

Health Human Resources Planning and the Production of Health: Development of an Extended Analytical Framework for Needs-Based Health Human Resources Planning

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Health human resources planning is generally based on estimating the effects of demographic change on the supply of and requirements for healthcare services. In this article, we develop and apply an extended analytical framework that incorporates explicitly population health needs, levels of service to respond to health needs, and provider productivity as additional variables in determining the future requirements for the levels and mix of healthcare providers. Because the model derives requirements for providers directly from the requirements for services, it can be applied to a wide range of different provider types and practice structures including the public health workforce. By identifying the separate determinants of provider requirements, the analytical framework avoids the “illusions of necessity” that have generated continuous increases in provider requirements. Moreover, the framework enables policy makers to evaluate the basis of, and justification for, increases in the numbers of provider and increases in education and training programs as a method of increasing supply. A broad range of policy instruments is identified for responding to gaps between estimated future requirements for care and the estimated future capacity of the healthcare workforce.

KEY WORDS: health human resources, healthcare planning, populations, healthcare needs

Health human resources planning (HHRP) is concerned with ensuring that the right number and type of health human resources are available to deliver the

right services to the right people at the right time. The level and mix of services required will depend on the goals and objectives of a particular healthcare system. The focus of HHRP to date has been on the impact of demographic change on individual healthcare professions, that is, the effect of an aging population on the requirements for particular healthcare providers and the effect of an aging workforce on the capacity to meet requirements.¹⁻⁸ The general approach followed has tended to focus exclusively on particular provider groups and consists of estimating shortfalls or surpluses in those groups and calculating changes in the sizes of training programs required to eliminate any such imbalances in human resources. As a result, HHRP has occurred largely in isolation of, or separately from, matters relating to other aspects of healthcare policy (eg, changes in the range of services covered by public programs) and population health

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(eg, the introduction of aggressive smoking cessation policies).⁹ In this way, the research questions that HHRP has aimed at addressing have usually been unclear or poorly defined.^{10,11} Research questions about “how many healthcare providers are required” need to be developed and refined to incorporate the objectives for the use of healthcare providers and the contexts in which they will be used (ie, how many providers are required to do what, how, for whom, and under what circumstances?).

The requirements for providers are endogenously determined through the political or social choices that underlie the healthcare system being studied.¹² Systems that ration access to healthcare according to ability and willingness to pay will have different requirements for providers than systems that ration access according to relative needs for care, even where the levels and distribution of health are the same. Funding arrangements that influence the production of healthcare (the level and mix of different resources) will affect the requirements for a particular type of provider. Only where the social and political choices about the access to and delivery of care are explicit can scientific methods be used systematically to derive the requirements for healthcare providers in a particular population.

In the absence of clear and contextualized research questions, it is not surprising that most studies have focused on the current numbers and demographic profiles of providers in the context of the current size and demographic mix of the population (ie, provider-to-population ratios, in some cases adjusted for age and gender of populations and/or providers) applied to the future projected population. As a result, HHRP has been largely an exercise in demography based on implicit assumptions that population age structure determines the service needs of the population and that the age of providers determines the quantity of care provided.¹³ The failure to incorporate healthcare needs and service provision into the analytical framework further assumes that the relationships between age and needs and between the numbers of providers and the quantity of services are exogenous and independent of other factors and hence are constant over time. However, if epidemiology and production processes are not “fixed,” then HHRP based on these assumptions will estimate human resource requirements inaccurately.

For example, much attention has been given to the challenges of an aging population for healthcare systems. Because health risks differ by age and, after childhood, generally increase with age, an older population will generally have greater needs for care than a younger population, all other things equal.¹⁴ But observed cross-sectional or “point in time” differences in age-specific needs cannot be used as a basis for modeling the needs of a future population. Health risks

and hence the needs for care change over time. Life expectancies have increased over time at all ages.¹⁵ Dramatic improvements in health status have been reported over the last 10 to 15 years.¹⁶ Similarly, it has been argued that over time morbidity in populations has been increasingly “compressed” into the later years of life.¹⁷ Not only have years been added to life but also life to years. In terms of the production of health in populations, the effect of age on health has changed over time, that is, 65-year-olds *on average* can expect to be healthier and hence have less healthcare needs than 65-year-olds *on average* 20 years ago. Models for HHRP need to embrace the dynamic nature of the healthcare needs of populations.

