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Health Workforce Planning in OECD Countries

A REVIEW OF 26 PROJECTION MODELS FROM 18 COUNTRIES

Tomoko Ono, Gaetan Lafortune, Michael Schoenstein

JEL Classification: I10, I11, I12, I18, J11

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ABSTRACT

Health workforce planning aims to achieve a proper balance between the supply and demand for different categories of health workers, in both the short and longer-term. Workforce planning in the health sector is particularly important, given the time and cost involved in training new doctors and other health professionals. In a context of tight budget constraints, proper health workforce planning is needed not only to guide policy decisions on entry into medical and nursing education programmes, but also to assess the impact of possible re-organisations in health service delivery to better respond to changing health care needs.

This paper reviews the main characteristics and results from 26 health workforce projection models in 18 OECD countries. It focuses mainly on physician models, but also includes some nurse models. While many health workforce planning models remain fairly traditional and focus mainly on demographic trends to assess the future supply and demand for doctors and nurses, some of the more elaborated models include a broader range of variables that can be expected to have an impact on future health workforce requirements. On the supply side, the models developed in countries such as Australia and the Netherlands better take into account the retirement patterns of doctors, although there remain some uncertainties about how this might evolve in the future. The nurse models in Australia, Canada and France also show that recent trends and different assumptions about future retention rates of nurses may lead to large differences in any projected gap. On the demand side, the few models that have tried to link health expenditure projections with health workforce projections in countries such as the United Kingdom and Norway indicate that different health expenditure growth scenarios can lead to very different conclusions about the future demand for health workers, and any projected shortages or surpluses. Some models have also started to take into account possible extensions of the roles of certain providers, including some “horizontal substitution” (e.g., between general practitioners and medical specialists) and “vertical substitution” (between doctors and “mid-level” providers such as physician assistants and nurse practitioners). The models in countries such as the Netherlands and Switzerland suggest that a significant part of any projected gap in certain categories of health workers might be addressed by increasing such task sharing.

Health workforce planning is not an exact science, and the models on which they are based inevitably involve a series of assumptions about how the various supply-side and demand-side factors might evolve in the future. These models require regular updating and a broadening of their scope, to take into account changing economic and health service delivery contexts and to become more relevant in assessing the impact of different policy options and scenarios.

RÉSUMÉ

La planification de la main-d'œuvre dans le domaine de la santé vise à atteindre un juste équilibre entre l'offre et la demande pour les différentes catégories de professionnels de santé, à court et à long terme. La planification de la main-d'œuvre dans le secteur de la santé s'avère particulièrement importante compte tenu du temps et des coûts investis dans la formation de nouveaux médecins et autres professionnels. Dans un contexte de fortes contraintes budgétaires, une planification appropriée du personnel de santé est nécessaire non seulement pour guider les décisions en matière d'admission aux études de formation médicale et infirmière, mais aussi pour évaluer l'impact d'éventuelles ré-organisations dans la prestation des services de santé afin de mieux répondre aux nouveaux besoins.

Ce document passe en revue les principales caractéristiques et les résultats de 26 modèles de projection de la main-d'œuvre dans le domaine de la santé dans 18 pays de l'OCDE. Il se concentre principalement sur des modèles s'intéressant aux médecins, mais comprend également certains modèles pour les infirmiers. Alors que de nombreux modèles restent assez classiques et se concentrent principalement sur les tendances démographiques pour évaluer l'offre et la demande à venir pour les médecins et les infirmiers, certains des modèles plus élaborés comprennent un plus large éventail de facteurs susceptibles d'avoir un impact sur les besoins futurs de personnels de santé. Du côté de l'offre, les modèles dans des pays comme l'Australie et les Pays-Bas prennent mieux en compte les départs effectifs des médecins à la retraite, bien qu'il reste des incertitudes sur la manière dont cela pourrait évoluer à l'avenir. Les modèles concernant les infirmiers en Australie, au Canada et en France montrent également que les tendances récentes et les différentes hypothèses concernant les futurs taux de rétention peuvent entraîner des différences importantes dans tout déficit projeté. Du côté de la demande, les quelques modèles qui ont essayé de lier les projections des dépenses de santé aux projections des professionnels de santé dans des pays tels que le Royaume-Uni et la Norvège indiquent que différents scénarios de croissance des dépenses peuvent conduire à des conclusions très différentes sur la demande future des professionnels de santé, ainsi que toute pénurie ou excédent projeté. Certains modèles ont également commencé à prendre en compte l'élargissement possible des rôles de certains fournisseurs de soins, y compris certaines «substitutions horizontales» (par exemple, entre les médecins généralistes et spécialistes) et «substitutions verticales» (entre les médecins et les fournisseurs de niveau « intermédiaire » comme les médecins adjoints et les infirmières praticiennes). Les modèles dans des pays comme les Pays-Bas et la Suisse suggèrent qu'une part importante de tout déficit projeté pour certaines catégories de professionnels de santé pourrait être comblée en augmentant le partage des tâches.

