined below, the project updates the Vestimetra International Incorporated HHR forecast modelling review of 2005 by providing an inventory of all new models, those currently in use and those under development. It also provides a description and cross-comparison of model components and their application and considers how they are being administered, monitored and evaluated.

This report uses to advantage the analytical framework development by Vestimetra. This methodological approach allowed for a more thorough comparative review of inter-jurisdictional modelling capacity and development between 2005 and 2009. It also allowed the consulting team to spend less time on survey design and to place greater emphasis on the analysis of survey results.

The final component of the review includes the development of options and strategies to support forecast model development as well as broad criteria to facilitate model selection.

2.2 Methodology

Stage One: Update of the Inventory of HHR Forecasting Models

The principal source of data for this component of the forecast modelling project was through an e-mail questionnaire directed to those involved in the development and application of HHR forecast models who were willing to share their experiences.

The 2004 list of modellers was updated through the F/P/T Advisory Committee on Health Delivery and Human Resources, universities and through contacting individual modellers directly.

The *updated model inventory questionnaire* identifies models by type (supply, demand), scope (regional, provincial, national), development costs, provider group (nurse, physician, etc.), model timing (frequency of forecasts), model assumptions, data variables and model history (creator, time in development and in-service).

Details were collected where available on how and when the model was *implemented*, whether it was successful and what modifications have been made to strengthen the model, how the model is being utilized, as well as how it is being administered and whether it is labour intensive or user-friendly.

Capacity for model *evaluation* was also considered. Is there a plan to measure the effectiveness and accuracy of the model and has it been applied? What were the results of the evaluation? Is the information provided transferrable or accessible by other jurisdictions? Is there a mechanism for transferring forecasted results to HHR policy makers? And most critically, have model results been used to advance policy and planning decisions?

How do the inventoried models *compare* with respect to their utilization of population health need indicators, their methods and sources of collecting and calculating health workforce supply and the range of health professions and disciplines for which data are being collected? Do they have the capacity to do simulations regarding HHR training and productivity, etc. under different planning assumptions?

Stage Two: A Comparative Analysis of the Needs of Decision-Makers for Forecast Models

The principal source of data for this component of the forecast modelling project was through personal telephone interviews with decision-makers, i.e., senior administrators with responsibilities for health human resources who would have a need for - and were most likely to utilize - HHR forecast model results to inform their HHR management processes. An interview guide was send to all respondents in advance of the interview.

The 2004 list of decision-makers/model-users was updated primarily through the F/P/T Advisory Committee on Health Delivery and Human Resources.

A personal interview format was chosen with the decision-makers in order to have the opportunity to explore in sufficient detail the more specific needs and concerns of those interviewed than a mail-out questionnaire would allow. The government decision-maker interviews included a broad range of individuals including Assistant Deputy Ministers, Executive Directors, Directors of Health Human Resources, Managers of Modelling Units, Project Leaders and hands-on forecast modellers within the respective Ministries of Health.

This open dialogue was very helpful in exploring current and emerging HHR planning and modelling concerns, plans and priorities. The kinds of models being considered, as well as opportunities for future collaboration both inter-provincially and with the federal government, were also explored.

2.3 Caveats and Limitations

By and large, the level of support for forecast modelling was considerable. Those who responded were extremely generous with their time, and the leads, contacts and additional documents that they provided were very helpful in conducting the final analysis.

There were a number of limitations to the review however:

- Despite a number of attempts to contact them, not all of the modellers responded to the survey. Those no longer in the modelling business were often the hardest to reach. In some cases modellers had moved on to other endeavours while others indicated that they were either planning to get involved in the work again or that they simply no longer pursued these activities.
- In light of the above, we chose to focus on the more current and prominent modellers and modelling activities that were identified by government and health professional association survey respondents. Our overall response rate for decision-makers was well over 90 percent, while the response rate for modellers was ov 80 percent.
- Given the nature of their work, copyright restrictions, proprietary information, and the competitive environments in which they work, any information regarding models being developed by private companies were obtained, on a limited basis, primarily through the purchasers of these services.
- What is recorded in our tables and summaries represents what we were told in interviews or had gathered through the survey process. If disparities arose between information collected in interviews and questionnaires, attempts were made to validate information through supplementary sources and official reports where available.
- In those instances where interviewees may have responded on a confidential basis, we elected to reflect their views and concerns - without attribution - in the discussion and challenges section of the report and in the recommendations.
- Despite high developmental and implementation costs, few models have been formally evaluated. Model development seems to be driven more by emerging needs than past successes. Although concerns were raised, there were limited findings to report regarding model assessment.

- Finally, and perhaps most importantly, if this inventory had been conducted six months later the results and level of detail available may have been significantly different given that a number of new forecast models are currently being developed and implemented.

  For example: Alberta is making a considerable investment in a new needs-based planning approach through Praxia and Hay which should be available before the Fall of 2009; the Canadian Nurses Association is launching the results of a major new modelling initiative by a team lead by Dr. Tomblin Murphy in May 2009; Ontario has commissioned the Conference Board of Canada to develop a population needs-based physician forecasting model, as well as Gail Tomblin Murphy's team to develop needs-based simulation models to support planning for three nursing groups; and, Nova Scotia began implementing a set of needs-based simulations models, adapted from Med-Emerg Inc. work and lead by Gail Tomblin Murphy's team, in November 2008.

Despite these concerns, we are confident that the most significant forecast modelling initiatives currently in operation in Canada have been identified.

3.0 HEALTH HUMAN RESOURCES PLANNING

3.1 Scope of Health Human Resources Planning

Health human resources (HHR) planning is about ensuring that there are enough health workers to meet the health care needs of the Canadian population. The aim of HHR planning is to provide the information and tools needed for decision makers to make informed and strategic decisions in getting and keeping the health workers that are required and making the best use of their skills within a health system that is affordable and sustainable.

The traditional approach to health human resources planning in Canada has relied primarily on projecting current utilization patterns into the future (taking into account changes in the total size, and age-sex structure, of the population), estimating the resulting requirements for increased supply in specific health professions, and then determining if currently-projected supply will be adequate to meet those requirements. Responding to short-term concerns, this approach has equated utilization of services with need for those services. A needs-based planning approach on the other hand attempts to estimate future health needs on the basis of the estimated health status of the population. It also considers the potential for addressing identified needs using a mix of different health human resources to provide effective health services in more efficient ways.

A broader more comprehensive and integrated approach to health human resources planning, developed by O'Brien-Pallas and others in 2005, identified the major factors that impact on the HHR planning process. In addition to considering the current factors of supply, education and training and HHR management and deployment, this approach considers some of the system-wide factors (social, political, geographic, economic and technological) that define health needs, shape the health care delivery system and determine the health human resources needed to support it.

Central to this approach is the recognition that HR must respond to the health care needs of the population. Planners, researchers and decision-makers must have a clear picture of the current and predicted health status of the population including the prevalence of disease and death rates, injuries, chronic ailments and those with restricted mobility. In addition to the broad factors noted above, population health needs are also influenced by other factors that contribute to health including people's genetic make-up, how healthy they feel and how they choose to manage their health issues. The social and physical environments in which they live, their income, their accessibility to and the quality of the health care services that they receive - and the way that they receive it - *all* affect the health needs of the population, their health choices and the outcomes of these choices on their health status.

Having the right supply, distribution and appropriately deployed health workforce is critical to having an effective and efficient health care delivery system. Policies on licensure, recruitment and retention and education and training - as well as the factors that contribute to labour force participation, employment status, mobility and attrition - all impact on the availability of health workers and the stability of the health workforce. The efficiency and effectiveness of health service delivery depends to a large extent on the appropriate use of health personnel.

Given the overall complexity of the health system, it is important that HHR plans and forecasts are updated and assessed regularly. The fiscal capacity of governments to implement health reform initiatives, and their ability to respond effectively to emerging health system priorities and trends, is of particular importance given the growing inter-jurisdictional competition for limited health human resources.

The management, organization and delivery of health services also contribute to health outcomes by influencing the way work gets done, the amount and quality of care provided, provider health and job satisfaction and the costs of service delivery. An appropriate mix of human, fiscal and other resources are needed to achieve a healthier and more stable health workforce and to enhance the overall effectiveness and efficiency of the health service delivery system.

Health human resources must be considered within the broad range of factors noted above that impact on the health system's capacity to delivery effective and efficient health care services. Stronger linkages between HHR planning and health services delivery are necessary to ensure maximum program coordination and mutual support. A greater alignment of government priorities in planning, management and spending is needed to achieve sustainable results.

3.2 Role of HHR Forecasting

Given a climate of growing fiscal restraint and increasing competition for limited resources, the importance of having effective planning tools to better inform government decision-making processes is becoming more critical. While in the past forecasting was mainly used to determine future HHR supplies and the appropriate output of health professional schools to meet estimated requirements, the increasing complexity and rate of change within the health care delivery system has demanded that forecasting also evolve to become more responsive to and reflective of the complex planning needs of governments in both the short and longer terms.

As such, there is increasing demand for governments to develop and implement HHR modelling and forecasting tools that more successfully contribute to evidence-based planning by:

i) identifying emerging trends and issues;
ii) estimating future gaps between health workforce supply and population health service needs;
iii) determining the degree of alignment between the output of the health education system and the long-term requirements of the health care delivery system;
iv) considering the impact and risks of inaction and continuing the *status quo*;
v) projecting, *a priori* through simulation, the probable long-term impacts of new programs, policies, funding mechanisms and management strategies;
vi) determining which kinds of changes to health delivery and health workforce deployment will have the greatest impact on health system efficiency and effectiveness;
vii) estimating the impact of social, political and economic factors external to the health care system on its performance and sustainability; and finally,
viii) helping to develop appropriate options and contingency plans should existing policies and programs not achieve the desired long-term results.

While it is understood that HHR forecasts are only one component of the complex fiscal and political decision-making processes within governments, the more robust, timely and supportable the forecasts are, the more valuable their contribution will be to this overall planning and resource allocation process.

3.3 Role of the Health Regions in HHR Forecasting

While the health regions (District and Regional Health Authorities) were not officially surveyed in this review, discussions were held with select officials on health human resources planning.

In the Atlantic provinces, where the DHAs are relatively small, they tend to participate in broader provincial HHR planning/modeling exercises. For the most part they do not have sufficient critical mass, influence or capacity to engage in their own HHR modeling/planning exercises. In many of the smaller provinces the role and capacity of district/regions to engage in HHR modeling is also limited. As a result the districts/regions tend to lobby for their fair share of medical specialists, GPs and other health professional groups based on anticipated vacancies and retirements, or as part of new program planning, all part of a provincial exercise where districts/regions make their case for additional staff. In most cases, HHR planning at the district/regional level is based on real or anticipated vacancies rather than on any population needs-based planning criteria.

The reality for many districts/regions throughout Canada that service rural areas is that they are facing disturbing shortages in so many of the medical specialties and nursing in particular that the idea of concerted planning has basically broken down into recruiting whomever they can from wherever they can. Short-term and crisis planning tends to dominate the agenda with long-term planning being a much lower priority. Many districts/regions are facing significant pressures to keep services afloat amidst personnel shortages and increasing staff turnover and

chronic vacancies. When specialists leave in critical areas, service delivery is often significantly compromised. Shortages in nursing present particular problems in rural areas and in specialty fields such as critical care and long term care. In times of shortages, rural areas are hit harder still as medical specialists, nurses and other health professionals gravitate to larger urban centres because of greater flexibility regarding on-call schedules and better peer group support.

Some of the larger districts/regions do engage in more elaborate HHR planning (including forecasting) which is then rolled up into a provincial/territorial plan. This is particularly so for those RHA/DHAs that are affiliated with medical schools. In these cases their medical staff numbers are so large and their programs so complex that they really do need to keep a firm handle both on their current numbers and on their projections of future need. Workforce planning tends to be a part of the larger district/regional budget and strategic planning process with an emphasis on needs "at the coal face," while utilizing basic linear projections with an eye on expected service growth levels. While there is a broad range in capacity and interest across districts/regions to engage in modelling initiatives, by and large they contribute to the overall process but leave the more complex forecasting initiatives to be developed at the provincial level.

That being said, regions/districts do possess a wealth of information to support the forecast modelling process. Payroll information, provincial pensions data, utilization data (workload measurement), population health data, clinical practice standards, patient acuity data and broad HHR indicators all provide depth, power and relevance to workforce analysis and needs determination. While it may not be possible or appropriate for most regions/districts to engage in sophisticated forecasting activities at this time, it is recognized that they do represent important partners in the ongoing development of workforce planning, data development and access and in HHR modelling development and application processes.

4.0 DECISION-MAKER SURVEY FINDINGS

4.1 The Perspective of Model Users/Decision Makers

Methodology

Using a standard interview guide (see Appendix C), responses were obtained from persons in mid/senior management positions in all ten provinces, two territories (Yukon and Nunavut) and two national organizations (the Canadian Medical Association (CMA) and the Canadian Nurses Association (CNA). In each case, the respondent was the person who represents their jurisdiction/organization on the Advisory Committee on Health Delivery and Human Resources (ACHDHR), or a delegate for that person. For purposes of this survey, this group of respondents was referred to as 'decision-makers,' to differentiate it from the other group of respondents for this study – the 'modellers.' For a list of the 'decision-maker' respondents, see Appendix D.

In almost all cases responses were obtained via telephone interviews (which lasted approximately 60 minutes). [1] The questionnaire, accompanied by a letter of introduction, was distributed to respondents prior to the telephone interviews.

Key Findings

- All provinces, plus the CMA and CNA, use forecasting models (or have used in recent years) to assist them with their health human resources planning. The majority of forecasting models in use are projection models; the rest are needs-based models as set out below. (See definitions and details in Appendix E.)
  - *Projection Models*: NL, PEI, NB, ON, SK, AB, BC, CMA
  - *Needs-Based (or partially needs-based) Models*: QC (for family physicians); MB (for nurses), CNA (for nurse practitioners); NS (for physicians, RNs and MRTs)
  - *No formal forecasting models used:* YK, NU

- When asked if and how their current models could be improved, most respondents said that the availability and quality of data, especially on the supply side of their models, are the principal areas for improvement – and they hope/plan to make these improvements. (See Appendix F for details.)

  The following are representative of respondents' comments on this topic:
  - We have difficulty in obtaining reliable data about some professions. We are developing a service provider registry to address the problem of obtaining data about certain professions.
  - Good basic data are needed - re: workforce movement; and educational seats, attrition & graduates. We are continuing to work with associations and undertake targeted studies to quantify some of these factors.
  - We are working with CIHI and the professional colleges to build a data base (re: allied health professions).
  - We lack quality, standardized data. We want to get our data shop in order – e.g. develop standardized data sets.
  - Our biggest problem is availability and quality of data. 90% of the effort to build our new model is regarding data.

- The provinces that currently use projection models generally find them adequate for their current needs, and give reasons such as the following for why they have not to date attempted to build needs-based models:
  - Needs are difficult to define and/or measure; Needs-based models are complex.
  - Limited resources (human and financial) are being devoted to improving existing projection models.

[1] The only exceptions were Nunavut (which submitted written responses) and Newfoundland & Labrador (which submitted written responses and then provided additional information in a telephone interview).

- Nevertheless, virtually all provinces and territories, plus the CMA and CNA, said they believe needs-based models are a good idea in principle, and they would be interested to learn about others' accomplishments and efforts in this regard. (See Appendix F for details). Particular interest was expressed by several respondents in Alberta's needs-based model, which is currently under construction.
- The number of respondents currently building needs-based models is relatively small:
  - Alberta is building needs-based models for MDs, RNs and MLTs in that province, and hopes to have something ready by late 2009.
  - The CNA is building a national needs-based model for RNs, and plans to unveil this model at a news conference in May of this year.
  - Ontario is building needs-based models for MDs, RNs, NPs and RPNs in that province.
- On the issue of inter-jurisdictional collaboration regarding HHR forecasting models, most respondents report that they do not currently engage in effective pan-Canadian collaborative analytical work. They report that they do share information about HHR forecasting and modelling, but don't 'roll up the sleeves' in order to fully understand others' models – but they would like to do so, and are generally willing to share their own models with others.

  Respondents in Western and Northern Canada report that effective collaboration at the regional level is currently occurring, via the Western & Northern HHR Planning Forum.

  Looking to the future, most respondents see pan-Canadian collaboration as being potentially productive. Some respondents (especially in the western provinces) see collaboration at the regional level as the most productive.

  In terms of how to foster inter-jurisdictional collaboration, many respondents support the federal government being a facilitator (and notably a funder) of collaboration among provinces and territories – and several cited Health Canada's funding of the Western and Northern HHR Planning Forum as a positive example. On the issue of who should provide the intellectual/organizational leadership regarding collaboration, those respondents who expressed an opinion did not support the federal government playing this role. As just noted, some respondents favour *regional* P/T collaboration; in terms of potential *pan-Canadian* P/T collaboration, the possibility of CIHI playing a leadership role was mentioned by two respondents.

  The comments made by respondents re: collaboration included the following:

  - The collaboration has to be at the technical/analytical level. There is value in putting provincial researchers & forecasters together to share/compare their provincial-level models and other knowledge…[C]onnect people to grind real work out.
  - A useful role for the federal government is to fund collaboration among P/Ts at the analytical/technical level; this will aid capacity-building.
  - The main collaborative work that is done outside of actual meetings of ACHDHR (or the HHR Planning Subcommittee) is among P/Ts, without the federal government.

  - Perhaps the best role for the federal government is to figure out a mechanism to help P/Ts do knowledge transfer from one P/T to another

- During several interviews, the issue of sustainability of the existing health care system arose. Among those expressing a view, the consensus is that sustainability is at risk (in financial terms and/or HHR terms), and is not ye being adequately addressed. Among the comments on this topic:
  - There is currently a shortage of 800–1,000 family physicians in my province, mainly in rural regions. This can't be solved simply by increasing seats. We will need creativity…increased productivity of MDs, more IMGs and NPs.
  - We need to look at efficiency, and ways to increase productivity.
  - Public expectations are a challenge…wants are viewed as needs…Half of the growth in expenditures comes from utilization increases. We need to look at utilization.
  - We also need to look at appropriateness of care….We need to follow clinical-practice guidelines – e.g. we do far too many MRIs.
  - We must start thinking more about how we deploy/utilize our current workforce. There is tremendous opportunity in this area.
  - The lack of clear health goals is a major problem; you need to know what you're trying to achieve before you design and staff a delivery system.

5.0 MODELLER SURVEY FINDINGS

5.1 HHR Modelling in Canada

Health care services are financed and delivered primarily through Canada's public sector rather than its private sector. Consequently HHR planning is central to Canada's health care system. Federal/Provincial/Territorial/Municipal governments each play different and complementary roles in financing and delivering health care. Achievement of health policy objectives through maximization of health outcomes requires that human and other health care resources be allocated efficiently.

The Canada Health Act established five principles for Canada's Medicare insurance system: universality, comprehensiveness, portability, public financing and zero co- payments. Provincial governments are most actively engaged in HHR planning than other levels of government because they are directly responsible for delivering services insured by the Canada Health Act, and other health care programs. HHR planning informs decision-makers about current or impending HHR imbalances. Decision-makers may then initiate appropriate policy, program or administrative changes to avoid or alleviate HHR imbalances.

Modelling Public Sector Demand for HHR

Public sector demand for HHR is determined by many factors. Jurisdictions and organizations choose to model public sector demand in various ways, according to their particular HHR

planning needs and resource constraints. Demand, as an economic concept, exists when wants or needs are manifested as expenditures through the actions of decision-makers with fiscal capacity and willingness to pay. The demand for private sector consumer goods and services reflects the individual tastes, preferences, needs, fiscal capacity and willingness to pay of consumers. The demand for public sector goods and services reflects, in principle, the collective tastes, preferences and needs of citizens as manifested through public policy, contingent upon fiscal capacity and willingness to pay. Total demand for public sector health care services and HHR is constrained by the public's competing demands for other public sector programs and limited fiscal capacity.

Modelling the supply of HHR to the public sector

The supply of HHR to the public sector is also determined by many factors. Supply, as an economic concept, refers to the collective willingness or persons to accept employment when certain job opportunities, compensation packages and working conditions are offered. The supply of HHR to a public sector jurisdiction is the number of persons willing to accept employment in response to the jurisdiction's demand for HHR. If HHR demand equals supply there is no imbalance. If demand exceeds supply there will be shortages and unfilled vacancies. If supply exceeds demand there will be surpluses and unemployment.

HHR supply is a different concept than the stock of HHR licensed to practice within a jurisdiction in regulated occupations at a given point in time or time period. Modellers agree on how to model inventories of HHR stocks and net flows. Modelling HHR supply presents many more challenges and choices. Consequently, HHR supply models differ greatly with respect to which supply factors to model, besides stocks and flows. HHR in- and out-migration tends to alleviate shortages and surpluses. Response times may be unacceptably long, however. Decision-makers may exercise various policy options in order to reduce current imbalances more quickly and to avoid future imbalances. Short-term options include changes in HHR recruitment and retention practices. Long-term options include changes in HHR training strategies.

Policy relevance of HHR demand and supply estimates

Estimating future demand and supply of public sector HHR is inherently difficult and uncertain. HHR models range from basic to complex. Estimates may be highly aggregated or very specific by occupation, age and sex. For smaller jurisdictions, basic HHR models of total demand and supply for a few occupations may be sufficient. Smaller jurisdictions dependent more on in-migration of HHR trained elsewhere and have fewer policy options available. Larger jurisdictions which train a substantial portion of their HHR may require more complex and specific models. More complex and specific HHR simulation models cannot remove the uncertainty associated with forecasts, but they can simulate many scenarios that are relevant to decision-makers.