Similarly, the service output per provider will vary among providers and over time. The average rate of service delivery per nurse will depend on the availability and use of other resources.⁹ Innovation involves the identification of new ways of production, aimed at increasing the productivity of resources (ie, more output from a given level or combination of resources). The human resources required to meet the needs of a population will therefore be dependent on the role human resources play in serving needs and the other resources available to use in combination with human resources in providing services.

Failure to identify changes in needs and productivity undermines HHRP processes by overestimating health human resources (HHR) requirements and the costs of healthcare services. Newton and Buske⁴ suggested that Canada faced a possible future shortage of physicians based on an estimated 31 percent reduction in the estimated physician-to-population ratio in the next 25 years. However, if age- and gender-specific needs were to be reduced by 1 percent per annum and average productivity of physicians increased by 1 percent per annum, the physician-to-population ratio, after adjustment for changes in activity level and changes in needs, would *increase* by 27 percent over the same period! Birch and Maynard¹⁸ highlighted the implications of failing to take account of changes in needs and provider productivity in an appraisal of UK government plans for dental school expansion. Shipman et al⁸ note that the number of general pediatricians in the United States will expand by nearly 64 percent by the year 2020 as compared with an increase of only 9 percent in the child population, producing a substantial increase in the physician-to-population ratio. The authors note that if pediatricians are to maintain workloads, they may need to “provide expanded services to the children currently under their care, expand their patient population to include young adults, and/or compete for a greater share of children currently cared for by nonpediatricians.” No consideration is given to the appropriateness of these required changes to maintain workloads

from a population perspective. Maybe, instead of focusing attention on maintaining provider workloads, consideration could be given to reducing the number of practicing pediatricians and/or the size of pediatric training programs.

The focus of this article is to develop existing HHR frameworks in order to relax the strict assumptions about epidemiology and production embodied in current practice of HHRP and hence accommodate changes in the levels and distribution of healthcare needs in the population and changes in levels of productivity of healthcare providers.

● The Needs-Based Analytical Framework

The purpose of the analytical framework is to provide a link between principles identified in theoretical models and the application of these principles in health human resources policy development. It is based on several key features as follows:

- HHRP occurs within, not independent of, healthcare planning,
- Needs are not indicated by measures of service delivery (utilization), expenditures on care (demand), or availability of providers (supply). Need is measured independently of these other healthcare constructs.
- Requirements for health human resources are derived from the need for healthcare services that health human resources produce.
- Healthcare services are produced from a range of healthcare inputs that include both human and non-human resources.
- The production of healthcare services and the use of human resources in the production of those services occur in prevailing social, cultural, economic, and political contexts. These contexts are largely determined outside of the immediate remit of human resources policy makers and planners. However the particular contexts will define the opportunities and constraints within which HHRP occurs.
- The capacity of training programs is just one of many policy levers available to human resources policy makers aiming to respond to estimated gaps between future human resource requirements and supplies.

The framework incorporates the essential elements of HHRP in a way that captures the dynamic interplay among factors that have previously been conceptualized as separate and independent. It consists of two independent components: provider supply and provider requirements.

“Provider supply” measures the number of providers who are (or will be) available to deliver

healthcare services to the population. Supply can be seen as the “outcome” of two determinants:

- The *stock* of individuals, representing the number of licensed providers in each age and sex group who are potentially available to provide healthcare services, and
- the *flow* of activities generated from the stock, representing the quantity of input (eg, time spent in the production of services).

The flow of activities depends on (1) the proportion of the current stock that is active in the provision of healthcare (ie, the participation rate) and (2) the level of activity or hours spent in delivering services by those participating in the provision of healthcare (ie, the activity rate). Hence the supply of providers measured in hours of labor, *L*, is given by

$$L = (\text{Number of providers}) \times (\% \text{ delivering services}) \times (\text{hours per participant}) \quad [1]$$

And the full time equivalent (FTE) supply of providers *N^s* is given by

$$N^s = L / W \quad [2]$$

where *W* is the number of hours of service delivery by a full time provider (ie, excluding time devoted to nonservice delivery tasks such as administration).