La planification de la main-d'œuvre dans le domaine de la santé n'est pas une science exacte, et les modèles sur lesquels elle est basée impliquent inévitablement une série d'hypothèses sur la façon dont les différents facteurs de l'offre et de la demande pourraient évoluer à l'avenir. Ces modèles nécessitent une mise à jour régulière et un élargissement de leur champ d'application pour tenir compte de l'évolution des contextes économiques et de l'organisation des services de santé, et pour devenir plus pertinents aussi dans l'évaluation de l'impact de différentes options d'action publique.

EXECUTIVE SUMMARY

Health workforce planning aims to achieve a proper balance between the supply and demand of different categories of health professionals in both the short and longer-term. This is desirable to ensure adequate access to care, a key goal of health policy in all OECD countries. Workforce planning is particularly important in the health sector, given the time and cost involved in training new health professionals. One of the main purposes of health workforce planning is to provide guidance for policy decisions on the "numerus clausus" -- the quantitative limits on the number of students entering into education and training programmes for doctors, nurses and other health professions which exist in nearly all OECD countries. But health workforce planning can also serve other purposes. In some countries, health workforce planning has been used, for instance, to assess the potential impact of a re-organisation in health service delivery to better respond to ageing populations and the growing burden of chronic diseases.

Tight budget constraints and changing health care needs make proper health workforce planning more important than ever, but it is also getting more complicated. Health systems and health service delivery models are becoming ever more complex, characterised by greater teamwork and overlaps in the roles and responsibilities of different providers. The current context for health workforce planning in many countries is also characterised by conflicting pressures from "cyclical" factors which may be pulling down the demand for certain categories of health workers in the short term, and more "structural" factors which point toward growing and changing demand for health care in the longer term.

The main aim of this review of health workforce planning models is to share information about recent developments in approaches to assess the possible future supply and demand of health workers, as well as to identify persisting challenges and limitations. This paper reviews 26 health workforce planning models that have been developed over the past few years in 18 countries involved in the OECD project on Health Workforce Planning and Management. These models include a mix of traditional approaches to health workforce planning focussing mainly on demographic variables (but with some variants) and more elaborated models which try to take into account a broader range of supply and demand variables which might have an impact on future health workforce requirements. Most of the models reviewed here focus on doctors, but some of them also relate to nurses. A few of the most advanced models also take a multi-professional approach, taking into account the interactions between different health care providers.

Key findings

- Many health workforce planning models do not try to address the question of whether there is any current imbalance in the labour market for different categories of health workers. Due to a lack of any clear definition and indicator of "shortages" or "surpluses", many health workforce planning models make the convenient assumption that the labour market for different categories of health workers is currently in balance (i.e. there is no gap between supply and demand), and then simply depict the evolution over time of any projected gap between supply and demand. However, if there are any current shortages or surpluses, this will obviously affect the estimated gap throughout the projection period. A few models have lifted this convenient assumption and incorporated the possibility of current imbalances, using information that may be used as indicators of shortages (e.g. hard-to-fill vacancies) or surpluses (e.g. unemployment).

- The recent economic crisis has led to a re-assessment of the labour market situation of certain health professions in some countries hard-hit by the recession. Prior to the economic crisis in 2008, there was widespread concern across OECD countries that the demand for doctors and nurses was going up more rapidly than their supply. The main policy recommendation from health workforce planning models then was to substantially increase the training of new doctors and nurses. However, since the outset of the economic crisis, the assessment of the labour market situation of different categories of health professionals and the outlook in the short to medium-term has changed quite radically in some countries. Following the recent slowdown or decrease in health spending, previous concerns about shortfalls in the training of health professionals relative to projected demand have been replaced in some countries by concerns about an over-supply of certain categories of health workers (e.g. hospital specialists in the United Kingdom).