5.2 Summary of Inventory of HHR Forecast Models

Methodology

The principal source of data for this component of the forecast modelling project was through an e-mail questionnaire directed at those involved in the development and application of HHR forecast models who were willing and able to share their respective experiences. The tables also include some supplementary data from other sources and reports, including interviews with decision-makers as well as follow-up correspondence with select modellers.

The 2004 list of modellers developed by *Vestimetra International Incorporated* was updated through the F/P/T Advisory Committee on Health Delivery and Human Resources, universities and through contacting individual modellers directly.

The updated model inventory questionnaire identified models by type (supply/demand), scope (regional, provincial, national), provider group (nurse, physician, etc.), model timing (frequency of forecasts), model assumptions, data variables collected and considered and model history.

Key Findings

This section provides a *summary* of the inventory of forecast models. More detailed findings can be found in Tables 1 to 14 in Appendix A of this report.

Scope of HHR Modelling Capacity within Jurisdictions

- All jurisdictions, with the exception of PEI and the Territories, were actively engaged in HHR forecasting modelling, with six provinces undertaking modelling for the health regions.
- While PEI, NB, NS and NL all participated in HHR planning at the Atlantic regional level in affiliation with the Atlantic Health Human Resources Association, provincial models with the Region continue to evolve unilaterally, using the models developed by Fujitsu in NB and Gail Tomblin Murphy et al in Nova Scotia.
- Major new initiatives looking at the needs for HHR have been undertaken by Praxia and Hay in Alberta. The Ministry of Health and Long Term Care of Ontario has also commissioned the Conference Board of Canada to review physician HHR needs, as well as Tomblin Murphy and partners to examine the need for nurses in that province. The Nova Scotia Department of Health, also in collaboration with Tomblin Murphy and partners, is reviewing the need for nurses, family physicians, MRTs and Medical Imaging Assistants.
- Manitoba has developed a simulation model to forecast nurses, Alberta is developing a Health Workforce Information Network and BC is developing a forecasting model with the Health Employers Association of British Columbia.
- At the national level Health Canada has developed the MSDAD Physician Supply Model, the CMA continues to apply its Physician Resource Evaluation Template and the CNA is developing a national simulation model for nurses with Gail Tomblin Murphy and others.

Health Occupations Included in HHR Models

- The number of health professions being modelled has expanded significantly since 2005. As models become more robust and data becomes available, they are being applied more widely to a variety of health professions and disciplines.
- While the survey only recorded responses for about a dozen health disciplines, many jurisdictions far exceeded that number. New Brunswick for example has modelled twenty occupations while the Conference Board of Canada analysis includes fifty-nine medical specialties.

Supply Variables Included in HHR Models

- In both 2005 and 2009 HHR supply models included many of the same variables (stock, annual additions and attrition, output from educational programs and employment status). There was no consensus about which labour market and government policy variables to include in HHR models. Manitoba had one of the more complete models with respect to labour market variables while the CMA and Ontario tended to include a wider reflection of government policies in their modelling design.
- Between 2005 and 2009 there was a slight shift from a fixed to a variable representation of supply-side model factors. Walker Economics and the Conference Board of Canada (Ontario), Manitoba and B.C. all provided a strong showing in this regard.

Supply Model Variable Characteristics

- There was a wide range and diversity of the characteristics of the components used in the supply components of the models by jurisdiction.
- The majority of jurisdictions used models based on historical data representing global populations. An increasing number were expanding their supply-side population variables by age and sex to also include educational data, immigration and career patterns.

Demand Variables in HHR Models

- Similarly with respect to demand factors, most jurisdictions were relying on variable rather than fixed assumptions about population demographics, health-care needs and health services utilization.
- The Conference Board of Canada appeared to include the widest number of variables in their estimates of the demand for physician services.
- Nova Scotia has looked at a broad number of factors including population demographics, population health status, self-assessed health status, health care needs, and income adequacy, all with fixed variable assumptions.
- Only two jurisdictions reported including socio-economic variables in their demand calculations, while no jurisdictions included government policy variables.

Demand Model Variable Characteristics

- A far greater number of factors are used in supply-side modelling, with population distribution and health care utilization being the main considerations in demand-side determinations.
- While more jurisdictions are beginning to investigate needs-based planning, only three jurisdictions have been exploring this area (NS, Ontario and Manitoba) on an ongoing basis.
- Components used in demand modelling are most often based on historical data broken down by age and gender.

Model Collaboration and Pan-Canadian Applications

- Most jurisdictions agreed that it would be useful to have consistent standards or guidelines across the nation, but some also feared that national level forecasting may not be sufficiently sensitive to and reflective of local area variations.
- Most of the suggestions for stronger federal support noted the need to enable greater access to data for researchers. The creation of a national networking mechanism to foster communication, share expertise and facilitate comparative project development and implementation among jurisdictions was also mentioned.

Challenges in Model Sharing

- Most respondents reported challenges in sharing their models with other jurisdictions. The most common challenges related to copyright issues and the fact that models were generally specific to local requirements and not always applicable to other jurisdictions.
- Almost every jurisdiction reported that there were possible benefits of inter-provincial partnerships, including greater shared knowledge and technological insights among forecasting organizations, more consistent inter-jurisdictional data collection, greater savings in model developmental costs and improved modelling capacity overall.

Ongoing HHR Forecast Development Priorities

- Most jurisdictions expressed the desire for better data to enable them to produce more accurate and timely results and projections.
- More information is sought regarding the net impact of expanding health program enrollments. Better and more versatile modelling software is also being sought. There is also an expressed desire to further develop their modelling capacity, including simulation modelling and model evaluation.
- An expressed interest in sharing modelling practices, in developing data sharing agreements and in working cooperatively with other stakeholders, emerged as common themes.

Knowledge Transfer Mechanisms, Barriers and Utilization

- The majority of respondents communicated with policy-makers through reports and presentations while others used seminars and publications to relay information.
- While some respondents produced media releases, scientific papers and government reports, budgets reductions sometimes limited their distribution.
- Most jurisdictions report that the results of their forecast modelling were used by the organization for which the results were produced. Some utilize the results of their modelling activities to develop more effective HHR recruitment and retention strategies and to better align the enrollments of health professionals schools with perceived HHR needs.
- While modelling has helped to identify HHR resource gaps, knowledge transfer is still limited because much of the research is still conducted in silos.

HHR Data Problems

- Twenty-five percent of all respondents indicated that lack of cooperation with data providers, lack of resources to exploit available data and the fact that the data often could not be disaggregated, as their most significant data problems.
- The lack of timely access to data was the next highest concern. Lack of timely, current accurate and comprehensive data ranked next on the list of priority data issues.
- In comparison with 2005, lack of resources to exploit available data and the lack of access to timely data were of primary concern to fifty percent of all respondents.
- It is noteworthy that lack of cooperation with data providers (ranking at the top of the list in 2009) was listed as the least persistent problem in 2005, with only ten percent of jurisdictions indicating that it was a concern.

Reported HHR Data Sources, Aggregation and Availability

- Many of the provinces extract data from a wide range of both provincial and national databases as well as local organizations. This illustrates the complexities that can arise when attempting to transfer and share data between jurisdictions.
- Of the data collected, about half was being aggregated at the group, rather than individual level.
- Difficulties in retrieving data varied, depending on the jurisdiction and the level of information required. For example, while some found Statistics Canada and CIHI difficult, most jurisdictions ranked them among the easiest from which to obtain data. Similarly, while some found professional associations/regulatory bodies easy with respect to obtaining data, most found them difficult.
- By and large, it seemed somewhat more difficult to obtain required HHR data from national than local organizations.

Active Model Sharing and Potential to be Shared

- For the most part, models have not been shared between jurisdictions. Traditionally there have been greater opportunities and relevance with respect to sharing activities and results of national modelling activities than there have been at jurisdictional levels.
- While the responses to the question regarding the potential to share their models were not particularly complete, post-survey correspondence from a number of jurisdictions has suggested that the potential is there if more collaborative opportunities were provided.

Modelling HHR Supply and Demand in Canada 2009

- Some jurisdictions rely on comparatively basic HHR supply and demand models developed prior to 2005, while continuing to invest in more timely access to quality data. Others have invested heavily in developing new HHR models and data acquisition.
- While the more basic HHR models have been developed within Departments of Health, the more complex models have been commissioned externally, often at considerable cost, with university-based or private sector experts in the field.
- The CNA, Alberta, Ontario, and to some degree Nova Scotia, have recently invested most heavily in needs-based planning. It is expected that these models will be completed and applied in 2009.
- Complex simulation models require skilled programmer-analysts to populate and run HHR scenarios which has sometimes been an issue regarding ongoing model application.
- While most jurisdictions reported concerns about retrieving timely and relevant data from health professional organizations, some of the smaller provinces had developed good informal stakeholder partnerships that have resulted in timely access to quality data.
- None of the forecasting models reviewed at the time of the survey had undergone a thorough evaluation. This was a concern to a number of jurisdictions given the considerable investment that HHR modelling generally required in terms of time, expertise and fiscal resources.

5.3 Commentary on Modeller Survey Findings

Appendix A (Tables 1 – 14) presents the findings from the 2009 survey of HHR modellers in Canada. The commentary below contrasts HHR models and practices developed in period 2005 – 2009 with the New Brunswick Fujitsu HHR demand and supply model developed in 2002. This Fujitsu model is typical of comprehensive utilization-based demand and supply models developed prior to 2005.

Conceptual Frameworks and Modelling Practices from 2005 - 2009

The March 2005 *Vestimetra* survey of HHR capacity and practices in Canada found widespread agreement regarding what was an appropriate HHR conceptual framework at that time (*Vestimetra, 2005).* Comparative reviews of HHR models developed in the 1990's and early 2000's by Arminee Kazanjian found great similarity regarding the demand and supply components included in HHR models of that time period. The February 2009 *Cameron* survey of HHR capacity and practices in Canada found increased diversity in both the conceptual

frameworks and the methods used when modelling demand and supply. This diversity across both jurisdictions and modellers is evident in Appendix A, Table 14, which consolidates data from Tables 1 - 13.

The HHR Conceptual Framework

Since 2005 the conceptual framework for HHR model has expanded somewhat for both demand and supply factors. Most Canadian jurisdictions and modellers continue to work within and apply the earlier conceptual framework, while refining models and improving data access. Other jurisdictions and modellers have included: "needs-based" factors and utilization patterns within demand models; productivity factors within demand and/or supply models; socio-economic, labour force participation and public sector employment factors in their supply models. Formerly static models were enhanced to simulation models where resources permitted.

Utilization-Based and Needs-Based Demand Models

Since 2005 certain HHR demand models are described as utilization-based demand models, common practice up to 2005, while others are described as needs-based demand models. Part of this commentary is divided along these lines. 2009 HHR survey responses, phone interviews and available documents suggested that NL, PEI, NB, QC, MB, SK and BC continue to operate largely within the 2005 conceptual framework, where historical health services utilization patterns and HHR supply patterns served as proxies for public sector demand and supply. Jurisdictions that have moved to needs-based demand models include ON, AB and NS, although the distinction is unclear because these models also rely heavily on historical utilization and HHR supply data.

Various government, university-based and consultant researchers helped to expand HHR conceptual frameworks, methods and applications, with or without simulation models.

Managing Expectations

Modellers are well aware that forecasting HHR supply and demand is an inexact science. Greater recognition and general acknowledgement of the limited precision of HHR forecasts may help to modify unreasonable expectations regarding their role in the allocation of scarce resources.

HHR Model Complexity and Data Requirements

Basic models and minimum datasets may satisfy certain macro-level HHR planning objectives. Only more complex models and expanded datasets, however, are capable of producing forecasts that will satisfy more ambitious micro-level HHR planning objectives.

Basic HHR models may be developed and implemented using standard computer hardware and software, by modellers themselves or with competent programmers. Complex HHR models, including simulation models, may be developed using standard software alone or in combination with proprietary software, but require highly skilled programmers.

Describing the inner-workings of complex simulation models is difficult to do in plain language. Even given good plain language descriptions, understanding what happens within other people's

models is challenging for professionals, let alone to lay persons. To address this issue, complex models are increasingly being re-packaged in user-friendly versions for non-technical users.

Dissemination of HHR Model Forecasts

Manitoba developed and distributed a user-friendly Microsoft PowerPoint version of their Registered Nurse Projection Model (RNPM). This version enables stakeholders, decision-makers and others to explore five-year forecasts of RN supply and vacancies for a host of scenarios. The scenarios menu includes: rate of graduate loss between graduation and registration; attrition from enrolment to graduation; increase in enrolment; expected retirement rate; growth in RHAM RN positions; growth in EFT/positions; and, public sector employment.

Alternative Approaches to HHR Modelling and Data Acquisition

Evidence from the 2005 and 2009 pan-Canadian HHR surveys found considerable diversity of both HHR models and data acquisition practices across jurisdictions and organizations. Diversity increased from 2005 – 2009. This constitutes a form of natural experiment and presents opportunities to gather evidence on the benefits and costs associated with alternative HHR planning and modelling practices.

Towards Evidence-Based HHR Planning and Data Acquisition Practices

The benefits and costs associated with the development, implementation and maintenance of complex HHR models, relative to simpler models, are not presently known. New concepts and methods for modelling and implementing HHR forecasts should be encouraged. HHR modellers and decision-makers in most jurisdictions, while continuing to rely on standard HHR methods, want to know what may be gained from the adoption of alternative modelling and data acquisition practices.

Each jurisdiction and organization engaged in HHR planning made their own assessments about what type of HHR model and dataset would best meet their needs, subject to budget constraints. Given the current state of the art, HHR planners and modellers should be encouraged to explore novel ways of conceptualizing, measuring and modelling health care needs as a determinant of health care and HHR demand.

Some jurisdictions and modellers have found that that simpler HHR projection models, populated with within-jurisdiction data, are more transparent, user-friendly and policy-relevant than more complex models, populated with various local, regional and national data. Simpler HHR models require only modest computer skills and standard software. Simpler models that are shared with local data providers encourage cooperation among stakeholders, which results in more timely access to high quality data. Consequently, HHR forecasts from basic models seem to meet the HHR planning needs of some decision-makers, particularly in smaller jurisdictions.

Access to person-level data enables modellers to enhance and populate basic models and to develop and populate more complex models. Person-level HHR utilization, needs, supply and MIS data enables modellers to develop and populate more detailed, targeted and policy-relevant models than is possible with group-level data.

The robustness and credibility of HHR forecasts is typically greater for larger than for smaller jurisdictions, and for larger than for smaller occupations. Projections for sub-specialties are feasible only for very large jurisdictions. Timely access to the high quality data required to populate complex HHR models continues to improve, but remains a concern in all jurisdictions.

Using HHR Simulation Models to Evaluate Alternative Modelling Practices

Complex simulation models were developed to forecast HHR demand and supply for various scenarios. The same simulation models could be used to study the robustness and sensitivity of HHR forecasts, by simulating various HHR models and data acquisition scenarios. For example, scenarios could include/exclude particular demand or supply factors, while populating models with all or a portion of available data. Simulation models may be able to do this quickly and at modest cost. If a pilot project demonstrated the feasibility of estimating the comparative effectiveness of competing HHR modelling and data acquisition strategies, then a subsequent study might simulate their cost-effectiveness.

5.4 Developments in HHR Modelling and Data Acquisition

The Fujitsu HHR Model (2002)

The Fujitsu model and report developed for New Brunswick in 2002, "Health Human Resources Supply and Demand Analysis," is representative of comprehensive HHR demand and supply models prevalent prior to 2005. [2] The Fujitsu generic model and minimum data requirements were designed to estimate public sector demand for twenty-seven occupations over five and ten year projection periods. Data requirements included historical HHR stocks and flows; historical data on population demographics and health services utilization; recent trends and technological change and anticipated changes in HHR demand. Data requirements by occupation were extensive. Yet forecasts were made for twenty of the twenty-seven occupations of interest.

New Brunswick continues to use the Fujitsu model. Although population health status was included in the Fujitsu model's conceptual framework, in practice the model uses only historical health services utilization and HHR stocks data to forecast demand for public health services and the derived demand for HHR.

In HHR "utilization" models, historical health services utilization data serves as a proxy for (unmeasured) public sector demand for these services. Demand is constrained by a jurisdiction's global budgets and their allocations between health services and other programs.

The Manitoba Registered Nurse Projection Model (RNPM)

The Manitoba RNPM is a supply and demand model populated with person-level data. On the supply-side it includes person-level RN supply stock and flow data. On the demand side the Manitoba RNPM is ground-breaking in the specificity, quality and timeliness of its RN public sector demand data. The Ministry of Health and Healthy Living funded a position to oversee the

[2] http://www.gnb.ca/0051/pdf/; HRStudy/ SupplyandDemandAnalysis.pdf; http://www.gnb.ca/ 0051/pdf/HRStudy/ DirectionPhysicianWorkforce.pdf. See also James Ayles, ACHDHR Vancouver Workshop PPT Presentation, 2007.

standardization of HR data collection to ensure consistent and automated records of HR flows between Regions. The record goes to the individual in the position and at what capacity the position has been filled. The employee ID attached to a position enables the determination of an employee profile including their hours worked, whether they are employed in multiple jobs, working casually, have been previously retired, etc. The elimination of paper and previous Excel surveys facilitated RHA buy-in to the new software. Employee records can now be better streamlined with records from benefit parties (Blue Cross, Health Care Employees Benefit/Pension Plan (HEPP/HEBP), etc. In the near future, it is expected that the HHR data will be linked to staff mix and to the Health Workplace Project.

This person-level data is derived from quarterly updates from the payroll systems (QHR) from ten of the eleven Regional Health Authorities. The specificity and timeliness of Manitoba's RNPM five-year projections of RN public sector demand and supply make this HHR planning and management tool useful at provincial, district and institutional levels. Successful implementation of the RNPM reflects past investments in public sector data systems and in nurturing stakeholder trust and cooperation in order to populate the model with timely high quality data.

The Manitoba Centre for Health Policy - Physician Resource Projection Models

A report by MCHP for Manitoba Health, "Physician Resource Projection Models," was published in February 2009. The report describes a new Equivalent Services Measure (ESM) methodology. An ESM adjusts for billings practices that changed over time, e.g., for annual physicals. ESM for all GP services were constructed from 1984 – 2006 billings data, and for paediatrics, general surgery and orthopaedic surgery from 1991- 2006 billings data. Age-sex-specific trends in each ESM, for all services, were combined with age-sex population projections to forecast ESM utilization in 2010, 2015 and 2020. These ESM utilization projections were then converted to demand for FTE physicians, which were converted to numbers of physicians required, by adjusting for trends in physician demographics, hours of work, productivity and geographic distribution. These new MCHP methods advance the credibility of utilization-based HHR demand and supply models.

Med-Emerg International Inc. (2005 – 2006)

Med-Emerg International Inc. developed a needs-based demand and supply HHR model as part of the Atlantic Health Human Resources Planning Study, done for the Atlantic Health Human Resources Association. This HHR model was developed by Stephen Birch, George Kephart, Linda O'Brien-Pallas and Gail Tomblin Murphy. This Atlantic model included a single need indicator, self-assessed health status. Although designed for the four Atlantic Provinces, it was never fully implemented. [Ref: Med-Emerg Int. Inc., "Atlantic" model, 2005]

A variant of the 2005 Med-Emerg International Inc. model was used in a 2006 the study "HHR Planning and Simulation Model for NPs (Nurse Practitioners) in Primary Health Care" commissioned by the Canadian Nurses Association (CNA). The study team included Tomblin Murphy, Alder, Birch and O'Brien-Pallas [Ref: Med-Emerg Int. Inc., 2006]

Tomblin Murphy Needs-Based Planning Models (2007 – 2009)

A detailed description of a generic needs-based HHR model developed since 2005 is found in: Stephen Birch, George Kephart, Gail Tomblin Murphy, Linda O'Brien-Pallas, Rob Alder and Adrian MacKenzie, Human Resources Planning and the Production of Health: A Needs-Based Analytical Framework, *Canadian Public Policy* (2007) VOL XXXIII, Supplement. [Ref: Birch et al, 2007]

Gail Tomblin Murphy and associates are currently undertaking the five HHR studies described below. Each study applies a needs-based requirements and supply HHR model. This is a proprietary model. It continues to evolve over time and is adapted to meet the particular requirements of each new study. Insufficient detail is available to compare the different versions of this proprietary model. As explained by Adrian MacKenzie (PAHO/WHO HHR Collaborating Centre, Halifax):

"The needs component of our approach to modeling has changed in three main ways: First, where in the Atlantic model we used a single need indicator (self-assessed health status) corresponding to most sectors and professions for the sake of simplicity, we are now selecting indicators (including chronic conditions and injuries and so on) specific to sectors (e.g., acute or long-term care) and professions, and in some cases using multiple needs indicators for a single sector.

Second, where in the Atlantic model (again, for simplicity's sake) our method of projecting future trends in health need indicators was a basic linear projection, we have refined this approach by using an adjusted power trend regression, which is both more realistic and also based on a greater number of data points (we were often limited to two for the Atlantic project).

Third, we have begun explicitly incorporating measures of unmet need into our models, which was done only indirectly in the Atlantic project.