Both participation and activity rates represent policy variables for HHR policy makers and hence alternative or complementary approaches for changing the provider supply.

In addition to changes in the flow of activities, the number of licensed providers changes over time. This is the result of new entrants to the provider population (inflows of providers from other regions and other countries together with new graduates within the region) and exits from the provider population (outflows of providers to other regions and other countries, retirements, and deaths among providers). Hence,

$$\text{Number of providers this year} = (\text{number of providers last year}) + (\text{new entrants}) - (\text{exits}) \quad [3]$$

This provider supply component is a common element of most approaches to HHRP research. However, unlike previous models, in this framework, the levels of participation and activity are allowed to vary with time.

“Provider requirements” measures the number of providers required to ensure sufficient “flow” of healthcare services to meet the needs of the population. Traditional approaches to estimating the required number of FTE providers, *N^r*, have largely been based on

an implicit analytical framework based on just two elements—the demography and the current level of providers, that is,

$$N^r = (\text{providers/population}) \times (\text{population size}) \quad [4]$$

However, because service requirements and hence the number of providers differ according to age and gender mix of the population, requirements are calculated for each age/gender group by using equation 4, and then, these age-/gender-specific requirements are summed to provide total provider requirements. In this way, total provider requirements are simply a weighted average of the size of different age-sex groups in the population, irrespective of any changes in needs within population subgroups and changes in productivity among provider groups over time. In some cases, the provider-to-population ratio is disaggregated into two separate elements: a “services per population” ratio and a “provider per services” ratio. Hence,

$$N^r = (\text{provider/services}) \times (\text{services/population}) \times (\text{population size}) \quad [5]$$

However, both the provider per services ratio, which represents the inverse of the average productivity of providers, and the services per population ratio are assumed to be constant over time. As a result, the estimated requirements for providers are determined entirely by demographic factors applied to existing levels of utilization per capita and output per provider.

It is worth noting that population need for care does not appear in equation 5. Yet, as argued above, both needs and the service requirements to meet needs (and hence the providers required to satisfy these service requirements) are dynamic concepts. Explicit recognition of needs for care within the population provides a more appropriate approach to expressing provider requirements. This involves disaggregating the provider population variable further so that

$$N^r = (\text{provider/services}) \times (\text{services/need}) \times (\text{needs/population}) \times (\text{population size}) \quad [6]$$

Each expression on the right-hand side of equation 6 represents a separate determinant of the provider requirements:

Demography

Population size represents the *demographic* determinant and captures the size and age distribution of the population, changes to the distribution over time as a result

of population aging, changes in migration, and birth and death rates.

Epidemiology

Needs/population introduces the levels and distribution of needs in the population. In this way, different levels of need are incorporated into the estimation, independent of the demography variable. So, for example, two populations identical in size and age/gender distribution might have very different levels of prevalence of, say, diabetes. So the epidemiology variable “adjusts” the basic demographic data to allow for the differing prevalence of needs in the two populations.

Level of service

Services/need represents a *level of service* determinant of provider requirements. Policy decisions to increase service provision to a particular group, say, by instituting more frequent screening of various risk factors, increases services/need, the service weight applied to the population group with this need. With all other things equal, this increases the required number of providers.

Productivity

Providers/services represents the inverse of the average level of productivity of providers. Productivity depends on a variety of factors, including the intensity of work (proportion of paid hours devoted to patient care), how work is organized, technological inputs, and inputs of other types of professionals.

This enhanced, needs-based analytical framework estimates the number of healthcare providers required to meet the healthcare needs of each age and sex group in the population.

The estimated requirements are summed over all age and gender groups to generate the total provider requirements. Unlike in traditional models of HHRP, the estimated requirements are based on the recognition that all four determinants of requirements may vary, thus extending the framework beyond the confines of a demographically driven model. Moreover, the framework is dynamic with changes in one determinant having potential effects on other determinants. For example, changes in the level of service may have an impact on the levels and distribution of needs (ie, epidemiology).

Because levels of activity vary among providers (eg, part-time, full-time, and overtime), requirements are measured in activity-standardized units (ie, FTE providers), the same units used to measure provider

supply in equation 2. Although older populations may require more provider inputs (eg, hours of care) to produce the same service output (ie, address the same health condition), this variation in resource intensity by population age-sex group can be incorporated in the framework in terms of a severity or complexity adjustment to the levels of service component.