- With one exception only, the health workforce planning models reviewed in this paper do not include wages (or other modes of provider payment) as a variable affecting the future supply and demand for health workers. This is a limitation given that wages can be expected to play an important role in determining the supply and demand of workers in the health sector, as in any other sectors. On the supply side, wages (or other modes of payment) can be expected to influence the attractiveness of different fields of study and occupations, the choice of practice location, as well as retention rates and retirement patterns. On the demand side, since wages (or other modes of provider payment) represent a large part of health spending, their level can be expected to influence the number and mix of health workers that can be employed under any overall or sectoral budget constraints. Any current or future gaps (shortages or surpluses) of different categories of health care providers can also be expected to be mitigated through wage adjustments, but these adjustments are almost never taken into account in the models.

- Most health workforce planning models have focused their attention on 'replacement needs'. Using information about student intakes and graduation rates, and convenient assumptions that all doctors and nurses may retire at a given age, these models can easily estimate whether the future "inflows" of new doctors or nurses may be sufficient to replace the projected "outflows". However, many health workforce planning models have had more difficulties dealing with possible fluctuations in retention rates (particularly for nurses) and using more realistic data and assumptions about retirement patterns (particularly for doctors). In some countries, there is evidence that retention rates of nurses have increased in recent years (e.g. Australia), and that doctors may retire later than previously assumed (e.g. Canada), although it is not always clear yet whether this may be due to cyclical factors or more structural factors (including the impact of policies to increase retention rates and raise retirement age).

- Surprisingly, there have been few attempts to link health workforce projections with health expenditure projections. Health expenditure growth can be expected to play an important role in determining the future demand for health workers, but only a few models reviewed here have tried to link health workforce projections with health expenditure projections. This may be due at least partly to uncertainties about future growth in health spending, as well as how such growth may be allocated between the recruitment of additional staff, increases in pay rates and other benefits, or allocated to capital expenditure and other items. Those models that have tried to build such links between expenditure and workforce projections show that different health expenditure growth scenarios can lead to very different conclusions about the future demand for health workers and any possible future shortages or surpluses.

- Some models have tried to move beyond current health service utilisation to "needs-based" models to provide better estimates of current and future health workforce requirements. Recent developments of "needs-based" models often take into account information about unmet care needs or any gap between the actual use of services and their recommended use (according to current clinical guidelines) to improve estimates of current health care needs, and use information on trends in risk factors and the incidence/prevalence of different diseases to improve estimates of future needs. While "needs-based" models try to overcome clear limitations with the more traditional "utilisation-based" models, they face the challenge of coming up with reliable estimates of current and future health care needs, which are subject to normative judgements and high uncertainties.

- While most health workforce planning efforts so far have tended to look at each professional group in isolation from other groups, there have been some recent attempts in some countries to break down these "silos" and to take into account the potential overlaps and re-allocation of activities within the same professional group (e.g. between general practitioners and different medical specialists) or across different professional groups (e.g. between doctors and "mid-level" providers such as physician assistants and nurse practitioners). Such multi-professional models are necessarily more complex and may raise sensitive issues around the scope of practice of different providers, but they point out that a certain degree of "horizontal" or "vertical" substitution may help to reduce any projected gaps for different categories of providers.

- Productivity growth is sometime included in health workforce planning models, but almost always as an exogenous variable (an arbitrary assumption), reflecting high uncertainty about the different factors that may be driving productivity growth in the future. Most health workforce planning models simply assume that some productivity gains (usually defined as a greater amount of outputs per hour of work or per worker) might help to narrow any projected gap between the future demand and supply of health workers. In most models, productivity growth is assumed to arise from some form of technological progress or innovations in work organisation ("working smarter"), and this is then reflected as a reduction in the demand for health workers. In some models, productivity growth is more linked to changes in working time ("working longer"), and the effect is then reflected as an increase in supply.