As for our current HHR modeling projects, we are developing needs-based simulation models along the same lines as the Atlantic, NS and CNA models for 3 nursing professions in Ontario, 2 more professions for Nova Scotia (in addition to the 3 we've already done) as part of our evaluation of the new models of care initiative, 16 professions in one Region of Jamaica, and 8 in two Brazilian states."

The studies underway in February 2009 are:

2009 CNA RN Study: Tomblin Murphy, Birch, Alder, MacKenzie, Little, Lethbridge and Cook. The study and model components are described on the CNA website. The study is expected to be completed in the second quarter of 2009. Details of the model are set out below. [Ref: Tomblin Murphy et al, 2009a]

2008-2009 RN Study, Ontario MHLTC Nursing Secretariat: Tomblin Murphy, Birch, Alder, MacKenzie and Lethbridge. This study is expected to be completed in August 2009. [Ref: Tomblin Murphy et al, 2009b]

2007-2009 NS Study (RN's, FP's, MLT's): Tomblin Murphy, Alder, MacKenzie, Pelletier, Murdoch and Denney. [Ref: Tomblin Murphy et al, 2009c]

2008-2009 Jamaica HHR Study: Tomblin Murphy, Alder, MacKenzie, and Tomblin. [Ref: Tomblin Murphy et al, 2009d]

2008-2009 Brazil HHR Study: Tomblin Murphy, Alder, MacKenzie, and Tomblin. [Ref: Tomblin Murphy et al, 2009e]

The last two studies above are being conducted through the WHO/PAHO Collaborating Centre, Health Workforce Planning and Research, Halifax, Nova Scotia.

The Canadian Nurses Association (CNA) 2009 National Simulation Planning Model

The CNA, in collaboration with HHR researchers Gail Tomblin Murphy, Stephen Birch, Rob Alder and others, has created a national simulation planning model, specific to RNs who provide direct clinical care, which estimates the supply of and requirement for RNs (excluding nurse practitioners) in Canada for each year over fifteen years. The model is adaptable to a provincial/territorial context. Unfortunately, due to data limitations, the health needs of the Aboriginal population are not specifically accounted for in this model – instead the model is based on the needs of the entire Canadian population, including Aboriginals. This model is aligned with federal, provincial and territorial policy, which calls for population health needs-based health human resource planning. The model enables the testing of various policy scenarios.

The methodological approach in this study is informed by a conceptual framework developed by O'Brien-Pallas et al. (2005).

The analytical model (Birch et al., 2007) consists of two broad elements: provider supply and provider requirements.

Provider supply is, in essence, the answer to the question "How many providers are available to deliver health-care services to the population?" Supply can be seen as the 'outcome' of two broad determinants:

- The *stock* of individuals, namely the number of providers in each age and sex group who are potentially available to provide health-care services
- The *flow* of provider time from the stock, influencing the quantity of service output – in short, time spent in the production of services. This time depends on:

  - The proportion of the current stock participating in providing health care, or the *participation rate;* and,

  - The quantity of time devoted to service provision by those who do participate in the provision of health care, or the *activity rate*.

In addition to changes in the flow of provider time, the size of the stock changes with new entrants (inflows of health-care providers from other countries together with new graduates from within Canada) and departures from the stock (outflows of providers to other countries, and retirements and deaths among providers). In terms of policy responsibilities, education and training (i.e., the production of new providers) are generally separate from the management and regulation of providers (the use of existing providers). Thus provider supply can be seen as the combination of two components: training of new providers and management of existing providers.

The second element of the analytical model, provider requirements, has four distinct components:

- *Demography:* the number of people by age and gender group in the population.
- *Epidemiology*: the rate of health and illness as well as risk factors for future illness across the population subgroups.
- *Level of service*: the amount of health-care services to be provided for individuals at different levels of illness or risk of illness.
- *Productivity*: the amount of health-care services a full-time equivalent (FTE) provider performs per unit of time.

Because each of these components varies across age and gender groups in a population, the analytical model is applied to each age-gender group to come up with the provider requirements for each group. These results are then added together to provide an estimate of total provider requirements. Combining the first three components of the framework – demography, epidemiology and level of service – yields an estimate of the number of health-care services required by a population, given its size, demographic mix, levels and distribution of health and illness, and levels of service. The fourth component – productivity – translates the number of services required into the number of health-care providers required to perform them.

Building on the analytical framework, this simulation model simultaneously estimates present and future HHR requirements and present and future HHR supply. The model was designed using a system dynamics approach (Forrester, 1968; Richardson, 1991; Sternman, 2000) and implemented using Vensim (2002) simulation software.

Note: The official release data of the report will not be until May 2009.
A copy of the report outlining the model design will be available at:
http://www.cna-aiic.ca/CNA/issues/hhr/default_e.aspx

The Walker Economics Inc. 2006 Physician Demand and Supply Model

This generic simulation model was developed initially for oncologists, but may be adapted for other HHR. Demand factors include population, disease incidence/prevalence and historical health services utilization. Health care needs are represented by historical and projected age-sex-specific disease incidence and prevalence. Disease-specific needs are then associated with FTE requirements by specialty. Supply factors include HHR stocks and flows, training enrolments, and interactions among health service occupations. This is an elegant and complex model. Data

requirements are high, but perhaps no higher than those of other recently developed needs-based models. The Walker Economics model has not yet been populated with data from a Canadian jurisdiction.

The Ontario Population Needs–Based Physician Forecasting Model

The HHR Forecasting and Modelling Unit, HHR Policy Branch, Ontario Ministry of Health and Long Term Care, developed the model in a partnership with the Ontario Medical Association with the assistance of the Conference Board of Canada (CBoC). The approach and methodology used to develop the model were presented at the ACHDHR HHR Data & Modelling Workshop, March 2009, in Vancouver.

The model incorporates assumptions and structural aspects of the ADIN ("Assessing Doctor Inventories and Net-Flows") supply model. This forecasts physician headcounts and converts them to FTE by specialty, age and sex. Representative surveys of Ontario Family Physicians and Specialists were conducted in May 2008 to collect the data required to populate the model, including, total patient encounters, patient care hours, time spent and number of encounters by major ICD-10 diagnostic categories and sub-categories, geographic location of patients, and total weeks of work in a typical year. Data on the top ten conditions/diseases treated were used to model the supply of physician services in additional to health needs. Physician productivity factors were examined, but data to populate this model component were not available. Fifteen socio-economic and lifestyle factors were included in the demand side of the model. Accessing data to populate the model was challenging. The model is expected to be completed and operational in June 2009.

Alberta HHR Planning Models and Data Acquisition

The Alberta Health Human Resource (HHR) - Demand Modelling and Simulation Project (DMASP) is developing a new HHR needs-based demand and supply model. Alberta is simultaneously investing in new data acquisition systems to populate these models. The HHR Demand Simulation System forecasts HHR demand for key health occupations (subject to data availability), across the continuum of care, based on population health need, service delivery mode and workload trends. The initial occupation demand models will be for family physicians, registered nurses and medical laboratory technologists.

The Alberta Health Workforce Information Network (HWIN) Supply Model pilot project will forecast stocks and flows of Registered Nurses and Licensed Practical Nurses by age and sex. Praxia and Hay are working with Alberta Health to build and test the three models of the Alberta Health Human Resource (HHR) – Demand Modelling and Simulation Project (DMASP). Details on how needs-based demand is being modeled are not yet public. The models are expected to be operational by the end of 2009.

6.0 DISCUSSION: CURRENT CHALLENGES IN HHR MODELLING

Health human resource forecasting models have been steadily evolving over the past twenty years. *Utilization-based* approaches have tended to use current levels of health care service provision as baseline, and assuming they are appropriate, project utilization rates to change in lock-step with future estimates of the age-sex composition of the population. *Effective demand-based* approaches consider that the definition of health care needs is imprecise and is affected by social, political and economic considerations as well as the health needs of the population. This approach emphasizes the efficient utilization of resources and tends to recognize relative - rather than absolute - levels of need based on resources available. *Needs-based* approaches to HHR planning on the other hand, involve estimating the health services required to meet the needs (and identified unmet needs) of the population based on epidemiological profiles that are then translated into the required number of appropriately deployed health care providers to deliver these services as effectively and efficiently as possible.

In recent years HHR models have evolved beyond simple supply-side forecasting and utilization analyses to include dynamic health system-based *simulation modelling* approaches that attempt to combine needs-based population health approaches, health service utilization measures and effective-demand, at least with respect to potential efficiencies achieved through competency-based staff re-deployment and productivity analyses.

While the scope and complexity of models have increased considerably, there are still a number of challenges that should be considered with respect to the application and interpretation of models in order to better understand and strengthen their capacity to inform government decision-making processes. A summary of some of the challenges related to these recent approaches are discussed below, gleaned from a perusal of the literature, a review of the design and application of a couple of past models and our discussions with both modellers and model users about their issues and concerns.

6.1 Simulation Modelling

Scope

This approach to forecast modelling has the capacity to simulate the impact of one or more policy changes simultaneously, under a wide range of planning assumptions. The benefits of an increase in immigration targets, for example, could be compared with - or without - the benefits of additional supportive policy changes, such as increasing training seats or improving overall staff retention. While some model factors can be held constant, others can be varied independently considering a range of assumptions and planning scenarios, to determine the likely impact on service delivery or the health workforce. Because of its more specific focus on policy impact (sensitivity analysis) compared to other types of projection models, this approach often has more relevance and application for government decision-makers involved in policy and program development and budgetary planning.

Challenges

Depending on their power and complexity, simulation models can contain several hundred or even several thousand equations that attempt to describe and predict the inter-relationships of various factors that impact upon the supply and demand for health human resources. The models are often quite comprehensive in scope and identify many of the most relevant and important factors to be considered. As such, a huge amount of data is often needed to populate the models and to map the complex inter-relationships of variables in order to produce long-term forecasts. The data and information needed to support simulation modelling is often unavailable - or in some cases may not even exist - and considerable time and resources are often required by model-users to develop it.

Because the models are often complex and expensive and developed by external consultants, there may not be the ongoing resources or in-house capacity or support to continue to run the models in the future. This may undermine a model's overall capacity and ongoing utility with respect to informing HHR decision-making processes.

The theoretical strength of simulation models is that they are able to pick one policy or planning variable (e.g. enrolments) and test its impact on long-term supply by using different training intake assumptions, while holding other factors in the model constant and by assuming that any inter-relationships between the most relevant factors is linear. In fact, many of these relationships – which may be casual or merely correlative - are often neither linear nor constant and are affected by other factors that were unknown in ways that were not anticipated. The 'weighting' of the importance of various model factors is critical and these too can change for unforeseen reasons both inside and outside the framework of the model. Unsubstantiated assumptions and weak or substitute data in particular can significantly weaken a model's overall capacity and utility.

This leads to a final point regarding the incorporation of effective-demand factors into simulation modelling. While the broader conceptual models do pay lip-service to the notion, the larger economic, social, contextual and political factors that influence health system priorities and spending are rarely, if ever, taken into adequate consideration. In view of the current economic climate and the mounting pressures on government spending, these factors will need to be further developed and to feature more prominently in HHR modelling activities and planning initiatives.

Next Steps

At the core of this approach are fundamental assumptions about the direction in which the health care delivery system is moving, the kinds of changes that are coming about with respect to health reform and other external factors (e.g. economic climate) and how the health system components will impact upon one another because of it. While no model of the future can be completely comprehensive in this regard, it does emphasize the need to test a variety of scenarios under varying assumptions and to look at a range of possible outcomes. To forecast well, one must forecast often using a variety of approaches, techniques and assumptions. And contingency plans should be kept at the ready should unanticipated trends occur or unexpected outcomes result from policy and program actions that have been taken.

In the longer term, however, this approach is expected to have enhanced utility as new data sets emerge, modelling capacity is enhanced and new collaborative planning initiatives between modellers and decision-makers are developed to support it.

6.2 Productivity Analysis

Scope

The traditional approach for provincial and territorial governments to address anticipated increases in the demand for health human resources has been simply to increase health professional school enrolments. Because this approach tends to be long-term, given the length of training programs, it does nothing to deal with identified needs in the short term. Furthermore, the delay in the output of graduates exacerbates the situation in the longer term by contributing to a wider swing in the amplitude of the "boom-bust" cycle in HHR supply, thereby further destabilizing the health workforce.

In more recent years, as evidenced by the Pan-Canadian Planning Framework, a more strategic approach to health human resources planning has been adopted which looks at a more balanced investment in health human resources development. For example, increasing enrolments without addressing the issues that destabilize the health workforce may well be "throwing good money after bad". Health human resource management strategies now include a wide range of recruitment and retention strategies, such as healthy workplace initiatives, fiscal and work-life incentives, flexible working conditions and staff re-deployment, etc., aimed at employing the health workforce more effectively and efficiently. Making these kinds of changes – including adopting new models of health care delivery that utilize staff to their full competency levels – are expected to contribute significantly to achieving a more stable and productive health workforce.

Challenges

While it is acknowledged that even small improvements in workforce deployment and efficiency can result in large improvements in overall productivity, the implications on other components with the health care delivery system are unclear. And model simulations, as discussed above, tend to hold other factors constant and look at the linear gross impact of select changes on long-term projections, rather than the net impact on other related and important factors that affect overall health service delivery. An examination of the overall impact of the redeployment of registered nurses to work at their full competency levels, for example, would be instructive.

In this regard, a number of questions arise: Will employers have less flexibility in the way nurses are deployed? Will it require that both core staff and total staff complements be increased? What will be the direct impact on LPNs and PCWs and other support disciplines? Will it create more rigid tiers within nursing and other groups that affect the overall flexibility of the health care team? What will be the impact on the size and content of training programs across all disciplines? Does it affect the continuity of patient care? Are there administrative barriers within health care institutions? Will the proportion of junior, causal and part-time nurses affect its implementation? What will the impact be across the several dozen accredited and

unaccredited nursing specialties? Will the evolving role and increasing trend towards specialization across LPN groups limit options or delay implementation? Will the change in overall complexity and intensity of regular nursing duties have an impact on the shift capacity, flexibility and salary expectations of other health disciplines? Are there barriers to its full implementation from a union perspective? What will be the impact on physicians, particularly the role of Family Practitioners? How are improvements in productivity and workforce efficiency linked to improvements in the overall effectiveness of the health workforce and on better population health outcomes? How will it impact on overall patient satisfaction? What will be the impact on worker satisfaction across all nursing fields and other affected health disciplines and levels? What degree of compliance across unions, institutions and professions is required to make it viable? If different levels of compliance are negotiated, how will that affect how the proposed changes are implemented and administered? And finally, what changes have to be made to make any proposed nursing role changes acceptable across the full health care team?

Next Steps

Indeed, any approach that increases workforce productivity and has significant potential for developing a more stable, effective and efficient health workforce should be examined. In view of the concerns noted above however, it is critical that the full impact of proposed policy decisions be carefully and fully evaluated before action is taken. This approach also helps stage and prioritize the implementation process, provides a clearer indication of the kinds and levels of support that will be required and identifies the outcomes that can be expected. It also provides more insight into the practical application and limitations of forecasting models and helps manage expectations overall. As many potential unintended consequences and barriers to implementation should be identified as possible to ensure that all the necessary supports and critical conditions for success have been identified and put into place to ensure the viability and long term sustainability of any proposed changes.

6.3 Needs-Based Planning

Scope

Needs-based HHR planning involves estimating the health services required to meet the needs of the population and then translating them into the required number and type of health care providers to deliver these services. A needs-based approach estimates future health human resource requirements for the estimated health deficits of the population, based on epidemiological profiles, i.e. the age and sex-specific needs of the population, that are essentially independent of current health service utilization levels. While historical health service utilization trends may include unnecessary services (i.e. both provider and patient-induced demand) and overlook unmet needs (not everyone who requires health care asks for or has access to it), the needs-based approach is expected to address these concerns by linking more directly to population health needs rather than relying primarily on past utilization trends.

Some of the needs-based indicators linking to population health include; disease and death rates, injuries, chronic ailments and reduced mobility, health risk factors and service accessibility, as

well as income adequacy and self-reported health status. Demography, health status, service levels, productivity and system resources are often combined to get a broader picture of overall population health.

Challenges

It is to be noted, however, that with respect to needs-based planning models (and forecasting models in general) that one size does *not* fit all. Both modellers and decisions-makers should be clear on both the strengths and challenges relating to the various models and approaches to workforce planning before choosing a model to be sure that it meets their requirements, budgets and capacities.

At the moment there appears to be no clear and consistent understanding of what needs-based planning actually is. The operative definitions used by planners seem to range from identifying specific components of population health on one hand, to being considered synonymous with evidence-based planning or any kind of "needs" identified within the health care delivery system on the other. Conceptual models that attempt to encompass a wide range of factors (population characteristics, service utilization, socio-politico-economic context and health system outcomes based on differential staff utilization) tend to be referred to generally as "needs-based" approaches. More clarity and consistency would be helpful.

As many population health indicators tend to exhibit only modest variation in most long-term forecasting applications, what level of investment is justified to obtain this additional data? Are there other areas of health human resource modelling (e.g. productivity analysis) that would provide a greater return for the investment with respect to better informing the HHR management decision-making process? As such, are the overall costs and complexity of model development, implementation and maintenance prohibitive for some of the smaller jurisdictions? Are needs-based approaches less helpful in securing partner and stakeholder buy-in and support for actions plans to address current priorities? We are developing better tools to *measure* population health needs, but are the opportunities and policy levers to better *manage* HHR for greater cost-savings and efficiencies not on the service delivery (through better deployment and improved productivity) and supply-side of the HHR planning equation? Ultimately, is the definition of "health needs" not a social, political and economic construct rather than simply a fixed technical one? Even if ideal population health services needs could be identified, is health services utilization still not the primary reference point for short and medium term program funding and HHR planning? Does self-reported health status provide us with a more reliable or complete indicator of population health needs? As an indicator, is it not equally prone to the over and underestimating health service requirements? Can the indicator be meaningfully used for projections over the longer term? How does population health data contribute to current baseline HHR needs identification? Is there any direct linkage between population health data and individual health status and service utilization? How are the outcomes of needs-based planning initiatives used to directly influence HHR policy and management decisions? The needs-based approach focuses attention on the more efficient use of resources within the health care sector, but how does it deal with the need for allocating resources between health and other sectors (education, housing, etc.) that also contribute to population health? Is there any direct

link between needs-based approaches and a more efficient reallocation of resources, delivery of health care services or improved health outcomes?

Next Steps

As forecasting models continue to evolve, it appears that many of the distinctions between utilization, effective demand and needs-based planning approaches to modelling are beginning to blur. The new more comprehensive models tend to be a *blend* of all three approaches (plus productivity analysis), basically utilizing *all* data and related information that are available to strengthen overall model flexibility, capacity and completeness. The information that HHR modeller's use is not so much dictated by their model type as it is by data access and the perceived cost-benefits of its acquisition.

It is noted that while needs-based planning approaches continue to evolve (the Conference Board of Canada recently conducted its own community health surveys and identified fifteen socio-economic indicators in its physician forecast model), there has been somewhat of a "sea change" in the last couple of years towards simulation models generally and productivity analyses particularly, targeted at achieving greater workforce efficiencies. Decision-makers have responded positively to this shift.

A common understanding and working definition of needs-based planning and its components (e.g. population health, service utilization, effective demand and workforce productivity and deployment) is a place to begin. How these model components get applied to determine overall population *needs* - especially the social, political and economic factors – remains a collective challenge.

6.4 Criteria for Forecast Model Selection

In view of the above, federal, provincial and territorial governments have an important ongoing role in overseeing and supporting the development and application of HHR forecasting models, in identifying their strengths and limitations and in defining the conditions critical to their success.

With respect to HHR forecast model selection, as aforementioned, *one size does not fit all*. Prospective model users need to tailor their model selection to meet their specific needs, budgets and capacities. A preliminary list of potential selection criteria are set out below.

A forecast model should be:

- *Valid and Reliable* – Does the model use solid data, with sound assumptions to produce results that have a degree of dependability? Is the model robust overall?
- *Consistent and Timely* - Does the model produce consistent results on a regular basis? How relevant is the model to ongoing policy and planning activities? How often are reports required and what degree of precision is required to support decision-making?
- *Comprehensive and Innovative* – Is the model complete and have the capability of taking into account health reform initiatives, including new models of health care delivery?

- *Feasible and Simple* - Is the model easily understood, applied and managed?
- *Practical and Flexible* – Can the model provide sounds results? Is it capable of accommodating a wide range of assumptions to reflect a changing health care system?
- *Comparable and Portable* – Has the model been applied elsewhere? Was it successful? Will the results be useful to – or able to be compared to - other jurisdictions?
- *Accessible and Translatable* – Will the model produce results that are meaningful to all partners and stakeholders involved in the planning process?
- *Affordable and Sustainable* – Is it cost-effective? Is the expense justifiable in terms of its application and impact? Will it be supportable in the long term?
- *Relevant and Supportive* – Does it relate directly to decision-maker priorities and does it support the overall policy and planning agenda of the user? Do the model forecasts help governments to make better-informed decisions?

Closer working relationships between modellers and decision-makers will better align model development, application and evaluation with emerging health workforce planning priorities.

7.0 SUMMARY AND CONCLUSIONS

Health human resources are critical to the effective and efficient delivery of health care services. The ongoing implementation of health reform initiatives, a deteriorating economic climate combined with emerging shortages in health human resources, have placed significant and growing pressures on the health care delivery system. As such, the importance of health human resources planning, and the capacity to predict future gaps in the supply and demand for health human resources, is well recognized. Models that can estimate changing population health needs and simulate the impact of proposed new policy and program changes on both reducing this gap and on increasing workforce efficiency, are valuable planning tools.