● Discussion

An important contribution of the needs-based approach to HHRP is the central role played by the needs of the population in “driving” provider requirements. In addition, it allows analysts to consider retrospectively the relative pressures behind past trends in human resource deployment: To what extent are expansions in the numbers of physicians, nurses, and so on, explained by aging populations, poorer health levels, and expanding services?

Previous approaches to HHRP have implicitly adopted age and sex as proxy measures of need. However, this fails to allow for variations in needs within age and sex subgroups of the population (eg, needs among 35–45-year-old males may differ according to economic, behavioral, social, or environmental factors) and changes in these needs over time.⁹ The levels and distribution of needs in the population are introduced explicitly as a determinant of provider requirements into the analytical framework. So, for example, if the average health status of 65- to 75-year-old men increases over time, the number of providers required to serve this subgroup of the population would fall, other things equal, because the number of services required by this subgroup to meet current levels of service would be lower.

Introducing different levels of need explicitly into the analytical framework means that some method is required for translating need into requirements for services. There are no “gold standard” “weights” for this translation, and this presents a significant challenge to needs-based approaches to HHRP. Needs can be translated into service requirements by using estimates of current average levels of utilization by level of need in the population. However, planning on this basis may not incorporate efficient and effective service provision, and so existing inefficiency is perpetuated. Although we might expect populations with lower levels of health status to be provided with greater quantities of services, the size of the “health status–service provision” relationship is largely the result of provider discretion guided by professional guidelines and ethics and subject to the constraints imposed by prevailing budgets. Because *level of service* is a determinant of provider requirements, changes in the level of service will affect

requirements for providers. Suppose, research suggests that more frequent screening of diabetic patients would improve patient outcomes and decision makers seek to change service delivery to this patient group accordingly. Such a change increases the level of service and, with all other things equal, this increases the required number of providers.

Similarly, a method is required for translating estimated service requirements into provider requirements. This translation will depend on the rate of productivity of providers (ie, services per provider). Productivity depends on a variety of factors, including the intensity of work (proportion of paid hours devoted to patient care), how work is organized, technological inputs, and inputs of other types of professionals. Research by O’Brien-Pallas et al¹⁹ found that above certain thresholds, increases in intensity of work (as measured by workload measurement systems) reduce nursing productivity. For example, the introduction of an automated pharmacy project in New Brunswick, Canada, was associated with a reduction in requirements for pharmacists to maintain service levels for the population.²⁰ A recent report on estimating the future requirements for registered nurses in Canada and policy options for satisfying these requirements provides an example of the practical application of the framework.²¹

The framework has been presented as a generic tool that can be applied to different healthcare programs and settings. It is important to note that a key feature of the framework is that the requirements for providers are derived from the (needs-based) requirements for services. Hence, the first steps in applying the model are to clearly define the services that are being planned and identify population characteristics that reflect the relative need for these services among populations. For example, in planning a public health workforce for programs of targeted screening, data on risk factors for the condition being screened would constitute a measure of relative need for services so that the capacity for screening differed according to relative levels of need among populations and over time. However, for a universal screening program, capacity to screen need reflects only the size of the population (eg, the number of women of screening age for a breast cancer screening program).

The framework has the capacity to consider interdisciplinary teams of providers, as might be the case in many areas of public health services, and substitution among different types of providers in the delivery of care. For example, the framework was used to estimate the future requirements for primary care nurse practitioners in the context of primary care service provision in which nurse practitioners are part of multidisciplinary primary care teams.²²

The framework also has the capacity to consider different policy settings for service provision, including universal publicly funded systems, private funded, and mixed models. The particular type of system will determine the “level of service” variable, that is, the average level care provided by level of need among the population. In a predominantly public system, we would expect the level of use to increase with level of need at a higher rate than in a fully private system because the capacity to pay for care is often inversely related to levels of need for care within populations.

By identifying the separate determinants of provider requirements, the analytical framework helps avoid HHRP “falling” for the “illusions of necessity” of continuous increases in provider requirements.¹⁵ Moreover, it enables policy makers to evaluate the basis of, and justification for, increases in the numbers of provider and increases in education and training programs as a method of achieving increased numbers of providers.

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