- Few models address adequately the geographic distribution of health care providers within the country. Many models focus their projections and recommendations at a national level, although there are often large imbalances across different regions (with shortages in certain areas possibly co-existing with surpluses in others). Some countries deal with this issue through decentralised planning systems at a regional level, based on national guidelines (e.g. Germany). Some country-wide projections also try to address this issue by taking into account the mobility of health care providers within the country (e.g. United States) or by accounting for differences in training capacities across regions (e.g. France), assuming that there is a higher likelihood that health care providers will practice in the region where they have been trained.

- Very few health workforce planning models have been formally evaluated. Many criteria can be used to assess the quality and impact of health workforce planning models, but probably the main ones are their actual *use* in policy decision-making and their *accuracy* in helping to achieve their main objective of ensuring a proper balance over time between the supply and demand of different categories of health workers. A recent evaluation of the health workforce planning model in the Netherlands, focussing on general practitioners, concluded that the results in terms of recommended student intakes had generally been accepted by the key stakeholders and implemented by government, and that the implementation of these recommendations had helped to maintain a good balance between supply and demand. The evaluation also noted that several improvements to the model were still possible, including the need to broaden its scope to address more fully possible substitutions between different professions to plan from a broader perspective.

- The priority and amount of resources allocated to health workforce planning vary a lot across countries. Some English-speaking countries (such as Australia and the United Kingdom) have recently set up dedicated health workforce planning agencies to improve the data and modelling approaches, with sizable budgets to support their activities. In other countries (such as France, Italy or Denmark), the responsibility for health workforce projections has fallen on existing agencies (such as divisions within health ministries or national board of health, with little resources allocated for these activities. Health workforce planning in some countries is under-resourced to allow continuous improvements in the scope, degree of sophistication and frequency of health workforce planning exercises.

Key recommendations

- **Health workforce planning is not an exact science and needs regular updating:** Assessing the future supply and demand for doctors, nurses or other health professionals 10 or 15 years down the road is a very complicated task, fraught with uncertainties on the supply side and even more so on the demand side. Projections are inevitably based on a set of assumptions about the future; these assumptions need to be regularly re-assessed in light of changing circumstances, new data, and the effect of new policies and programmes.

- **Need to know first where we are before we can know where we're heading:** The first step of any good health workforce projection is good data about the current situation. One of the main benefits of strengthening health workforce planning efforts is that it often triggers improvements in this crucial first step.

- **Health workforce projections should help avoid a "yo-yo" approach to student intakes and entry into medical and nursing occupations:** Available evidence shows that employment in the health sector tends to be less sensitive to economic cycles than employment in other sectors, and there is also a long time lag between decisions about medical student intakes and when these students will actually enter the labour market. Hence, health workforce planning should keep an eye on long-term structural factors and avoid being overly sensitive to cyclical fluctuations.

- **Supply-side improvements need to focus more on retirement patterns:** Most health workforce projection models have focused their attention on new entry into different professions, but have paid less attention to exit through retirement. There is a need to consider more closely the complex issue of work-to-retirement patterns, particularly for doctors but also for other professions, as a large number of health care providers are approaching the "standard" retirement age and their retirement decisions will have a major impact on supply in the coming years.

- **Need to move from uni-professional to multi-professional health workforce planning:** Health workforce projection models need to be able to assess in a more integrated way the impact of different health care delivery models, as many countries are looking at ways to re-organise the delivery of services to better respond to population ageing and the growing burden of chronic diseases. Moving from uni-professional to multi-professional approaches to health workforce planning is particularly important in the primary care sector where the roles and responsibilities of different providers (doctors, nurses and other providers) is rapidly evolving in some countries.

- **Health workforce planning models need to address adequately the geographic distribution of health workers:** Any nationwide balance of health workers does not necessarily mean that regional shortages or surpluses do not exist. A proper assessment of gaps between supply and demand needs to go below the national level to assess the geographic distribution of health workers, and how this might evolve over time under different scenarios.