Most jurisdictions engage in some form of HHR forecasting, the majority of these being supply-side projection models. As such, the major improvements being sought for existing models are with respect to strengthening supply-side data. Although improving, much of the HHR planning is still done in stovepipes within provinces, within government departments and divisions and among the health professions. It is acknowledged that health needs are difficult to measure and most jurisdictions note that there are limited resources to explore this issue. Core modelling concepts are well understood, software and hardware are well advanced and data availability is vastly improving. Local models appear to have the greatest success and utility while the benefits of the larger more complex models are as yet unknown.

There is general agreement that needs-based planning is a good idea in principle and a close watch is being kept on developments across jurisdictions. While some have engaged in needs-based planning in a limited way - Manitoba (Nurses), the CNA (Nurse Practitioners), Ontario (Nursing Secretariat) and Quebec (Family Physicians) - Alberta (Praxia and Hay), Ontario (Conference Board of Canada) and the CNA and Nova Scotia (both Tomblin Murphy et al) currently have major new needs-based planning initiatives underway. Those jurisdictions which expressed less interest in adopting the needs-based approach at this time, sited cost, complexity, lack of data and limited technical capacity as the principal reasons.

While there is some high-level, inter-jurisdictional exchange of ideas around forecast models, there are few opportunities to engage in effective collaborative planning at technical and analytical levels. The Western and Northern HHR Planning Forum provides an exception in this regard. Most see regional planning options as potentially the most productive in this regard with the federal government continuing to play a supportive facilitator role in funding these initiatives. Some respondents suggested that it might be appropriate for CIHI to assume a higher profile on this issue.

It was also noted that the sustainability of the health system was a growing concern and that the issue was not being adequately addressed. While some models do pay lip-service to the notion, the economic, social and political factors that influence health system priorities and spending are rarely, if ever, taken into adequate consideration. In view of the current economic climate and the ongoing pressure upon governments to increase their expenditure on health, these factors will need to feature more prominently in HHR modelling activities and planning initiatives in the future. Effective planning models are needed that can assist decision-makers in identifying policy options that, if implemented, provide a reasonable expectation of improving program efficiencies, of further stabilizing the health workforce and of achieving a more sustainable health delivery system over the long-term.

Approaches to modelling generally - and needs-based planning specifically - need to be evaluated carefully in terms of their applicability, viability and cost-effectiveness. A common understanding of the overall capacities and limitations of models to support both short and long-term HHR policy and planning initiatives may be a place to begin. This may provide more focus and direction as to how forecasting model development may be collaboratively supported and developed. Given that health human resource modelling is an emerging science, there is benefit to encouraging and supporting competition, innovation and diversity in HHR model development and application.

8.0 RECOMMENDATIONS

While the focus of this review is on forecasting models, the scope of these recommendations includes the identification of the critical conditions necessary to ensure their continued development and support. Improvements in data development, the strengthening of individual jurisdictional capacity and the broadening of partnerships remain central to advancing this enterprise.

While individual capacities and resources differ across jurisdictions, and provinces and territories will likely continue to develop and apply their own approaches to meet their own needs using their own data, there are significant opportunities and benefits to building upon a common modelling foundation. Common data definitions, software development, assumption exploration and modelling techniques can be developed collaboratively and best practices and lessons learned can be shared among jurisdictions. A common understanding of key concepts, including the overall scope, options, application and utility of needs-based planning, would be an important place to begin.

Some of the components of that collaborative foundation are set out below.

Partnerships and Collaboration in Planning

Issue:

Dialogue on modelling occurs only intermittently among partners and jurisdictions, discussed at a high-level at the occasional workshop or HHR planning meeting. Currently there is no consistent, on-going planning mechanism to coordinate HHR modelling activities or to oversee collaborative opportunities to share experiences and best practices across jurisdictions.

It is recommended that:

- The F/P/T Working Group on HHR Modelling and Data Development be reactivated immediately to oversee the coordinated development and implementation of a pan-Canadian strategy to advance HHR modelling;
- Options to enhance CIHI's role in supporting pan-Canadian HHR forecast modelling - in terms of both data and model development - be reviewed and considered;
- Formal opportunities be created specifically to bring decision-makers, HHR modellers and employers together to ensure maximum relevance and optimal alignment of modelling activities with the priorities of health system managers;
- The new needs-based HHR forecasting models being developed by Ontario, Alberta and the CNA – when completed - be show-cased as an inter-jurisdictional opportunity to share best practices and lessons learned in model development and application; and,
- A virtual HHR Observatory be established to integrate forecast modelling with other HHR data development, planning and evaluation activities in order to promote overall knowledge translation and exchange on HHR planning activities at the pan-Canadian level.

Modeller Technical Capacity Development

Issue:

Modellers have noted, in this survey and in workshops, that they would value opportunities to actually "roll up their sleeves" to tackle some the technical and operational aspects of HHR modelling in a concerted and collaborative way. The technical, fiscal and administrative capacity to undertake HHR modelling varies considerably across jurisdictions. As such, opportunities to conjointly develop, test, implement and evaluate individual modelling experiences would benefit all partners involved in the modelling enterprise.

It is recommended that:

- A Network of Modellers be formally established and supported with the aim of enhancing general communications and information sharing at a technical level;
- Workshops be developed and supported to address, explore and resolve technical and analytical issues related to the ongoing development and application of forecasting models; and,

- As a first step, a common understanding of the key HHR planning concepts that frame the modelling exercise, including the overall scope and range of options regarding the application of needs-based planning, should be explored, developed and documented.

Data Development

Issue:

While minimum data sets have been developed for health human resource supply, additional complementary, standardized minimum data sets are needed to measure population health needs (a range of health status indicators) and to measure and monitor changes in both workforce stability (turnover, vacancy, absenteeism, migration and workforce participation rates) and efficiency (overall cost-effectiveness of service delivery).

These performance indicators are needed to establish benchmarks and to measure the ongoing impact of health policy and program changes on health care delivery and the health workforce.

It is recommended that:

- Minimum data sets and common performance indicators be developed for population health, for overall workforce stability and for productivity efficiency (including fiscal indicators) to strengthen HHR modelling scope and capacity;
- Modelling data bases be standardized, as far as practicable, to support cross-linkages at core data levels (educational, employment, professional registries, etc.) and to enhance the capacity for inter-jurisdictional comparisons and collaborative planning;
- A unique identifier be developed to permit the inter-jurisdictional tracking of health professionals throughout their work-life cycles; and,
- An HHR Data Inventory be developed to support HHR modelling and facilitate the identification of data gaps and data development priorities.

Research

Issue:

Health system research priorities are not always aligned with the needs of forecast modellers. Those involved in needs-based planning, simulation modelling and productivity analyses all require research – in addition to data - to better inform their modelling initiatives. Simulation modelling requires a high degree of qualitative and quantitative information to establish credible planning assumptions with respect to the likely impact of proposed policy and program changes upon the operation and outcomes of the health care delivery system. More contextual research is required on how some of the broader social, economic, political factors may impact on the capacity and priorities of the health industry and how they should be included in the modelling process.

A synthesis of existing research around HHR efficiency and effectiveness is required, not only to better craft model assumptions, priorities and options in simulation modelling and productivity analysis, but to support HHR planning generally. Research to identify the challenges and

conditions critical to the successful implementation of proposed HHR policies and programs would also benefit government planning and decision-making.

Health care needs and HHR plans are often identified independently from fiscal forecasts, system capacity and any considerations of sustainability. With health care costs continuing to consume a greater share of government expenditure and world-wide shortages of HHR continuing to grow, fiscal forecasts are expected to assume greater relevance in determining HHR policies, plans and priorities.

It is recommended that:

- An HHR research agenda be established with CIHR and CHSRF that is supportive of the broader contextual informational requirements (social, political and economic) of HHR forecast modelling;
- Research synthesis initiatives be undertaken to explore the linkages between the introduction of new models of health care delivery and their resultant impact on workforce efficiency and effectiveness and overall health outcomes;
- On the basis of the research synthesis above, the conditions critical to the success of introducing new HHR policy and program initiatives be identified;
- Some of the key challenge questions set out in this report regarding model simulation, productivity analysis and needs-based planning, be further explored to more clearly understand the scope and limitations of current modelling processes and to determine how they may best be strengthened and made more comprehensive and useful; and,
- Opportunities be explored to include more fiscal considerations and economic forecasts in HHR modelling applications and interpretations to enhance their overall relevance to decision-makers.

Evaluation

Issue:

Although HHR planning and forecasting models have been evolving for the past two decades, very few have been thoroughly evaluated in terms of their scope, viability, costs, output and overall capacity to appropriately inform and influence government decision-making processes.

Model users are often not fully aware of the range of model options that are available to them. Without specific knowledge of the strengths and limitations of the various approaches, they may be unable to select the most appropriate HHR models to match their specific planning needs, administrative capacities and budgets.

It is recommended that:

- Evaluation criteria be developed to assess forecasting models currently in use in terms of costs, complexity, outputs and application, including their relevance and direct impact upon HHR policy and program planning and development; and,
- Criteria be developed to assist new, prospective modeler-users in selecting appropriate forecast models to meet their respective needs, capacities and budgets.

Next Steps

In light of emerging HHR shortages and growing fiscal concerns, it is important that HHR modelling initiatives build on the current HHR planning momentum and opportunities for collaboration.

In terms of next steps, it is suggested that the development of common HHR performance indicators on population health needs and workforce stability and efficiency, as well as the development of evaluation criteria to assess forecasting models, are high priorities. Showcasing the needs-based planning initiatives soon to be completed by Ontario, Alberta and the CNA would be a highly relevant and important place to begin. The establishment of a virtual HHR Observatory to oversee the integration of forecast modelling with other HHR data development, planning and evaluation activities, would promote and strengthen inter-jurisdictional knowledge creation and exchange.

APPENDIX A

HHR Modeller Survey Findings : Tables 1- 14

Findings from a March 2009 survey of HHR modelling practices in Canada, by the *Cameron Health Strategies Group*, are presented in tables below. These tables are based primarily on responses to questionnaires that were emailed to HHR modellers, but include some supplementary data from other sources, including interviews with decision-makers. The questionnaire emailed to HHR modellers in March 2009 is similar to that used by *Vestimetra International Inc*. in February 2005, except for minor changes and additions.

Table 1: Scope of HHR Modelling Capacity by Jurisdiction

Jurisdiction	National	Provincial	Regional	Institutional	Other
Federal (Health Canada)	√	√			
Other (CMA)	√	√	√		√
Newfoundland & Labrador		√			
Prince-Edward Island					
Nova Scotia		√			
New Brunswick		√			
Quebec		√	√		
Ontario		√	√		√
Manitoba		√			√
Saskatchewan		√			
Alberta		√	√		
British Columbia		√	√		
Yukon					
Northwest Territories					
Nunavut					
MedEmerg Inc.	√	√	√		
Walker Economics Inc.	√	√	√		

All provinces engaged in HHR planning and modelling for their jurisdictions, with the exception of the Territories. At least six provinces did HHR modelling for health regions at least three at the institutional level. There is little change from 2005 to 2009, except at the institutional level.

Newfoundland & Labrador: HHR forecast modelling efforts are now being put forth by the Department of Health and Community Services. Previous modelling activities were in collaboration with the Atlantic Departments of Health and Education with Atlantic Health Human Resources Association (AHHRA).

Prince-Edward Island: This province is not undergoing any current HHR modelling activities. In previous years the province took part in the AHHRA model development, as well as developing their own model for health professionals through the Department of Health and Social Services.

Nova Scotia: Modelling efforts in Nova Scotia have been undertaken by the Department of Health. The current model being used today was originally developed in 2005 (Med-Emerg), but continues to evolve (Tomblin Murphy et al) as additional and better data becomes available. Health Canada has also committed to provide forecasting models of physicians within the province.

New Brunswick: The province is continuing to utilize the forecasting model developed in 2002/2003, the Fujitsu Supply & Demand Forecasting Model. The last time this model was applied was in 2008.

Québec: The Comité de gestion des effectifs médicaux en médecine générale (The management committee of the physicians in general medicine) have created forecasting plans for physicians, intended for the Ministère de la santé et des services sociaux (Department of Health and Social Services). While at one time involved in physician forecast modelling, the Groupe de Recherché Interdisciplinaire an Santé (GRIS) of the University of Montréal are currently not undertaking any modelling activities.

Ontario: Ontario is developing HHR forecasting models for the provincial, county, and local health integration network (LHIN) levels, scheduled to be completed by April 2009. The Conference Board of Canada (CBoC) was commissioned to develop a model for physicians with a target completion date of June 2009. A final report will be provided to the MOHLTC and the OMA. The decision to disseminate the model results will be made conjointly between the two parties.

Manitoba: The Simulation Model developed by Manitoba Health & Healthy Living in June of 2008 continues to be used. This model provides the province and regional (rural north, rural south, and Winnipeg) forecasts for nurses. A new Physician Resource Projection Model, developed by the Manitoba Centre for Health Policy, was published in February 2009.

Saskatchewan: A consultant from QED Information Systems Inc was hired to develop a HHR forecasting methodology (similar to a supply model) for nursing staff on a provincial scope. This model was last applied in July of 2003.

Alberta: Alberta Health & Wellness (AHW) is currently developing the Health Workforce Information Network (HWIN) Supply Model. This model will provide provincial and regional forecasts for all health occupations. It is currently being piloted with RNs and LPNs.

British Columbia: The previous HHR forecasting model resulted from a collaboration between the province and UBC but was halted after reduced funding. The current forecasting model for British Columbia was developed by the Health Employers Association of British Columbia (HEABC) in collaboration with the Health Human Resource Data Group. Forecasting has been performed for both the province and the individual Health Authorities.

Territories: The territories (Yukon, Northwest Territories and Nunavut) do not have any formal HHR modelling capacity.

Other: The CMA developed the Physician Resource Evaluation Template in 1998 and continues to apply it; its last use was in November of 2008. This template can be applied on a national, provincial, and regional level for a variety of different physician specialists. Health Canada has developed the MSDAD Physician Supply Model to be applied on a provincial basis for family physicians and all medical and surgical specialists. Walker Economics developed a forecasting model in 2003, MedOncs, which has the ability to provide national and provincial forecasts of any health profession.

Jurisdictional forecasting capacities are similar to those seen in 2005, with the exception of the Atlantic Provinces. A discontinuation of the collaborative HHR research undertaken by Med-Emerg Inc. between the Atlantic HHR Association and the Atlantic Provinces has had varying effects on their modelling activities; Newfoundland & Labrador took it upon themselves to undergo modelling activities; New Brunswick has revived their Fujitsu forecasting model; Nova Scotia has continued to develop their planning models adapted from the Med-Emerg model; while Prince-Edward Island discontinued their research for the time being but maintains an interest on the topic. British Columbia, Alberta and Ontario have made HHR forecasting an ongoing priority and have since dedicated significant resources to their modelling programs.

Generally, most provinces seem to have settled on an acceptable HHR forecasting model that they apply from year to year, updating and improving the model's capabilities as new data and information becomes available.

Table 2: HHR Models by Jurisdiction and Occupation

Jurisdiction	Family Physicians	Specialists Physicians	Registered Nurses	Registered Psychiatric Nurses	Licensed Practical Nurses	Nurse Practitioners	Dentists - generalists	Dentists - specialists	Physiotherapists	Occupational Therapists	Pharmacists	Medical Laboratory Technologists	Medical Radiation Technologists	Other
Federal (Health Canada)	√	√												
Other (CMA, WE)	√	√												
Newfoundland & Labrador			√		√						√			√
Prince-Edward Island														
Nova Scotia	√		√										√	√
New Brunswick	√	√	√		√	√			√	√	√	√	√	
Quebec	√	√	√											
Ontario	√	√	√		√	√							√	
Manitoba	√	√	√	√	√	√			√	√	√	√		√
Saskatchewan	√	√	√	√	√									
Alberta	√	√	√		√									
British Columbia	√	√	√	√	√	√			√	√	√	√	√	√
Yukon														
Northwest Territories														
Nunavut														

Questionnaire "check-box" responses recorded modelling for the 11 occupational groups listed in Table 2. However, **New Brunswick** reported that they had model 20 occupations. And the Conference Board of Canada (**Ontario**) reported that they had modeled and would soon publish HHR demand and supply projections for family practitioners and 59 specialties and sub-specialties. The number of nursing specialties modeled has likely increased since 2005. Table 2 therefore under-reports the extent of HHR modelling by occupation. There has been an increase in the number of HHR occupations modeled since 2005.

Modelling capabilities by jurisdictions have generally remained the same since 2005, with a few exceptions. It seems there is no more interest in creating forecasts for dentists. While the table above reports that no single jurisdiction has the capacity to forecast all of the health professions listed above, **Walker Economics** reports that their HHR forecasting model is applicable to any and all health professions.

Nova Scotia is developing a forecasting model for Continuing Care Assistants (CCAs). The WHO/PAHO Collaboration Centre (Tomblin Murphy/Dalhousie) has focused on all nurses and medical radiation technologists in the province. In **Manitoba**, a separate model has been developed for each nursing labour classification by Manitoba Health & Healthy Living, although Nurse Practitioners were included with Registered Nurses due to their small pool size of approximately 40. RN(EP)s were recently removed from the RN model. The data foundation for allied health models continues to be developed. Separate models have also been developed for physicians, including pediatrician specialists, and general and orthopedic surgery specialists within the province.

Table 3: Supply Variables in HHR Models by Jurisdiction

Supply Variables	HC (Basu Physician Supply)	WE (Walker)	CMA (Buske)	NFLD (Wells)	NS (Jones)	NB (Ayles)	QC	ON (Stewart)	ON (Murphy)	MB (Konrad Simulation)	MB (Konrad PRPM)	SK (Elliott)	AB (Mahabir)	BC (Sousa)
Stock of Licensed Providers														
Baseline stock	F	V	F	V	V			V	V	V	V	F	F	V
Age/sex distribution	V	V	F		F			V	V	V	V	F	F	V
Growth projections	V	V	V	F	F			V	V	V	V		V	V
Other										F/V	V			
Annual Additions to Licensed Stocks														
Graduates from jurisdiction		V	V	V	F	V		V	V	V		V	F/V	V
In-migration		V		F	V	V		V		V		V		
Inter-provincial	V	V	F					V	F				F/V	V
Foreign-trained	V	V	F					V	F				F/V	
Immigrants	V		F					V	F				F/V	V
On temporary work permits			F					V						V
Canadians	V		F					V					F/V	
Returned to profession		V	F	F				V				V	F/V	
Other		V						V						
Education/Training Programs														
# Programs	F	V		V				V	F	V			V	
# Enrolled	F	V		V	V	V		V	V	V			F	V
Attrition within program	F	V		F	F	V		V	V	V			F	V
Years to complete program	F	V		V	V	V		F	F	F			F	V
# Graduates	F	V		V	F	V		V	V	V		V	F/V	V
Costs													F	
Other					F									
Annual Attritions to Licensed Stocks									V					
Retirements	F	V	V	V		V		F		V		V	V	V
Mortality	F	V	V			V		F				F	V	
Career changes		V	F					F				V		
Emigration		V				V		V		V		V		V
Inter-provincial	F		V					V						V
Abroad	F		V					V						
Other				F	V					F			V	

Table 3: Supply Variables in HHR Models by Jurisdiction (Cont.)

Supply Variables	HC (Basa Physician Supp	WE (Walker)	CMA (Buske)	NFLD (Wells)	NS (Jones)	NB (Ayles)	QC	ON (Stewart)	ON (Murphy)	MB (Konefal Simulation)	MB (Konefal HRPM)	SK (Elliott)	AB (Mahabir)	BC (Sousa)
Labour Market														
Occupational participation rates					F						V		F	V
Occupational employment rates					F						V			
Employment projections				F						V	V			
Vacancy rates						V				V				V
Turnover rates				F										V
Wage rates								V			V			V
Productivity growth		V			V			V	V	V	V			V
Cyclical factors											V			
Alternative career options											V			
Other											V			
Employment Status														
Full-time		V	V		F			V		V	V			V
Part-time		V	V		F			V		V	V			V
Casual					F			V			V			V
Full time equivalent (FTE)		V	F		F			V	V	V	V			V
Average hours worked		V	F		V			V	V		V			V
Direct patient care hours		V	F		F			V						
No longer practicing														V
Not licensed in jurisdiction														
Other													F	
Government Policy Variables														
HHR education funding		V	V	V										
Inter-provincial mobility			V						V					
Health-care expenditures														V
Alternative delivery modes						V		V						
Licensing regulations														
Professional roles/deployment						V		V						
Recruitment/retention strategies		V	V					V						
Immigration policy			V					V						
Remuneration rates/types														
HHR capacity-building budgets														
Other														

In both 2005 and 2009 HHR supply models included essentially the same variables (and data sources) for Stocks of Licensed Providers, Annual Additions to Licensed Stocks, Education / Training Programs, Annual Attrition to Licensed Stocks and Employment Status. There was less consensus about which Labour Market variables and Government Policy variables to include in HHR models. The table above presents a summary of the supply variables used in each of the HHR forecasting models by jurisdiction. 'V' is used to denote a variable assumption; 'F' represents a fixed assumption. All jurisdictions vary in their complexity and assumptions made when considering variables. Let us examine each jurisdiction in greater detail:

Health Canada: Has separate models for supply and demand. Their supply model focuses mainly on variable concerning the stock of license providers, annual additions/attritions to the stocks, and education/training programs. They also use an inflow-outflow model for determining stock numbers.

Walker Economics: All of the assumptions made in this model are variable. Additional variable considered in this model include changes in retirement patterns, pre-retirement withdrawals from practice, and the government's willingness to open more training slots.

CMA: Has developed a complex model. Their growth projections consider both physicians and the population. Many of their variable projections are based on 4-year averages.

Nova Scotia: Does not include government policy variables in their model. They also consider graduate age distribution as well as graduate rate of entry into stock.

New Brunswick: For their stock of licensed providers, this province only performs a one time actual count of current available resources. They also employ all variable assumptions in their supply model, and do not consider employment status.

Ontario: This province has the most comprehensive list of supply variables in their model.

British Columbia: All of the assumptions made in this supply model are also variable.

Alberta: This province only uses a supply model and does not consider demand. Many of the variables are dependent on the forecasting methods used.

Table 4: Supply Model Variable Characteristics

Supply	Current stock (incl. registry)	Attritions (retirements, exits)	FTEs or productivity, billing	Emigration	Inter-provincial migration	Enrolments	Educational attritions	Graduates	Out of province graduates	Immigration	Return to practice	Career changes	Stock at end of period	Other variable (please specify)
Federal (Health Canada)	d	d	d	d	d	d	d	d		d			d	
Other (CMA,)	a,c	a,c,d	a,c,d	a,c,d	a,c,d	a,b,d	a,c,d	a,b,d	a,c,d	a,b	a,c,d	a,b	a,c	
Newfoundland & Labrador	a,b,d	a,b,d		a,b,d	a,b,d	a,b,d	a,b,e	a,b,d	a,b,d	a,b,d	a,b,d	a,b		
Prince-Edward Island														
Nova Scotia	a,c	a,c	a,b			a,b	a,b	a,c		a,c			a,c	
New Brunswick	a,c	a,c,d		a,c,d	a,c,d		a,b,d	a,b,d	a,b,d	a,c,d			a,c	
Quebec														
Ontario	c,d	c,d	c,d	a,c,d	a,c,d	c,d	c,d	c,d	c,d	a,c,d	d	d	c	c
Manitoba	a,c,d	a,c,d	a,c,d	a,b,d	a,b,d	a,b,d	a,b,d	a,b,d	a,b,d	a,b,d			a,c,d	a,b,d
Saskatchewan		a,c,d		a,c,d	a,c,d	a,c,d, e		a,c,d		a,c,d	a,c,d			
Alberta	a,c,d, e	a,c,d, e	e		a,c,d, e	a,c,d, e	a,c,d, e	a,c		a,c	a,c		a,c	
British Columbia	a,c,d	a,c,d	a,c,d		a,c,d	a,c,d	a,c,d	a,c,d						
Yukon														
Northwest Territories														
Nunavut														

This table extends Table 3 by reporting details on whether supply model variables were: **a** = used in model, **b** = global population variables for all persons, **c** = population variables by age and gender, **d** = based on historical data, or **e** = based on hypotheses.

The above table demonstrates the wide range and diversity of the characteristics of the components used in the supply portions of the models by jurisdiction. The majority of the jurisdictions used models that had components based on historical data, while very few had any based on hypotheses.

Table 5: Demand Variables in HHR Models by Jurisdiction

DEMAND Variables in Models	HC (Basu - Physician Supply)	HC (Basu - Physician Demand)	WE (Walker)	CMA (Buske)	NFLD (Wells)	PEI (Weeks)	NS (Jones)	NB (Ayles)	QC	ON (Stewart)	ON (Murphy)	MB (Konrad - Simulation)	MB(Konrad - PRPM)	SK (Elliott)	AB (Mahabir)	BC (Sousa)
Population Demographics																
Total population		V	F	V			F	V		V	V		V			V
Age/sex distribution		V	F	V			F	V		V	V		V			V
Births/deaths				V						V						V
Population projections		V	F	V			F	V		V	V		V			V
Other										V						
Population Health Status																
Age/sex mortality										V						
Morbidity			F				F				V					
Acuity							F				V					
Other							F									
Health-Care Needs																
Types of services		V					F			V	V		V			
Types of providers		V	F				F			V	V					
Other																
Health-Care Utilization																
Types of services		V	F					V		V	V		V			
Types of providers		V	F							V	V					
Other				V												
Service Delivery Mode Substitutions																
Private practitioners																
Institutional in-services																
Institutional out-services																
Interdisciplinary teams										V						
Mix of service providers										V						
Other																
New technologies																
Types of services		V	V							V			V			
Types of providers		V								V						
Other																
Socio-economic variables																
Disposable income							F									
Ethnic factors																

Other										V						
Government policy variables																
Health insurance scope																
Drug insurance scope																
Immigration policy																
Other																
Other demand variables																

The table above presents a summary of the demand variables used in each of the HHR forecasting models by jurisdiction. 'V' is used to denote a variable assumption; 'F' represents a fixed assumption.

This table shows that all HHR demand models in 2009 included both Population Demographics variables and Health Care Utilization variables. This was also true in 2005. In 2009 only a few jurisdictions and modellers included Population Health Status variables and Health Care Needs variables in their models, i.e., directly from other sources rather than indirectly from utilization data. Only a few models included variables representing Service Delivery Mode Substitution, New Technologies, Socio-economic and Government Policy Variables. However, since not all questionnaire respondents provided full descriptions of their models, the information in Table 4 is likely incomplete.

Health Canada: In addition to the variables noted in the table above, this model takes into account a composite factor, which includes technological changes, along with the usual demographic factors.

Walker Economics Inc: The demand portion of this model is largely based on fixed variable assumptions, with the exception of new technologies. As this model is mostly intended for oncology HHR needs, the morbidity variable measured here refers to cancer patients. As well, the health-care services utilization refers to medical oncology services. However, this model can be applied to any health profession.

CMA: The demand section of this model takes into account only population demographics. Birth/death rates are only used for estimating needs for obstetricians. As for health-care utilization, the population is adjusted based on their age and sex to determine specific information on physician expenditures.

Nova Scotia: This province takes into account population demographics, population health status including self-assessed health status, health care needs, and income adequacy, all with fixed variable assumptions.

New Brunswick: This model focuses solely on population demographics and health-care services utilization, all based on variable assumptions.

Ontario: Their demand model is largely based on variable assumptions. Their population demographics are based on models built at the LHIN level and based on fertility rates,

immigration/emigration by type, mortality rates, all by single age category. They have also included 15 socio-economic risk factors such as low income, smoking rates, obesity rates, etc.

British Columbia: This provinces demand model only takes into consideration population demographics, which are all based on variable assumptions.

Tables 6: Demand Model Variable Characteristics

Demand	Current population	Population projections	Health-care needs	Health-care utilization	New technologies	Disease incidents	Mortality	Service substitution	Changes in service delivery	Professionals needed	Other variable (please specify)
Federal (Health Canada)	a	a		a	a						
Other (CMA,)	a,b	a,b		a,c,e							
Newfoundland & Labrador											a,b,d,e
Prince-Edward Island											
Nova Scotia	a,c	a,c	a,c	a,c,e		a,c					
New Brunswick		a,c,d		a,c,d							
Quebec											
Ontario	c	c,d	c,d	c,d,e	e	c,d	c,d	e	e	c,d	
Manitoba	a	a	a,b,d	a,b,d							
Saskatchewan											
Alberta											
British Columbia	a,c										
Yukon											
Northwest Territories											
Nunavut											

This table extends Table 5 by reporting details on whether demand model variables were: a = used in model, b = global population variables for all persons, c = population variables by age and gender, d = based on historical data, or e = based on hypotheses.

The table above shows the variation of component characteristics used in the demand models by each jurisdiction. In comparison with the supply model in Table 4, it is obvious that more components are used in the supply models. Those components that are used in the demand models are less often based on historical data, and are mostly broken down by age and gender.

Table 7: Modelling Collaboration and Pan-Canadian Applications

Jurisdiction	Pan-Canadian Level?	Federal Government Support
Federal (Health Canada)	Yes	
Other (CMA, WE)	Yes; good to have same assumptions	Funding, leadership; create public reports
Newfoundland & Labrador	Complex models have limited usefulness	
Prince-Edward Island	Yes	Facilitate dialogue, share expertise, connect the system/models, allow comparative projects
Nova Scotia	Results would be too general to apply to decision, too much local variation	Create a virtual network of simulation practitioners
New Brunswick	Possibly	
Quebec		
Ontario	Yes	To work on provision of data; have reliable data collected and accessible to researchers
Manitoba	Could happen at national but should remain at jurisdictional level	More support for researchers to ease the process; create networks for personnel; fund software and HR
Saskatchewan	Yes	
Alberta		
British Columbia	Yes	Encouraging all health agencies to collect the same level of data
Yukon		
Northwest Territories		
Nunavut		

This table lists the responses from modellers when asked if there is a role for HHR forecasting at the pan-Canadian level, and what specific actions the federal government could take to help better support HHR forecast modelling development. Most jurisdictions agree that it could be useful to have national standards or guidelines held consistent across the nation, but some also note that the national level of forecasting would ignore the local variations seen on a smaller scale. Most of the suggestions for federal support are concerning greater ease of access to data for researchers, and for the creation of a networking mechanism to foster communication between jurisdictions.

Table 8: Challenges in Model Sharing

	Challenges in Sharing Models						
Jurisdiction	Cost	Copyright	Required Specialized Personnel	Model too specific to organization/jurisdiction/etc.	Requires non-transferable data	Other	**Possible Benefits of Inter-Provincial Partnerships?**
Federal (Health Canada)							√
Other (CMA, WE)	√	√	√				√
Newfoundland & Labrador				√			
Prince-Edward Island							√
Nova Scotia		√					√
New Brunswick							
Quebec							
Ontario		√					√
Manitoba			√				√
Saskatchewan				√	√		√
Alberta							√
British Columbia				√			√
Yukon							
Northwest Territories							
Nunavut							

Most jurisdictions report challenges in sharing their models with other jurisdictions. (Questions 34 and 35) The most common challenges related to copyright issues, their model being too specific for their local requirements and not being applicable to others jurisdictions. However, almost every jurisdiction reported that there are possible benefits of inter-provincial partnerships. For example:

> **Nova Scotia:** Acknowledged it would be useful to share knowledge and technological insight with other jurisdictions and forecasting organizations. The WHO/PAHO

Collaborative Centre and Dalhousie School of Nursing see inter-provincial partnerships as an opportunity to provide consistency across jurisdictions with regards to data collection.

Saskatchewan: This province envisions cost savings as a potential benefit of promoting inter-provincial partnerships.

Alberta: Noted that inter-provincial partnerships would provide consistent data across jurisdictions, improve methodology and modelling capacity building in Canada, and could reduce development costs.

Table 9: Ongoing HHR Forecast Development Priorities by Jurisdiction

Jurisdiction	Top Priorities For Ongoing Forecast Model Capacity Development
Federal (Health Canada)	
Other (CMA, WE)	
School of Nursing	Continuing to try and find accurate, comprehensive data
Newfoundland & Labrador	Application to other occupations
Prince-Edward Island	
Nova Scotia	Developing internal capacity to do simulation modeling; evaluating models that have been developed to dat.
New Brunswick	Finding a way to automate the process so that we can be timelier with the results
Quebec	
Ontario	To continue to try and find accurate, comprehensive data
Manitoba	Continuing searching for software that allows animation of information to be disseminated
Saskatchewan	To obtain better information about the timing and net effect on graduations when expanding programs at the post-secondary institutions
Alberta	Establish data sharing agreements between key data sources and Alberta Health & Wellness
British Columbia	To keep improving upon the current model
Yukon	
Northwest Territories	
Nunavut	

This table reports what each jurisdiction has identified as a top priority in further development of their forecasting models. Most jurisdictions have expressed the desire for more timely and accurate data, as this would give them the ability to produce correspondingly accurate and timely results and projections. To develop the ability to share the models, and work cooperatively with other stakeholders also emerges as a theme. As can be determined from the number of responses in this table, the majority of provinces / organizations express the intent to further develop upon their forecasting capacity.

Table 10: Knowledge Transfer Mechanisms, Barriers, and Utilization by Jurisdiction

Knowledge Transfer	National (Health Canada)	Other (CMA, WE)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut
What mechanisms are/were in place to transfer/translate forecast results to HHR policy makers?															
Reports sent to senior policy makers	√	√	√		√	√		√	√	√		√			
Presentations to senior policy makers	√	√	√		√	√		√	√	√					
Seminars	√	√			√			√	√						
Publications	√	√						√	√			√			
Other															
If such knowledge transfer/translate mechanisms were not used, why not?															
Inaccuracy of the model's result															
Results are/were not timely enough for policy makers															
Too complex to present															
Lack of internal cooperation															
Lack of resources		√													
Others															
Have the results of the forecast model been utilized by the organization for which it was produced?															
Yes			√		√	√		√	√	√		√			
No	√	√													

The above table illustrates the mechanisms that have been used by each jurisdiction to impart the knowledge generated by their HHR forecast modelling activities. The large majority of jurisdictions sent the results in reports and made presentations to senior policy makers. Some of them used seminars and publications to relay the information.

There was very little response by the jurisdictions to the question regarding why transfer mechanisms were not used. This could possibly reflect the fact that most jurisdictions did in fact make an effort to relay their results to HHR policy makers. Accordingly, the majority of jurisdictions did report that the results of their HHR forecast modelling were used by the organization for which the results were intended for. Let us examine each jurisdiction in more detail:

Health Canada: The prototype model from Health Canada was recently developed for intended use in one province only; Nova Scotia. However, its forecasting capabilities can be applied to any province.

CMA: The supply and demand models are used by the CMA for their advocacy activities in ensuring a sufficient supply of physicians are produced, and to test various scenarios of attrition. The information produced from these models is included in various reports to governments, media releases, scientific papers (in collaboration with the community or specialty societies), etc.

Walker Economics: This organization found that their HHR forecast modelling has not been applied due to limited or inadequate budgets of the jurisdictions and organizations approached.

Nova Scotia: HHR projections have been used to evaluate relative policy impacts of various policy options in Nova Scotia. For instance, models were generated to determine the impacts of seat increases in health professional schools versus retention strategies, and the impact of assistive personnel to productivity rates.

New Brunswick: The results from modelling activities in this province have formed the basis for New Brunswick's HHR Recruitment and Retention strategy.

Manitoba: This province is open to sharing information on their models, but notes that much of the research ongoing in this field is occurring in silos within jurisdictions, hindering their ability to transfer knowledge to those involved in creating HHR forecasting models. Manitoba has been able to identify HHR resource gaps in selected specialties through their physician projection model.

Saskatchewan: The HHR forecasting results were used to help determine provincial government funding and enrolment requirements for post-secondary institutions that train nurses in the province.

British Columbia: The report created from the HHR projection results in British Columbia was shared with the Ministry of Health and Ministry of Education. As a result of this sharing effort more seats were created in universities and colleges to prevent future shortages in health professionals.

Table 11: HHR Data Problems

Data Problems	Percent
Lack of cooperation with data providers	25%
Lack of resources to exploit the available data	25%
Data is too aggregated	25%
Lack of timely access to data	19%
Data is not current	13%
Inaccuracy of data	13%
Lack of comprehensiveness of the data	13%
Lack of data to run the model or to allow a more sophisticated model to operate	13%
Lack of comparability of the data	6%
Other*****	19%

Results are based on the responses generated from the 16 returned surveys. Note: not all respondents reported having any data problems.

*** Health Canada**'s HHR forecasting model currently uses shadow billing data from **Nova Scotia**. It is difficult to get similar data from other provinces. Additionally, data mining mainly includes fee-for-service (FFS) physicians. **Newfoundland & Labrador** found that there were not always licensing bodies from which to gather the required data. The availability of the data also largely depended on the licensing body's own ability to access its data. Similarly, **British Columbia** found that not all licensing bodies collected the necessary data. They also found data limitations in regards to budgetary constraints. The most consistent problem with retrieving data by the jurisdictions was the cooperation with data providers (25%), the licensing bodies in particular. The **CMA** had concerns around the accuracy of their data on citizenship and immigration.

In comparison with 2005, lack of resources to exploit the available data (50%) was listed as the most consistent problem with the data. This was followed by lack of timely access to the data (45%). Interestingly, lack of cooperation with data providers ranked as the least persistent problem with the data across jurisdictions in 2005 with only 10% of respondents indicating it as a problem.

Table 12: Reported HHR Data Sources, Aggregation and Availability

Data and Data Sources	A	E
Health Canada		
SMD	P	1
CAPER	G	1
Stats Can Population Projection	P	1
Physician Billings Data from Nova Scotia	P	3
CMA		
Stats Can	G	5
CIHI	G	4
CMA Masterfile		
Welker Economics		
Stat Can	G	5
Canadian Cancer Society Annual Data	G	5
Canadian Association Medical Oncology Treatment Protocols	G	2
CIHI	G	1
WHO/PAHO; School of Nursing		
Stats Can, CANSIM	G	5
NPHS	P	4
CCHS	P	4
College of Nurses of Ontario (CNO)	P	1

Table 12: Reported HHR Data Sources, Aggregation and Availability (Cont.)

Provincial Data	A	E
NFLD		
School Data		5
Licensing Bodies		3
Nova Scotia		
Stats Can	G	1
CIHI Discharge Abstract Database (DAD)	G	1
Medical Services Insurance (MIS) database	G	1
Colleges/Associations/Regulatory Bodies/Employers	G/P	1/5
New Brunswick		
Medicare Database	P	5
Health Regulatory Bodies	P	5
Manitoba		
Community Health Assessments (performed by RHAs)		
Regulatory bodies		2
Council of post Secondary Education		5
RHA payroll data		
Population Health Research Data Repository (MCHP)		
Research Registry (MHSIP)		
Saskatchewan		
Professional Associations	G/P	5
Stats Can Census and LFS	G	5
Alberta		
Alberta Health Services		
Regulatory Bodies		
Alberta Provider Directory (ABPD)		
Advanced Education and Technology		
British Columbia (#)		
Health Sector Compensation Information System (HSCIS)		5
Ministry of Advanced Education (AVED)		5
Ministry of Health (MOH)		5
Health Employers Association of British Columbia		5

Table 12 describes the various data sources used by each jurisdiction and organization. 'A' is the manner in which the data was aggregated (on the 'P'erson-level, or the 'G'roup-level), and 'E' is the ease with which the data was obtained (5 being easy to obtain, 1 being difficult). Many of the provinces extract data from both national databases as well as provincial and local organization. This illustrates the complexities that can arise when attempting to transfer and share data between jurisdictions.

Table 13: Active Model Sharing and Potential to be Shared, by Jurisdiction

Model Sharing	National (Health Canada)	Other (CMA, WE)	WHO/PAHO; School of Nursing	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut
Has the model been shared with any of the following:																
Federal Government	√	√														
Provincial or Territorial Governments		√	√						√	√						
Regional Governments/organizations				√						√			√			
Health care institutions		√							√							
Researchers		√														
Consultants		√														
Others			√	√												
If not shared, is there potential to share model with:																
Federal Government										√		√				
Provincial or Territorial Governments	√				√					√		√				
Regional Governments/organizations					√					√		√				
Health care institutions					√					√		√				
Researchers					√					√						
Consultants					√					√						
Others																

Note: Post-survey communications with the Ministry of Health and Long-Term Care suggest that there is significant potential to share their model with governments and stakeholders.

Table 14: Modelling HHR Demand and Supply in Canada (2009)

Jurisdiction	Model & Developer	Status	Demand Factors	Supply Factors
Federal, (Health Canada)	- Demand and Supply Simulation Model - generic provincial model - FPs and specialists - Microsimulation Data Analysis Division (MSDAD)	Prototype uses Nova Scotia data presented Vancouver Conference March 2009	- demand factors: population demographics, services utilization and MD billings data; health care needs, technology, diagnostic services - data requirements: high - data access: disappointing	- supply factors: stocks and flows of GP, Medical & surgical specialists by age/sex FTEs, shadow billings for salaried - scenario simulation capacity - data requirements: standard - data access: disappointing
Newfoundland & Labrador (DHCS)	- Demand and Supply Model - developed internally - user satisfaction: high	Operational	- demand factors: detail lacking	- supply factors: stocks & flows - data requirements: moderate - model complexity: low - data access: good for regulated professions
PEI (DoH)	- Supply and Demand Projection Model for Health Professionals	Under revision	- demand factors: population forecasts	- supply factors: stocks, graduates, attrition, migration
NS (DoH)	- Needs-based Demand and Supply Model - FPs, Nursing, MRTs - Medical Imaging Assistants - Tomblin Murphy et al, 2009c	Application of model since 2008	- demand factors: population, utilization, needs, - model complexity: high - data access: challenging for needs	- supply factors: stocks & flows, labour market, productivity - model complexity: high - data access: challenging for occupational and MIS data
NB (DoH)	- Supply and Demand Projection Model - Fujitsu 2002 simulation model - MDs, RNs & allied health professions	Currently used	- demand factors: population projections, current utilization - data requirements: moderate - data access: good - assessment: model and implementation adequate for HHR planning needs	- supply factors: provincial HHR registry stocks and flows, net migration - data requirements: moderate - data access: good - links with policy makers
QC (Govt)	- Supply and Demand Model - Family practitioners	Applied 2009	- demand factors: population projections, utilization, needs, FTE-needs - province, regions	- supply factors: stocks, FTE, graduates, migration, attrition, - province, regions - parameters altered easily - model complexity: moderate - data access: good
ON (MOHLTC, OMA)	- Needs-based Demand and Supply Model - physicians, specialties & subspecialties - Modeller: Conference Board of Canada (CBoC) - models shared: MOHLTC, OMA	CBC model completion expected June 2009	- demand factors: population, needs, utilization, productivity - needs data: 2008 physician survey of: patients, FTE variables, top 10 ICD-10 prevalence, location - model complexity: high,E-Views software + EXCEL - data access: time consuming	- supply factors: stocks & flows, FTEs by specialty, age, sex - provincial, regional data - enhanced ADIN supply model - model complexity: iTHINK software - data access: multiple sources
ON (Ontario Nursing Secretariat, OMHLTC, MTCU	- Needs-based Demand and Supply Model - Nurses - Provincial scope - Tomblin Murphy et al, 2009	In progress completion expected August 2009	- demand factors: population, health status, disease incidence, health care needs & utilization - model complexity: high - Vensim software	- supply factors: stocks & flows, productivity growth, education programmes, FTE
MB (MCHP)	- Supply and Demand Physician Resource Model - FPs, Paediatricians, General & Orthopedic Surgeons - Modelled by: Manitoba Centre for Health Policy	Published Feb. 2009	- demand factors: population projections, utilization patterns, equivalent service measures (ESM) - model complexity: high - access to data: good	- supply factors: stocks & flows, provider demographics, family time, specialty market shares, geographic distribution - provincial, regional - model complexity: high - data access: good
MB (Govt)	- Needs-based Demand and Supply Model - Nursing - user-friendly version of simulation model shared with stakeholders	Applied 2009	- demand factors: population projections, utilization patterns, needs data from Comprehensive Community Health Survey every 5 year	- supply factors: stocks & flows, education detail, public sector demand -model complexity: unknown - data access: excellent timely access to HR/payroll system

Table 14: Modelling HHR Demand and Supply in Canada (2009) (Cont.)

Jurisdiction	Model & Developer	Status	Demand Factors	Supply Factors
SK (Govt)	- Supply Models - Nurses (2003) - MLTs (2004) - QED Info Systems; Elliott	Last applied 2004	- demand factors: not modelled	- supply factors; stocks & flows, education - nursing supply (RN, RPN, NP - MLTs supply
AB (AHW)	- Needs-based Demand and Supply Simulation Model (DMASP) - FPs, Nurses, MLT - comprehensive model in progress with consultant - modellers: Praxia and Hay - *Vensim* software, advanced - *Sable* software, basic users	Pilot Model nearing completion 2009	- demand factors: population, utilization, needs, FTE service needs, province, sub-regions - data requirements: high, person level, including HC needs - data access: good data access via partnership agreements - simulation capacity high	- supply factors: HHR stocks & flow projects, age/sex FTEs, productivity, province, regions, sub-regions - data requirements: high, person & group-level data - data access: good sharing agreement access to MIS data
BC (HEABC for MoH)	- Demand and Supply Model - physicians, 23 occupations: nurses, PT, OT, Pharm, MLT .. - Modeller: Health Employees Association of BC	Old model retired; new model in progress	- demand factors: population demographic projections	- supply factors: HHR stocks & flows, labour market, FTEs, health care expenditures - province, regions
Atlantic Canada Region	- Needs-based Demand and Supply Simulation Model - Atlantic Region projections sum of NL, PEI, NS, NB projections. - Med-Emerg Int. Inc., 2005 - funded by AHHRA	New 2005	- demand factors: population; utilization; health care needs; patterns - data requirements: high - data access: HC Needs data difficult for small provinces - model complexity: high - requires *Vensim* software	- supply factors: MD stocks and flows; migration; practice patterns; technological change; productivity growth - data requirements: high for employment factors - model complexity: high - simulation capacity: high
Canadian Medical Association (CMA)	- Supply Model - physicians, 18 specialties - developed by CMA, 1998	Applied annually, latest use 2008	- demand factors: population projections	- supply factors: stocks & flows, FTE, very complete accounting framework - Canada, 8 provinces - model complexity: moderate - data access: challenging
Canadian Nurses Association (CNA)	- National Simulation Model - RNs in direct clinical care -National scope/ P/T potential -system dynamics approach - *Vensim* simulation software -Tomblin Murphy et al, 2009a	Study publication expected May 2009, National data	- demand factors: population demographics, epidemiology, utilization, needs, technology, practice modes, productivity	- supply factors: stocks & flows, by age and sex, productivity, practice modes, participation and activity rates, service levels - model complexity: high - data requirements: high -user-friendly version planned
Walker Economics Inc.	- Needs-based Demand and Supply Model - Generic model, initially for oncologists but adaptable for other health occupations - dynamic simulation model - user-friendly interface	Completed 2006	- demand factors: population projections, disease incidence, utilization	- supply factors: stocks & flows, training enrolments, effect of one health occupation on others, - model complexity: high - data requirements: high

Table 14 provides an overview of HHR modelling practices in Canada in 2009. Data is organized by Jurisdiction, Model & Developer, Current Status, Effective Demand Factors and Effective Supply Factors. Certain jurisdictions rely on comparatively basic HHR demand and supply models developed prior to 2005, while continuing to invest in more timely access of quality data for their models. Other jurisdictions and organization have invested heavily in developing new HHR models and data acquisition. The more basic HHR models were usually developed within departments of health. The more complex models were either commission by departments or jointly developed with university-based or private sector consultants. Most jurisdictions had combined utilization and supply models, from basic through complex models. The few needs-based models were complex, with one exception. Most jurisdictions modeled only a few

occupations while others modeled a great many. Most jurisdictions had run their models recently. The jurisdictions and professional organizations that invested in new models are expecting to be able to publish model descriptions and results soon. Most basic supply models included similar variables. More complex supply models included other variables. Complex simulation models required skilled programmer / analysts to populate and run scenarios. However, some complex models also had very user-friendly supplementary software that enabled persons with minimum computer skills to explore scenarios of their choice. Virtually all respondents to the 2009 Modellers Questionnaire reported some difficulties in acquiring accurate and timely data for their models. Some smaller jurisdictions that had developed good informal stakeholder partnerships with the key HHR data providers within their jurisdictions had fewer complaints regarding timely access to high quality data.

APPENDIX B

Letter of Introduction to Modellers and Model Users/Decision-Makers

Dear _____

RE: Pan-Canadian Inventory, Assessment and Gap Analysis of Health Human Resources Forecasting Models 1

In September 2004, the First Ministers renewed their commitment to the objectives described in the *2003 Accord on Health Care Renewal*, including developing collaborative strategies to strengthen the evidence base for national health human resource (HHR) planning and to ensure an adequate supply of health care professionals.

The Federal/Provincial/Territorial governments agreed to increase the supply of health professionals, based on their assessment of the gaps and to make their action plans public, including targets for the training, recruitment and retention of these professionals by December, 2005. They also agreed to make these commitments public and regularly report on progress.

The ability to forecast HHR requirements in an informed manner is crucial to the development of action plans and targets for an optimal supply and distribution of current and future health care providers. To ensure that HHR forecasting needs are identified and addressed, Health Canada committed funding to the development and enhancement of forecasting capacity in Canada. In March 2005, *Vestimetra International Inc*. produced the report, "Pan-Canadian Inventory, Assessment and Gap Analysis of Health Human Resources Forecasting Models".

In order to determine the kind of progress that has been made since that time, *Cameron Health Strategies Ltd*. has been commissioned by the Health Human Resources Strategies Division of Health Canada to update that review. The review will update the inventory of HHR forecasting models being used in Canada and the HHR forecasting needs of the provinces and territories and consider potential options to collaboratively support forecasting capacity development.

As someone who is involved in HHR policy and planning at the federal/provincial/territorial level(s), the success of this project and the enhancement of forecasting capacity in Canada depend upon your participation. Therefore, we are asking for your support by taking the time to participate in an interview on forecasting needs and capacity to forecast HHR requirements.

The final report will be made available to you and will be helpful in terms of exchanging information on HHR forecasting and setting priorities. You are not required to provide any private or commercially sensitive information. Furthermore, the personnel collecting and analyzing the information are subject to the Enhanced Security provisions required of the federal Public Service.

Jim Houston, on behalf of *Cameron Health Strategies Ltd.*, will be calling you shortly to arrange a telephone interview with you. A copy of the interview guide is attached for your review in advance of the interview. Should you have any questions regarding this survey or any concerns regarding your participation in the project, please contact Mr. Houston at kellyhouston@eastlink.ca or by telephone at (902)441-3337. Or if you wish to reach me, my contact information is included below.

We thank you in advance for your participation in this project and look forward to sharing the results with you as we work towards a more collaborative approach to HHR planning.

Yours sincerely,

Cameron Health Strategies Group Ltd

APPENDIX C

Decision- Makers' Interview Guide

A Pan-Canadian Inventory, Assessment and Gap Analysis of Health Human Resources Forecasting Models

INTERVIEW GUIDE

Q1: Please tell me the principal responsibilities of your job, as they relate to Health Human Resources (HHR).

Q2: In what type of HHR-related activities does your jurisdiction engage?

Q3: In general, how does your jurisdiction determine the type and quantity of HHR your jurisdiction will need in the future, and how best to meet those needs?

Q4: To what extent and in what ways do HHR forecasting models assist your jurisdiction in determining future HHR needs, and how best to meet those needs?

Q5: How important is HHR forecasting, in comparison to other factors, in your decision-making about your jurisdiction's HHR needs in 5-10 years, and how to meet them? What are those other factors?

Q6: Please explain the type and source of any HHR forecasting models which you use.

Q7: Do you use any forecasting models that are based on population health needs?

If yes – Please describe that model/those models.

If not – Why not? Would you like to?

Q8: Thinking of the HHR forecasting models which you use, are there any improvements that could be made to make them more useful in meeting your needs?

If yes – What improvements are needed and what are the most important ones?

Q9: Do you have any plans to make these improvements?

Q10: Is there any work underway or planned in your jurisdiction to make significant changes to the way health care is delivered, including the roles & responsibilities of various health professions? If so, how do your forecasting models take this into account?

Q11: The *Framework for Pan-Canadian HHR Planning (revised 2007)*, prepared by ACHDHR, affirms that "…jurisdictions cannot plan in isolation…and require a collaborative pan-Canadian approach to certain aspects of HHR planning." (p.3)

Do you have any comment regarding that statement?

Q12: Following up on the previous question: What role do you see for (a) the federal government; and (b) PT or FPT collaborative efforts in helping your ministry/department with its work in the realm of HHR forecasting models specifically and HHR planning generally?

Q13: In closing, is there anything else you would like to tell us?

APPENDIX D

List of Respondents – Decision-Makers

(* denotes member of ACHDHR)

British Columbia
Libby Posgate
Director, HHR Planning (Physicians), HHR Planning Division
BC Ministry of Health Services
1515 Blanshard Street,
Victoria, BC V8W 3C8
Phone: 250-952-1107
E-Mail: libby.posgate@gov.bc.ca
Website address of employer: *www*.gov.bc/health

Judy Thompson
Director, Allied HHR Planning, HHR Planning Division
BC Ministry of Health Services
1515 Blanshard Street
Victoria, BC V8W 3C8
Phone: 250-952-1286
E-Mail: judy.thompson@gov.bc.ca
Website address of employer: *www*.gov.bc/health

Alberta
Glenn Monteith* Assistant Deputy Minister, Health Workforce Division
Alberta Health & Wellness
10th Floor, Telus Plaza North Tower, 10025 Jasper Avenue,
Edmonton, AB T5J 2N3
Phone: 780-644-2720
E-Mail: glenn.monteith@gov.ab.ca
Website address of employer: www.health.alberta.ca
Note: Mr. Monteith was accompanied by Linda Mattern (Executive Director, Health Workforce Policy & Planning Branch).

Saskatchewan
Ron Knaus
Executive Director, Workforce Planning Branch
Saskatchewan Health
3475 Albert St.
Regina, SK S4S 6X6
Phone: 306-787-6672
E-Mail: rknaus@health.gov.sk.ca
Website address of employer: www.health.gov.sk.ca

Manitoba
Terry Goertzen*
Assistant Deputy Minister, Health Workforce Division
Manitoba Health & Healthy Living

1038 - 330 Carlton Street
Winnipeg MB R3B 3M9Phone: 204-788-6674E-Mail: Terry.Goertzen@gov.mb.ca
Website address of employer: www.gov.mb.ca/health
Note: Mr. Goertzen was accompanied by Helen Konrad (Analyst, Workforce Policy and Planning, MHHL) and Jerry Ross (Executive Director, Health Workforce, MHHL).

Ontario
Jeff Goodyear Director, HHR Policy Branch, HHR Strategy Division
Ontario Ministry of Health & Long-Term Care
56 Wellesley Street West, 12th Floor
Toronto, ON M5S 2S3
Phone: 416-327-7482 (direct); 416-327-7483 (his assistant Linda)
E-Mail address: jeff.goodyear@ontario.ca
Website address of employer: http://www.health.gov.on.ca
Note: Mr. Goodyear was accompanied by Dan Singh and Hussein Lalani.

Quebec
Daniel Poirier
Director of Physician Human Resources
Quebec Ministry of Health and Social Services
1075 chemin Ste-Foy, 10th floor
Quebec City, Quebec G1S 2M1
Office phone number: 418-266-6975
E-Mail address: daniel.poirier@msss.gouv.qc.ca
Website address of employer: www.msss.gouv.qc.ca
Note: Mr. Poirier was accompanied by Jacques Piché (Senior Analyst).

New Brunswick
Lyne St. Pierre-Ellis*
Director of Health Workforce Planning (& Physician Resource Advisor)
New Brunswick Dept. of Health
520 King St., P.O. Box 5100
Fredericton, NB E3B 5G8
Phone: 506-457-3591
E-Mail: lyne.st-pierre-ellis@gnb.ca
Website address of employer: www.gnb.ca/0051/index-e.asp
Note: Ms. St. Pierre-Ellis was accompanied by James Ayles, Coordinator, Health Workforce Information & Analysis.

Nova Scotia Donna Denney*
Nursing Policy Advisor/Acting Head of HHR planning
Nova Scotia Dept. of Health.
1690 Hollis Street, PO Box 488
Halifax, NS B3J 2R8
Phone: 902-424-5881
E-Mail: donna.denney@gov.ns.ca
Website address of employer: *www*.gov.ns.ca/health

Prince Edward Island Patricia Devine*
Director, Health Recruitment & Retention Secretariat
PEI Dept. of Health
11 Kent Street, 5th Floor, P.O. Box 2000
Charlottetown, PE C1A 7N8
Phone: 902-620-3760
E-Mail address: pdevine@gov.pe.ca
Website address of employer: http://www.gov.pe.ca/health
Note: Ms. Devine was accompanied by Blair Weeks (Human Resources Planner).

Newfoundland and Labrador
Andrew Wells
Manager of Workforce Planning
Department of Health and Community Services
Government of Newfoundland and Labrador
P.O. Box 8700, St. John's, NL, A1B 4J6
Phone: 709-729-1890
E-Mail: andrewwells@gov.nl.ca
Website address of employer: www.health.gov.nl.ca/health

Yukon
Joy Kajiwara*
Director of Community Nursing
Department of Health and Social Services
Government of Yukon
P.O. Box 2703 - 307 Black Street
Whitehorse, Yukon Y1A 2C6
Phone: 867-667-8325
E-Mail: Joy.Kajiwara@gov.yk.ca
Website address of employer: www.hss.gov.yk.ca
Note: Ms. Kajiwara was accompanied by Ms. Jan Horton, DHSS.

Nunavut
Roy Inglangasuk
Director of Human Resources, Department of Health & Social Services
Government of Nunavut
Phone: 867-975-5738
E-Mail: ringlangasuk@gov.nu.ca
Website address of employer: www.gov.nu.ca/health

Canadian Medical Association
Owen Adams*
Assistant Secretary General - Research, Policy & Ethics
Canadian Medical Association

1867 Alta Vista Drive
Ottawa, ON K1G 3Y6
Phone: 613-731-8610 ext. 2259
E-Mail: owen.adams@cma.ca
Website address of employer: www.cma.ca

Canadian Nurses Association

Lisa Little
Director of Public Policy
Canadian Nurses Association
50 Driveway
Ottawa ON K2P 1E2
Phone: (613) 237-2133, ext. 209
E-Mail: llittle@cna-aiic.ca
Website address of employer: www.cna-aiic.ca

APPENDIX E

HHR Forecasting Models Currently in Use by Canadian Jurisdictions and National Organizations

DEFINITIONS

For purposes of this document, the working definitions given below were used.

Projection Model

In order to estimate future requirements for health care (and thus for HHR providers), this type of model typically

> (a) inserts utilization rates for various health care services in the health care system as it currently exists, and then
>
> (b) adjusts those utilization rates by assumed increase (or decrease) factors in future years, based on estimates of growth in demand/utilization.

A projection model typically does not attempt to determine whether the health care services being utilized are meeting health care 'needs' (in the abstract), nor does it typically use as a variable the design of the health care system (including the services delivered by the various health professions). It takes the type & quantity of services, plus the models of care used to deliver those services, essentially as givens, and focuses on (i) estimating growth in demand/utilization for each service, and thus (ii) estimating growth in demand for the various health professionals that supply those services.

Once the projection model has estimated future demand/requirements for the services provided by various health professionals, it turns its attention to the supply side of the model and looks at whether or not the demand/requirements for services will in fact be met in the future, given (a) the model's data re: current supply; and (b) the model's estimates/projections re: factors such as entry/exit to the profession hours worked, absenteeism & other productivity factors, etc. in future years. Typically, projection models focus much of their attention on the factors that determine supply of service by one or more key health professions.

Needs-Based Model

A needs-based model, unlike a projection model, does not take current utilization patterns (i.e. the type & quantity of health care services delivered, plus the models of care used to deliver those services) as 'givens,' although it does consider utilization data to be useful as one factor among several in estimating current and future requirements for health-care services (and thus HHR providers).

A needs-based model begins with an attempt to determine a population's health status (based on disease incidence/prevalence, self-reported health status, etc.) and uses that information - in combination with data re: utilization of health-care services - to estimate health-care needs. A needs-based model is thus able to directly address the issue of unmet needs, by comparing total need for services with total supply of services.

Typically, a needs-based model allows for simulations regarding (a) future health-care needs; and (b) the models of care used to deliver health services in the future.

In essence, a needs-based approach to modelling incorporates the approach of a projection model and then adds data & assumptions re: the health-care needs of a given population.

MODELS CURRENTLY IN USE

BC:

Physicians: Projection Model: A 'template' that began as a "negotiated instrument" with the BCMA and is "based on supply," but has been "updated re: demand." Currently, determining how many physicians are required is "a shot in the dark."

Other health professions (Nurses + Allied): Projection model: A "fairly simple model" covering 23 professions that uses an "across-the-board" assumed rate of growth (of 2.05% per annum) in future demand/requirements for all health professions.

AB:

Projection Model: Do not currently have a robust estimate of service demand…Model is heavily based on supply.

SK:

Projection Models (rudimentary): Do not have any models based on population health needs…haven't used a lot of forecasting…don't have a lot of capacity in-house to run models…have done a couple of labour-market forecasts in the past, using contractors – e.g. nursing (2003); MLTs (2004).

MB

(Partially) Needs-Based Model:

- The only health profession for which there is a model is nursing – it covers RNs, LPNs, RPNs.
- [On the supply side] this model uses record-level college data, vacancy data, and education data. It is updated each year; the next update will occur in April/May 2009.
- On the demand side, ministry uses RHAs' estimates of how many nurses they need; The RHAs do a comprehensive Community Health Assessment every 5 years, which informs their estimates of HHR needs.

ON

Projection Model(s):

- For all professions, to date the demand side has been utilization-based [not needs-based]. Generally "don't have good modelling re: demand."
- Right now, nothing re: population health needs. We go with political decisions and stakeholder pressure.
- Physicians: "It's just a Supply based model; it was documented well in the Vestimetra study - it's the 'ADIN' model."

- Nursing: No hard & fast model for nursing; don't have a thorough Supply model, "let alone a Demand model."
- Allied Health Professions: Same thing applies as in nursing; don't have thorough Supply side data, "let alone a Demand side model."

QC

Needs-Based Model re: current need for Family Physicians:

- Have a strong methodology/model to determine the *current* needs of the population in terms of the number of family physicians, and compare this to the actual number of physicians, to determine shortages. In terms of the future, we estimate demand by looking at population growth and structure; we assign a weight to each age/sex group. We also project supply, based on entry, exit, hours worked, etc.
- Do not have a strong methodology/model to determine the needs of the population (i.e. shortages) in terms of specialists.

NB

Projection Model for Nursing & Allied Health Professions; Projection (but 'closer to Needs-Based') Model for Physicians

- In 2001-2002 we hired consultants (Fujitsu) and did 2 major HHR studies/forecasts, which were based on models built by the consultants:
  - Physicians – a 10-year forecast;
  - Nursing + allied health professions– a 5-year forecast.
- We are in the process of updating those forecasts.

Nursing & Allied Health Professions

- "It's a standard stock-and-flow model, mainly a supply-side model."
- "It's not needs-based - It's weak on what the supply *should* be; it's weak on the demand side"

Physicians:

- "This model is stronger on the demand side that the Nursing/Allied model; it's closer to needs-based."

NS

Needs-based Models have been built by consultants for nurses, physicians and MRTs.

The NS Dept. of Health is working to increase its in-house HHR modelling capacity.

PEI

Projection Model:

"In 2001 consultants (DMR/Fujitsu) did a PEI-specific HHR study and built a PEI HHR model…In 2005-2006, we used that model to do some projections for certain health professions." But now the model is "in mothballs.

NL

Projection Models:

- "Forecasting models have been developed for RNs, LPNs, social workers and pharmacists, but not for physicians…The models allow for a simple 'expansion' demand factor, so accommodation is made for potential changing population needs, but the model is not based directly on population needs."

YK

No formal forecasting model in use.

- Do not do "statistical modelling"…"informally project utilization & supply."

NU

- "No formal forecasting model in use. Much of the work to date generally does not consider the complex factors that influence health human resources (HHR)."

CNA

- Built utilization-based models re: RNs models in 1997 and 2002. These models also of course incorporate supply-side info: "stock-and-flow" info.
- In 2006, built a needs-based model re: NPs. Three provinces – NL, ON, AB – worked with us.

CMA

Projection Model re: MDs:

- Model emphasizes the supply side; it's a stock-and-flow model. "Quite sophisticated"/detailed re: factors that influence supply.
- "We don't know how to do demand [well]." Use CIHI data re: age/sex distribution of the population and use this to adjust utilization.

APPENDIX F

Jurisdictions'/Organizations' Desires and Intentions to move to Needs-Based HHR Forecasting Models

BC:

Physicians:

- "We will be a having a 'conversation' this year in BC re: what methodology we will use to best determine demand [for MDs]." We're hoping to move from a model based on the profession's needs/wants/demands to one based on population health needs, etc. We will be looking at options this year. We are aware of what Alberta is doing [i.e. building a needs-based model].

Other Health Professions:

- We do not use any forecasting models based on population health needs, but we would like to. Apparently AB is doing some interesting work.
- We want to start adding information/intelligence re: changes to the service-delivery model in various professions."

AB:

- Working with consultants, we are building a new model that "will translate population health needs into service delivery." We want to translate population health needs into service delivery, then look at productivity.
- We are trying to move to a needs-based approach (from our current model, which is heavily based on supply).
- We are focusing initially on MDs, RNs and MLTs.
- We hope to have a workable prototype by summer 2009 and something we could actually use (and show to other PTs) by the end of 2009. However, this is a long-term process, and the model may not be 'rigorous' for 4-5 years.

SK:

- "We do not have any models based on population health needs; but it would be nice to have one." The service delivery model (e.g. technology, location of services) drives HHR needs.
- Planning for the future based on current practice assumes that it is appropriate, which is a big assumption.
- "We would be very interested in seeing Alberta's new model, but I don't necessarily see it as a magic bullet."

MB

"We want our forecasting models to be good enough to influence politics."

ON

Physicians:

- We're working with the Ont. Medical Association, Ont. Hospital Association, Ont. College of Faculties of Medicine, ICES (etc.) on a Demand model for physicians; the Conference Board of Canada is building this model. It will focus on population health needs, and will also incorporate productivity. It will also incorporate our existing supply-side model.

Nursing

- The Ontario Nursing Secretariat [a division of the Ministry of Health & Long-Term Care] has contracted with Med-Emerg (Gail Tomblin Murphy et al.) to develop a model re: nurses.

Allied Health Professions

- We are working with CIHI and the professional colleges to build a data base. We expect to have a really robust data base by mid-2010. We will then be able to start on modelling.

QC

- "The [current] physician model has limits."
- "It is difficult to forecast how the delivery system will change…. Access to primary heath care is the top priority of our ministry."

NB

Nursing & Allied Health Professions

- "We are not planning to refine the model at this time to add demand/needs" [because]:
  - It meets our needs. We don't need an exact number [re: future supply]; we just need a range;
  - It's not worth the time & effort required – e.g. We have been working for 3 years to update our Physician model.
  - Conceptually, it's difficult to determine 'need.'

Physicians

- Our current model generally meets our needs. We are adjusting/updating this model (and have been for 3 years).

NS

- "We would definitely be interested in looking at other provinces' models (e.g. Alberta's new one), and sharing ours;
- "Someone should objectively look at all the different models, and make recommendations re: the usefulness of each model, and whether there are possible synergies.

PEI

- "We want to be evidence-based and base our planning on population needs.
- "We are in exploration mode re: possible new models."

NL

- "Identifying and meeting population needs is however vital. Basing workforce projections directly on populations needs may force the issue of 'what services where', but is not particularly useful for facilitating decisions needed today."
- "We need to get the basics right (e.g. accurate entry/exit data) before we get too complex with needs-based models. We have developed models that are simple but robust, and can be presented in easy-to-understand terms, in a very short timeframe. The practical application of needs-based workforce planning has yet to be proven, but needs-based service planning should be foundational for all government departments of health."

YK

- Doesn't do 'statistical' modelling, and doesn't have plans to at this time.

NU

- "Much of the work to date generally does not consider the complex factors that influence health human resources (HHR). They do not consider the effect of HHR decisions on population health, provider outcomes such as stress, and the cost of a decision made….At some point, we would like to make these improvements."

CMA

- Modelling based on population-health needs is critical; someone needs to do this. But it has to be practical; don't make it too complex or expensive
- We have no current plans to make significant changes to our model.

CNA

- In May 2009 CNA will be holding a news conference to unveil a model re: RNs that is based on population health needs. The model will not initially include different delivery models.
- It uses health status data (e.g. from CCHS) and utilization data. It uses national (pan-Canadian) data, but could be adapted to a province by inserting province-specific data

APPENDIX G

Modeller Questionnaire

A PAN-CANADIAN INVENTORY OF HHR FORECAST MODELLING CAPACITY AND PRACTICES

Modeller Questionnaire

February 2009

Respondent Information

Name:

Title:

Jurisdiction/organization:

Address:

Business phone number:

Cellular phone number:

E-Mail address:

Web address:

PART A

Model Description

Q-1: Did you develop or use a generic model, or a model with a name to conduct HHR forecasts? (please check (√ or x) one of the following choices):

- Generic models [ ]
- A named model [ ]
- The model name is: _____

Q-2: What is the current status of the model? (check (√) one of the following):

- Currently being applied [ ]
- Under development [ ]
- Has been applied and since retired [ ]
- Other [ ] (Please specify):

Q-3: What were the objectives behind the model you built (or are planning to build)? (Please check (√) as appropriate):

- Control health costs:[_];
- Ensure that there are enough resources to meet health-care needs:[_];
- Ensure that the right mix of health occupations:[_]
- Estimate attritions:[_]
- Estimate the number of enrolments in a given occupation to meet needs:[_];
- Estimate time path required to meet demand:[_];
- Other:[_] (Please specify):

Q-4: Was the model acquired from an external supplier? (Please check (√)one choice):

- Yes: [_];
- No: [_];

Q-5: Who developed the model? (Please check (√) from one of the following choices):

- Federal Government:[_]
- Provincial or Territorial Government:[_] (please specify)
- Regional Governments/organizations: [_](please specify)
- Health care institutions: [_](please specify)
- Researchers/Consultants: [_](please specify)
- University: [ ] (please specify)
- Other: [_] (please specify):

Q-6: Approximately how many people and/or full-time equivalents (FTE's) were required to develop the model?

Q-7: If the model is now complete, when was it developed?

Q-8: If the model is currently under development, what is the expected completion date of the model? (Year/Month)

Q-9: If the model is no longer in use, please specify why: (Please check (√) one or more of the following choices):

- Results are unreliable:[_]
- Lack of data to support model:[_]
- Model no longer current:[_]
- Too costly to maintain:[_]
- Lack of resources:[_]
- Other (please specify):

Q-10: Was the model replaced by another version? (Please check (√) from one of the following choices):

- Yes:[_]; please also complete this survey for the replacement model.
- No:[_]

Q-11: When was the last time the model was applied? (Year/Month):

Q-12: When was the model retired? (Year/Month):

Q-13: What is the jurisdictional scope of the model? (check (√) one or more of the following):

- National:[_] (Please specify):
- Provincial:[_] (Please specify):
- Regional:[_] (Please specify):
- Institutional:[_] (Please specify):
- Other: [_] (Please specify):

Q-14: What health occupations has the model been applied to? (check (√) one or more from the following):

- All health occupations:[_]
- All Physicians:[_]
    - Family physicians:[_]
    - Specialist Physicians:[_]
        - Clinical Specialists (please specify):
        - Laboratory Specialists: (please specify):
        - Surgical Specialists (please specify):
- All Nurses:[_]
    - Registered Nurses:[_]
    - Registered Psychiatric Nurses:[_]
    - Licensed Practical Nurses:[_]

- Nurse Practitioners:[_]

- All Dentists:[_]
  - Dentists – generalists:[_]
  - Dentists – specialists (please specify):
- Physiotherapists:[_]
- Occupational Therapists:[_]
- Pharmacists:[_]
- Medical Laboratory Technologists:[_]
- Medical Radiation Technologists:[_]
- Other: [_] (please specify):

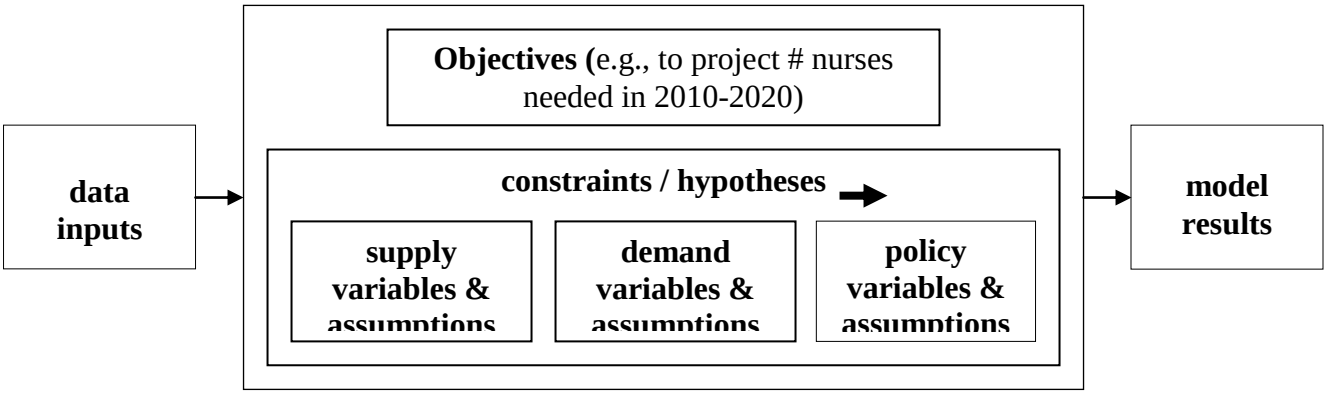
Q-**15**: What is the type of the model? (check (√) one of the following):

- Supply model: [_]
- Demand model (including utilization- and needs-based models):[_]
- Combined supply and demand model:[_]

PART B

HHR Model Components

The following diagram illustrates the components of a typical HHR model.



Q-16: What are the **SUPPLY variables** and **assumptions** in your HHR models?

Please check (√) the variables included in the model. Also please check (√) if a "Fixed" or "Variable" assumption is made. Note that a fixed assumption refers to one that is constant from year to year. For instance, the same rate of retirement could be applied from year to year. In such a case it would be considered a *fixed assumption.* In the case of a variable assumption retirement could change from year to year.

SUPPLY Variables in Models	Please check (√) if assumed:		Please describe assumptions (optional)
	Fixed	Variable	
Stock of Licensed Providers			
• Current (or baseline) stock			
• Age/sex distribution			
• Growth projections			
• Other (specify)			
Annual Additions to Licensed Stocks			
• Graduates from own-jurisdiction			
• In-migration			
o Inter-provincial			
o Foreign-trained			
• Immigrants			
• On temporary work permits			
• Canadians			
• Returned to profession			
• Other (specify			
Education / Training Programs			
• # Programs			
• # Enrolled			
• Attrition within program			
• Years to complete program			
• # Graduates			
• Costs			
• Other (specify)			
Annual Attritions to Licensed Stocks			
• Retirements			

• Mortality			
• Career changes			
• Emigration			
• Inter-provincial			
• Abroad			
• Other (specify)			
Labour Market			
• Occupational participation rates			
• Occupational employment rates			
• Employment projections			
• Vacancy rates			
• Turnover rates			
• Wage rates			
• Productivity growth			
• Cyclical factors			
• Alternative career options			
• Other (specify)			
Employment Status			
• Full-time			
• Part-time			
• Casual			
• Full Time Equivalent (FTE)			
• Average hours worked			
• Direct patient care hours			
• No longer practicing			
• Not licensed in jurisdiction			
• Other (specify)			
Government policy variables			
• HHR education funding			
• Inter-provincial mobility			
• Health-Care expenditures			
• Alternate delivery modes			
• Licensing regulations			

• Professional roles / deployment			
• Recruitment / retention strategies			
• Immigration policy			
• Remuneration rates / types			
• HHR capacity-building budgets			
• Others (please specify)			

Q-17: What are the **DEMAND variables** and **assumptions** of the model?

Please check (√ or x) the variables included in the model, and indicate if a Fixed or Variable assumption is made. Note that a fixed assumption refers to one that is constant from year to year. For instance, the same population growth rate could be applied from year to year. In such a case it would be considered a *fixed assumption*. In the case of a variable assumption, population growth could change from year to year.

	Please check (√) if assumed:		
DEMAND variables in model	**Fixed**	**Variable**	**Please describe assumptions (optional)**
Population Demographics			
• Total population			
• Age/sex distribution			
• Births/deaths			
• Population projections			
• Other (specify)			
Population Health Status			
• Age/sex mortality			
• Morbidity			
• Acuity			
• Other (specify)			
Health-Care Needs			
• Types of services			
• Types of providers			
• Other (specify)			
Health-Care Utilization			
• Types of services			
• Types of providers			

• Other (specify)			
Service Delivery Mode Substitutions			
Private practitioners			
• Institutional in-services			
• Institutional out-services			
• Interdisciplinary teams			
• Mix of service providers			
• Other (specify)			
New technologies			
• Types of services			
• Types of providers			
• Other (specify)			
Socio-economic variables • Disposable income • Ethnic factors • Other (specify)			
Government policy variables • Health insurance scope • Drug insurance scope • Immigration policy • Other (specify)			
Other demand variables (specify)			

Q-18: In the tables below, please check (√) the components used in your model and their characteristics. The term "Global variable" stands for a variable that is not broken down by age or gender or both. The term "Based on hypothesis" stands for variables that are not based on raw data but on hypotheses, assumptions or proxies that are entered into the model.

Supply	**Used in the model**	**Global variable**	**By age and gender**	**Based on historical data**	**Based on hypothesis**
Current stock (incl. registry)					
Attritions (retirements, exits)					
FTEs or productivity, billing					
Emigration					
Inter-provincial migration					
Enrolments					
Educational attritions					
Graduates					
Out of province graduates					
Immigration					

Return to practice					
Career changes					
Stock at end of period					
Other variable (please specify)					

Demand	**Used in the model**	**Global variable**	**By age and gender**	**Based on historical data**	**Based on hypothesis**
Current population					
Population projections					
Health-care needs					
Health-care utilization					
New technologies					
Disease incidents					
Mortality					
Service substitution					
Changes in service delivery					
Professionals needed					
Other variable (please specify)					

PART C

HHR Data Sources and Availability

Q-19: What data are needed to populate the model?

In the table below, please identify the data sources used in your HHR model(s) and rate the ease of obtaining each data component, with 5 being easy to obtain and 1 being difficult to obtain (√). Also check (√) whether the data required is group-level or person-level data. An example has been provided.

Data components	Data source name	Data aggregation		Ease of obtaining data				
		Group-level	Person-level	1	2	3	4	5
EXAMPLE: Employment	Statistics Canada Labour Force Survey	√						√
Demand variables Population Demographics								
Population Health Status								
Health-Care Needs								
Health-Care Utilization								
Service Delivery Modes								
New Technologies								
Socio-Economic								
Other								
Supply Variables								
Health Occupations								
Stocks of licensed providers • Annual additions • Education / Training • Annual attritions								
Labour Market								
Employment Status								
Other								

PART D

Knowledge Transfer

Q-20: What mechanisms are/were in place to transfer/translate forecast results to HHR policy makers (Please check (√) from the following choices):

- Reports sent to senior policy makers:[_]
- Presentations to senior policy makers:[_]
- Seminars:[_]
- Publications:[_]
- Other (Please specify):

Q-21: If such knowledge transfer/translation mechanisms were not used, why not? (Please check (√) from the following choices):

- Inaccuracy of the model's results:[_]
- Results are/were not timely enough for policy makers: [ ]
- Too complex to present:[_]
- Lack of internal cooperation: [_]
- Lack of resources: [ ]
- Other (Please specify):

Q-22: To the best of your knowledge, have the results of your forecast model been utilized by the organization for which it was produced?

- Yes:[_]; Go to **Question Q-23**
- No:[_] ; If no, why were the results of the model not utilized?

  (Please indicate all that apply from the list below):

  - Limited or inadequate budgets:[_]
  - Nobody to produce the forecasts:[_]
  - Lack of expertise: [ ]
  - Lack of awareness of its importance:[_]
  - Lack of internal cooperation:[_]
  - Lack of staff continuity
  - Results not consistent with nor supportive of current policies /thinking: [_]
  - Limited capacity for knowledge uptake
  - Lack of data: [_]
  - Forecasts are poor or incomplete: [_]

- Other (Please specify): [_]
- Do not know: [_]

Q-23: How have the results of your forecast model been specifically utilized to better inform HHR policy and planning decisions within your jurisdiction? Please describe.

Data

Q-24: What are the main data problems that have been encountered?
(Please check as many as apply (√) from the following choices):

- Lack of cooperation with data providers:[_] (please specify data set)
- Lack of resources to exploit the available data:[_] (please specify data set)
- Lack of timely access to data:[_] (please specify data set)
- Data is not current: [ ] (please specify data set)
- Inaccuracy of data:[_] (please specify data set)
- Lack of comprehensiveness of the data:[_] (please specify data set)
- Lack of comparability of the data:[_] (please specify data set)
- Data is too aggregated:[_] (please specify data set)
- Lack of data to run the model or to allow a more sophisticated model to operate:[_] (please specify data set)
- Other: [_] (Please specify problem and related dataset):

Evaluation

Q-25: What have been the greatest successes in the application of your forecasting model?

Q-26: What are the greatest challenges to your forecast model at the present time?

Q-27: What are your top priorities for ongoing forecast model capacity development?

Q-28: Has an internal evaluation of this model ever been conducted? (Please check (√) from one of the following choices):

- Yes:[_];
- No:[_], Go to **Question Q-30**.

Q-29: If an evaluation was conducted, how was it evaluated and what were the outcomes of the evaluation? (Please describe):

Partnerships and Collaboration

Q-30: If you are willing to share the model with others, what elements would you make available? (Please check as many as apply (√):

- Flow diagram (or logic flow):[_];
- Calculations:[_];
- Source code:[_];
- Compiled program:[_];
- Spreadsheet (excluding data) :[_];
- Database structures:[_];
- Actual data:[_];
- Synthetic (or notional) data:[_];
- Publication or write-up:[_];
- Nothing:[_];
- Other :[_] (Please specify):

Q-31: Are you interested in developing a model for a scope other than the one intended for the model? (Please check (√) as appropriate):

- National:[_];
- Provincial / territorial:[_];
- Regional:[_];
- Institutional:[_];
- Other :[_] (Please specify):

Q-32: Has the model ever been shared (i.e. for application purposes) with any of the following? (Please check as many as apply (√) from one of the following choices):

- With the Federal Government:[_]
- With Provincial or Territorial Governments:[_] (please specify)
- With Regional Governments/organizations:[_] (please specify)
- With health care institutions:[_] (please specify)
- With researchers:[_] (please specify)
- With consultants:[_] (please specify)
- With others (Please specify):

Q-33: If the model has not been shared, do you see any potential to share the model with the following groups? (Please check as many as apply (√) from the following choices):

- With the Federal Government:[_]
- With Provincial or Territorial Governments:[_] (please specify)

- With Regional Governments/organizations:[_] (please specify)
- With health care institutions:[_] (please specify
- With researchers:[_] (please specify)
- With consultants:[_] (please specify)
- With others (Please specify):

Q-34: What challenges do you see for sharing the model with others? (Please check as many as apply from the following choices):

- Cost [ ]
- Copyright [ ]
- Requires specialized personnel [ ]
- Model too specific to organization/jurisdiction/etc. [ ]
- Requires non-transferable data [ ]
- Other (please specify):

Q-35: Do you see any benefits in promoting greater inter-provincial partnerships in forecast modelling?

- Yes: [ ]; Please list.
- No: [ ]; Go to Q-36.

Q-36: Is there a role for HHR forecast modelling at the pan-Canadian level?

Q-37: What specific actions could the federal government take to better support HHR forecast model development ?

Q-38: Could you provide us with documents related to your model or Web links to such documents? If not, could you provide us with bibliographic references?

Q-39: If you have additional comments to add, please provide them here:

APPENDIX H

Modellers Summary Tables on Model Components

MSDAD Enhanced Physician Supply Model (Health Canada)

Modeller: Anil Gupta, Director, Microsimulation Modelling and Data Analysis Division, Health Canada; (613) 946-2091; anil_gupta@hc-sc.gc.ca

Model type: Supply model (including utilization and needs-based models)

Components[3]:

Stocks	√	**Graduates**	√	**Health care utilization**	
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**		**New technologies**	
FTEs or productivity, incl. billing		**Immigration**		**Population Health Status**	
Emigration	√	**Return to profession**		**Morbidity**	
Inter-provincial migration	√	**Career change**		**Service delivery mode substitution**	
Enrolments	√	**Population projections**		**Socio-economic variables**	
Educational attritions	√	**Health care needs**		**Other components**	

Status: Currently being applied

Scope: National (all provinces separately)

Occupations: All Physicians

Data used: SMDB; CAPER

Data problems: Data mainly includes the fee-for-service (FFS) physicians

Development effort: 2 FTEs

Acquired by: None

Developed by: Federal Government

Ever been shared with: Federal Government

Potential to be shared: Provincial or Territorial Governments;

Challenge to share: Open to sharing

Evaluation conducted: No

Satisfy Forecasting Needs: Yes

MSDAD Enhanced Physician Demand Model (Health Canada)

Modeller Anil Gupta, Director, Microsimulation Modelling and Data Analysis Division, Health Canada; (613) 946-2091; anil_gupta@hc-sc.gc.ca

Model type: Demand model (including utilization and needs-based models)

Components:

[3] A check mark (√)indicates that the component is probably based on raw data, whereas an asterisk (#) indicates that the component is most likely not based on data but on a ratio, assumption or a proxy variable. Such classifications were done by the authors of this report as a result of sifting through the information provided by the different modellers.

Stocks		**Graduates**		**Health care utilization**	√
Attritions (retirements, exits)		**Graduates from own-jurisdiction**		**New technologies**	√
FTEs or productivity, incl. billing		**Immigration**		**Population Health Status**	
Emigration		**Return to profession**		**Morbidity**	
Inter-provincial migration		**Career change**		**Service delivery mode substitution**	
Enrolments		**Population projections**	√	**Socio-economic variables**	
Educational attritions		**Health care needs**	√	**Other components**	√

Status: Newly developed

Scope: Provincial

Occupations: All physicians

Data used: Statistics Canada Population Projections; Physician Billings Data from Nova Scotia

Data problems: Current model uses shadow billing data from Nova Scotia, difficult to get similar data from other provinces.

Development effort: 3 FTEs

Acquired by: None

Developed by: Microsimulation Modelling and Data Analysis Division of Health Canada

Ever been shared with: Federal Government

Potential to be shared: Provincial or Territorial Governments;

Challenge to share: Open to sharing

Evaluation conducted: No

Satisfy Forecasting Needs: No, only a prototype model developed for one province, but can be applied to other provinces as well.

Physician Resource Evaluation Template (CMA)

Modeller: Lynda Buske, Director, Workforce Research, Canadian Medical Association; (613) 731-8610; Lynda.buske@cma.ca

Model type: Supply Model (Demand for Obstetrics)

Components:

Stocks	√	**Graduates**		**Health care utilization**	√
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**	√	**New technologies**	
FTEs or productivity, incl. billing	√	**Immigration**	√	**Population Health Status**	
Emigration		**Return to profession**	√	**Morbidity**	
Inter-provincial migration	√	**Career change**	√	**Service delivery mode substitution**	
Enrolments		**Population projections**	√	**Socio-economic variables**	
Educational attritions		**Health care needs**		**Other components**	

Status: Currently being applied

Scope: National; Provincial; Regional; other

Occupations: Physicians (18 specialties)

Data used: Statistics Canada; CIHI; CMA Masterfile; AFMC Medical Education Statistics; CAPER info

Data problems: Lack of cooperation with data providers; lack of resources to exploit the available data; inaccuracy of data; data is too aggregated.

Development effort: 0.5 FTE

Acquired by: None

Developed by: Canadian Medical Association

Ever been shared with: Federal Government; Provincial or Territorial Governments; researchers; consultants; individual specialty societies and provincial medical associations

Potential to be shared: Federal Government; Provincial or Territorial Governments; Regional Governments/organizations; health care institutions

Challenge to share: Requires specialized personnel

Evaluation conducted: Yes

Satisfy Forecasting Needs: Yes; results used by CMA for advocacy activities. Information included in reports for governments, media releases, scientific paper, etc.

MedOncs (Walker Economics)

Modeller: Hugh Walker, President and CEO, Walker Economics Inc; (613) 634-2097; hugh@walkerEconomics.com

Model type: Supply and Demand Model

Components:

Stocks	√	**Graduates**	√	**Health care utilization**	√
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**	√	**New technologies**	√
FTEs or productivity, incl. billing	√	**Immigration**	√	**Population Health Status**	√
Emigration	√	**Return to profession**	√	**Morbidity**	√
Inter-provincial migration	√	**Career change**	√	**Service delivery mode substitution**	
Enrolments	√	**Population projections**	√	**Socio-economic variables**	
Educational attritions	√	**Health care needs**	√	**Other components**	

Status: Developed and available for use

Scope: National; Provincial; any smaller area

Occupations: Initially for oncologists but can be applied to any health profession

Data used: Statistics Canada; Canadian Cancer Society Annual Data Publication; Canadian Association of Medical Oncologists treatment protocols; CIHI

Data problems: Data is not consistent

Development effort: 2 FTEs

Acquired by: No

Developed by: Walker Economics Inc

Ever been shared with: Provincial Governments; health care institutions; researchers; consultants

Challenge to share: Cost; Copyright; Requires specialized personnel

Satisfy Forecasting Needs: No

Supply and Demand Model (Newfoundland & Labrador)

Modeller: Andrew Wells, Manager of Workforce Planning, Government of Newfoundland and Labrador, (709) 729-1890; adnrewwells@gov.nl.ca

Model type: Supply and Demand Model

Components:

Stocks	√	**Graduates**	√	**Health care utilization**	
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**	√	**New technologies**	
FTEs or productivity, incl. billing		**Immigration**	√	**Population Health Status**	
Emigration		**Return to profession**	√	**Morbidity**	
Inter-provincial migration		**Career change**		**Service delivery mode substitution**	
Enrolments	√	**Population projections**		**Socio-economic variables**	
Educational attritions	√	**Health care needs**		**Other components**	

Status: Currently being applied

Scope: Provincial

Occupations: Registered Nurses; Licensed Practical Nurses; Pharmacists; Social Workers

Data used: Schools; Licensing bodies

Data problems: Difficult to get information from licensing bodies

Development effort:

Acquired by: No

Developed by: Provincial Department of Health

Ever been shared with: Regional Health Authorities; Licensing bodies; Schools; Other Gov. Departs

Potential to be shared:

Challenge to share: Model too specific to organization/jurisdiction/etc.

Evaluation conducted: No

Satisfy Forecasting Needs: Yes

Supply and Demand Projection Model for Health Professionals (Prince-Edward Island)

Modeller: Blair Weeks, Human Resource Planner, PEI Department of Health, (902) 620-3873; gbweeks@gov.pe.ca

Model type: Supply and Demand

Components:

Stocks	√	**Graduates**	√	**Health care utilization**	
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**		**New technologies**	
FTEs or productivity, incl. billing		**Immigration**	√	**Population Health Status**	
Emigration	√	**Return to profession**		**Morbidity**	
Inter-provincial migration		**Career change**		**Service delivery mode substitution**	
Enrolments		**Population projections**	√	**Socio-economic variables**	
Educational attritions		**Health care needs**		**Other components**	

Status: Under Revision

Data problems: Lack of comparability of the data

Developed by: PEI Department of Health

Potential to be shared: Provincial Government; Regional Government/organizations; health care institutions; researchers; consultants

Evaluation conducted: No

Satisfy Forecasting Needs: No; nobody to produce the forecasts; lack of staff continuity

Other comments: still premature to be able to provide answers to many of the questions in questionnaire.

HHR Planning Simulation Model (Nova Scotia)

Modeller: Pam Jones, Health Human Resource Planner, Department of Health, (902) 424-6275; Pamela.Jones@gov.ns.ca

Model type: Supply and Demand Model

Components:

Stocks	√	**Graduates**	√	**Health care utilization**	
Attritions (retirements, exits)		**Graduates from own-jurisdiction**	√	**New technologies**	
FTEs or productivity, incl. billing	√	**Immigration**	√	**Population Health Status**	√
Emigration		**Return to profession**		**Morbidity**	√
Inter-provincial migration		**Career change**		**Service delivery mode substitution**	
Enrolments	√	**Population projections**	√	**Socio-economic variables**	√
Educational attritions	√	**Health care needs**	√	**Other components**	

Status: Currently being applied

Scope: Provincial

Occupations: Family Physicians; Registered Nurses; Medical Radiation Technologists; Continuing Care Assistants

Data used: Statistics Canada Census; CCHS; CIHI Discharge Abstract Database; Medical Services Insurance Database; Colleges/Associations/Regulatory Bodies/Employers/Educational Institutions

Data problems: Lack of resources to exploit access to data; data is too aggregated

Development effort: Unknown

Acquired by: Yes

Developed by: Adapted from work conducted by Med-Emerg Inc. by a team lead by Dr. Gail Tomblin Murphy

Ever been shared with:

Potential to be shared:

Challenge to share: Copyright

Evaluation conducted: No

Satisfy Forecasting Needs: Yes

Fujitsu Supply & Demand Forecasting Model (New Brunswick)

Modeller: James Ayles, Coordinator, Health Workforce Information & Analysis; (506) 457-3591; james.ayles@gnb.ca

Model type: Supply and Demand Model

Components:

Stocks		**Graduates**	√	**Health care utilization**	√
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**	√	**New technologies**	
FTEs or productivity, incl. billing		**Immigration**	√	**Population Health Status**	
Emigration	√	**Return to profession**		**Morbidity**	
Inter-provincial migration		**Career change**		**Service delivery mode substitution**	
Enrolments	√	**Population projections**	√	**Socio-economic variables**	
Educational attritions	√	**Health care needs**		**Other components**	

Status: Currently being applied

Scope: Provincial

Occupations: All Physicians; Registered Nurses, Licensed Practical Nurses, Nurse Practitioners, Physiotherapists, Occupational Therapists, Pharmacists, Medical Laboratory Technologists, Medical Radiation Technologists.

Data used: Medicare Database; Health Regulatory Bodies

Data problems: Lack of resources to exploit the available data;

Development effort: Unknown

Acquired by: Yes

Developed by: Fujitsu

Challenge to share: Everyone is invested in his or her own model

Evaluation conducted: No

Satisfy Forecasting Needs: Yes

Tomblin Murphy (NS) / Med-Emerg International Inc. (Ontario)

Modeller: Dr. Gail Tomblin Murphy, Director, WHO/PAHO Collaborating Centre on Health Workforce Planning and Research; Dalhousie School of Nursing; gail.tomblin.murphy@dal.ca

Note: Med-Emerg International Inc., assisted by Tomblin Murphy, O'Brien-Pallas, Birch and Kephart, developed a needs-based model for the Atlantic HHR Association in 2005, and a simulation model for the CNA for NPs in 2006.

Between 2007 and 2009, Dr. Tomblin Murphy and her team (including Lethbridge, MacKenzie and Alder) further developed needs-based simulation models, adapted from their earlier work with Med-Emerg Inc., which include a CNA RN study, an RN Study for the Ontario MHLTC Nursing Secretariat, a Nova Scotia study on RNs, FPs and MLTs and ongoing HHR planning work in Jamaica and Brazil. (See pages 24-25 for further detail.)

Model type: Supply and Demand Model

Components:

Stocks	√	**Graduates**	√	**Health care utilization**	√
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**	√	**New technologies**	
FTEs or productivity, incl. billing	√	**Immigration**		**Population Health Status**	√
Emigration		**Return to profession**		**Morbidity**	√
Inter-provincial migration	√	**Career change**		**Service delivery mode substitution**	
Enrolments	√	**Population projections**	√	**Socio-economic variables**	
Educational attritions	√	**Health care needs**	√	**Other components**	

Status: Under development

Scope: National (CNA); Provincial (Ontario and Nova Scotia); Regional (Atlantic in 2005)

Occupations: Family physicians; Nurses (including Nurse Practitioners)

Data used: Stats Can, CANSIM; NPHS; CCHS and discharge abstracts data; College of Nurses of Ontario (CNO); Government

Data problems: Lack of cooperation with data providers; lack of resources to exploit the available data; lack of timely access to data; lack of comprehensiveness of data; lack of data to run the model or to allow a more sophisticated model to operate

Development effort: approx. 10 FTEs

Acquired by: No

Developed by: Tomblin Murphy, O'Brien-Pallas, Alder and Birch

Ever been shared with: Nova Scotia Government (ongoing); Canadian Nurses Association (2009); CNA Nurse Practitioners (2006); Atlantic Health Human Resources Association (2005); Nursing Secretariat of the Ontario Ministry of Health and Long-Term Care (2008); Government of Jamaica (ongoing); Government of Brazil (ongoing)

Potential to be shared:

Challenge to share: Copyright

Evaluation conducted: No

Satisfy Forecasting Needs: Yes

Physician Supply and Demand Model (Ontario)

Modeller: Dan Singh, Project Leader, HHR Forecast and Modelling Unit, Ontario Ministry of Health and Long-Term Care; (416) 327-9419

Model type: Supply and Demand Model

Components:

Stocks	√	**Graduates**	√	**Health care utilization**	√
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**	√	**New technologies**	√
FTEs or productivity, incl. billing	√	**Immigration**	√	**Population Health Status**	√
Emigration	√	**Return to profession**	√	**Morbidity**	
Inter-provincial migration	√	**Career change**	√	**Service delivery mode substitution**	√
Enrolments	√	**Population projections**	√	**Socio-economic variables**	√
Educational attritions	√	**Health care needs**	√	**Other components**	

Status: Currently being applied

Scope: Provincial, Local health integrations network and county level

Occupations: 59 Physician Specialties

Data problems: Lack of cooperation with data providers; Lack of timely access to data; lack of comprehensiveness of the data; data is too aggregated

Development effort: 12 people, 6 FTEs

Acquired by: No

Developed by: Matthew Stewart, Senior Economist, Conference Board of Canada; (613 526-3280; stewartm@conferenceboard.ca

Ever been shared with: Provincial Governments; health care institutions

Challenge to share: Copyright

Evaluation conducted: No

Satisfy Forecasting Needs: Yes

Demand and Supply Nursing Simulation Model (Manitoba)

Modeller: Helen Konrad, Analyst, Manitoba Health & Healthy Living; (204) 786-7165; helen.konrad@gov.mb.ca

Model type: Supply and Demand model

Components:

Stocks	√	**Graduates**	√	**Health care utilization**	√
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**	√	**New technologies**	
FTEs or productivity, incl. billing	√	**Immigration**	√	**Population Health Status**	
Emigration	√	**Return to profession**		**Morbidity**	
Inter-provincial migration		**Career change**		**Service delivery mode substitution**	
Enrolments	√	**Population projections**	√	**Socio-economic variables**	
Educational attritions	√	**Health care needs**	√	**Other components**	

Status: Currently being applied

Scope: Provincial

Occupations: All Nurses; Physiotherapists; Occupational Therapists; Pharmacists Medical Laboratory Technologists; Midwives; Psychologists

Data used: Various sources

Data problems: Lack of cooperation with data providers

Development effort: 0.5 FTE

Acquired by: None

Developed by: Provincial Government

Ever been shared with: Provincial Governments, Regional Governments in Manitoba

Potential to be shared: Federal Government; Provincial or Territorial Governments; Regional Governments/organizations; health care institutions; researchers; consultants

Challenge to share: Requires specialized personnel

Satisfy Forecasting Needs: Yes

Other comments: Do not be restricted by data limitations. I think it is essential that models have the ability to be as freely shared as possible, and should only be limited in sharing with other jurisdictions by the privacy-level of information used.

Physician Resource Projection Model (Manitoba)

Modeller: Helen Konrad, Analyst, Manitoba Health & Healthy Living; (204) 786-7165; helen.konrad@gov.mb.ca

Model type: Supply and Demand Model

Components:

Stocks	√	**Graduates**		**Health care utilization**	√
Attritions (retirements, exits)		**Graduates from own-jurisdiction**		**New technologies**	√
FTEs or productivity, incl. billing	√	**Immigration**		**Population Health Status**	
Emigration		**Return to profession**		**Morbidity**	
Inter-provincial migration		**Career change**		**Service delivery mode substitution**	
Enrolments		**Population projections**	√	**Socio-economic variables**	
Educational attritions		**Health care needs**	√	**Other components**	

Status: Currently being applied

Scope: Provincial

Occupations: Family Physicians; Specialist Physicians (Pediatricians); Surgical Specialists (General, Orthopedic Surgery)

Data used: Data Repository of MCHP mostly

Development effort: 6 FTE over 2 years

Acquired by: Yes

Developed by: Manitoba Centre for Health Policy

Ever been shared with: Available for use at

http://mchp-appserv.cpe.umanitoba.ca/deliverablesList.html

Challenge to share: Requires specialized personnel

Evaluation conducted: No

Satisfy Forecasting Needs: Yes

Supply Models (Saskatchewan)

Modeller: Doug Elliott, Owner, QED Information Systems; (306) 522-5515; sasktrends@sasktel.net

Model type: Supply Model

Components:

Stocks	√	**Graduates**	√	**Health care utilization**	
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**	√	**New technologies**	
FTEs or productivity, incl. billing		**Immigration**	√	**Population Health Status**	
Emigration	√	**Return to profession**	√	**Morbidity**	
Inter-provincial migration		**Career change**	√	**Service delivery mode substitution**	
Enrolments		**Population projections**		**Socio-economic variables**	
Educational attritions		**Health care needs**		**Other components**	

Status: Last applied in 2004

Scope: Provincial (Saskatchewan)

Occupations: All Nurses

Data used: Statistics Canada Census; Professional Associations; LFS

Data problems: Data is not current; Lack of data to run the model or to allow a more sophisticated model to operate

Development effort: 0.25 PY

Acquired by: No

Developed by: QED Information Systems Inc

Challenge to share: Model too specific to organization/jurisdiction/etc.; requires non-transferable data

Evaluation conducted: No

Satisfy Forecasting Needs: Yes

Health Workforce Information Network (HWIN) Supply Model (LPN Pilot) (Alberta)

Modeller: Merle Mahabir, Senior Workforce Planner, Alberta Health & Wellness; (780) 422-2725; merle.mahabir@gov.ab.ca

Model type: Supply Model

Components:

Stocks	√	**Graduates**	√	**Health care utilization**	
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**	√	**New technologies**	
FTEs or productivity, incl. billing		**Immigration**	√	**Population Health Status**	
Emigration		**Return to profession**	√	**Morbidity**	
Inter-provincial migration	√	**Career change**	√	**Service delivery mode substitution**	
Enrolments	√	**Population projections**		**Socio-economic variables**	
Educational attritions	√	**Health care needs**		**Other components**	

Status: Under Development, nearing completion in 2009

Scope: Provincial; Regional

Occupations: Applicable to all health occupations (currently piloted with Registered Nurses, Licensed Practical Nurses).

Data used: Regulatory bodies; Alberta Health Services; Alberta Provider Directory (ABPD); Advanced Education and Technology

Development effort: 3 FTEs; 5 external consultants

Acquired by: None

Developed by: Alberta Health & Wellness

Ever been shared with:

Potential to be shared: Federal Government; Provincial or Territorial Governments; Regional Governments/organizations; health care institutions

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Human Resources Forecast for Selected Health Occupations in British Columbia

Modeller: Natasha P. de Sousa, HR Planning & Statistical Consultant, Health Employers Association of BC (HEABC); (604) 714-3375; natashad@heabc.bc.ca

Model type: Supply and Demand Model

Components:

Stocks		**Graduates**	√	**Health care utilization**	
Attritions (retirements, exits)	√	**Graduates from own-jurisdiction**	√	**New technologies**	
FTEs or productivity, incl. billing	√	**Immigration**	√	**Population Health Status**	
Emigration	√	**Return to profession**	√	**Morbidity**	
Inter-provincial migration	√	**Career change**	√	**Service delivery mode substitution**	
Enrolments	√	**Population projections**	√	**Socio-economic variables**	
Educational attritions	√	**Health care needs**		**Other components**	

Status: Under Development

Scope: Provincial, Regional (Health Authorities)

Occupations: Twenty-five occupations, including all Nurses, Physiotherapists, Occupational Therapists, Pharmacists, Medical Laboratory Technologists, Medical Radiation Technologists, Social Workers, Medical Imaging Family, Ultrasonographers, Dieticians, Health Records Administrators, Public Health Inspectors, Respiratory Therapists, Speech Language Pathologists

Data used: Health Sector Compensation Information System (HSCIS); Ministry of Advanced Education and Labour Market Development (ALMD); Ministry of Health (MOH); Difficult to Fill (DTF) surveys from HEABC.

Data problems: Lack of comprehensiveness of the data; lack of comparability of the data; data is too aggregated; necessary data not collected; financial constraints

Development effort: 1 FTE

Acquired by: None

Developed by: HEABC in collaboration with BC Health Authorities and Ministry of Health

Ever been shared with: Regional governments and Ministry of Health

Challenge to share: Model too specific to organization

Evaluation conducted: No

Satisfy Forecasting Needs: Yes, once report was shared with Ministry of Health and Ministry of Education, more seats were created in health professional programs to prevent future shortages in supply

APPENDIX I

Bibliography

Note: This bibliography is not intended to be exhaustive on the topic of health human resources planning and forecasting. Its purpose is to provide an updated reference list of articles published since 2004 that highlight the most recent developments in this field that are most pertinent to the scope of this project. A few earlier seminal works relevant to this topic are also included.

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