1. INTRODUCTION

1. Ensuring proper access to health care is a fundamental policy objective in all OECD countries. Achieving this objective requires, among other things, having the right number of health care providers, in the right places, to respond to population's needs. However, determining what may be the "right number" of different categories of doctors, nurses and other health professionals is a very complicated task, fraught with uncertainties, given constant and hard-to-predict changes in the demand for health services, and the many different ways of organising health service delivery in different settings. Promoting a proper geographic distribution of health care providers also continues to be an important policy issue in most OECD countries, and there is no single "magic solution" to address the multiple obstacles to ensuring proper access in under-served areas (e.g. rural areas or deprived urban areas).

2. *OECD Health Data* shows that there are wide variations across OECD countries in the number of doctors and nurses per capita, as well as in the generalist/specialist mix. This suggests that different countries have made very different decisions about what may be the "right number" and "mix" of health workers, and that there is no "gold standard" benchmark in terms of physician-to-population ratios or nurse-to-population ratios (OECD, 2012).

3. Until the recent economic crisis, there were concerns in many OECD countries about a looming crisis in the health workforce (OECD, 2008), and these concerns continue to be expressed in several European countries (EC, 2012) and non-European countries (HWA, 2012a). In some countries however, previous concerns about a possible shortage of doctors, nurses or other health professionals have been tampered following cuts or slowdown in the growth rate in health spending following the recession (Morgan and Astolfi, 2013). The new concern in countries such the United Kingdom is that there may be a surplus (over-supply) of certain categories of health professionals (e.g. medical specialists in hospitals) over the coming years (CfWI, 2012).

4. The main aim of health workforce planning is to try to achieve a proper balance between the demand and supply of different categories of health workers in both the short and longer-term. This is important because any shortage of certain categories of health workers may create access problems for certain population groups if there are no adjustment measure, while any surplus involves a waste of human capital (in terms of unemployment or under-employment). Tight budget constraints and changing health care needs make proper health workforce planning more important than ever, but it is also getting more complicated. Health systems and health service delivery models are becoming ever more complex, characterised by greater teamwork and overlaps in the roles and responsibilities of different providers. The current context for health workforce planning is also characterised in many countries by conflicting pressures from "cyclical" factors, which may be pulling down the demand for certain categories of health workers in the short term, and more "structural" factors which point toward growing and changing demand for health care in the longer-term.

5. Health workforce planning is <u>not</u> a new activity in many OECD countries, but the attention and resources allocated to workforce planning has increased in recent years in some countries (e.g. the creation of Health Workforce Australia in 2008). Health workforce planning in many OECD countries dates back to the 1960s and 1970s, and the concerns at that time were not that different from the concerns that can be heard now. In some countries (e.g. the United States), one of the main concerns in the mid-1960s was a projected shortage of doctors at a time of the expansion in health insurance coverage for elderly and

disabled people (through Medicare) and some low-income households (through Medicaid). Similar concerns can now be heard following the expansion of health insurance coverage in the United States under the 2012 health care reform (U.S. Department of Health and Human Services, 2010). In other countries (e.g. France, the Netherlands and others), the concerns in the 1970s had more to do with a possible over-supply of doctors and the costs associated with this, and the need to introduce some "numerus clausus" to limit the number of students entering medical education programmes (Billaut et al., 2006; Van Greuningen et al., 2012).

6. In virtually all countries, health workforce planning initially focussed on doctors, which is not surprising given the central role that doctors play in health systems and the length and cost of their training. All OECD countries (with the exception of the Czech Republic, Chile and the United States) have, for many years, exercised control over the number of students entering into medical education programmes by setting a maximum number of student intake per year ("numerus clausus"). In several countries, a "numerus clausus" also exists for other health occupations, such as dentists and nurses. One of the main roles of health workforce planning has been to provide guidance and recommendations for policy decisions about these "numerus clausus" by projecting the possible future supply and demand of different categories of health workers under different scenarios.

7. In some countries, there have been in the past large cyclical variations in the "numerus clausus" for medical or nursing education programmes, with student intakes rising strongly in periods when there was a perceived or real shortage of doctors and nurses, followed by periods when the numbers were cut down markedly when there was a perceived or real surplus of certain categories of doctors or nurses.[1] Such large swings (which have been referred to as a "yo-yo" approach) create adjustment problems for medical and nursing schools, but also often reflect an over-reaction to short-term fluctuations (in perception or reality) which may not have lasting effects.

8. In some countries, one of the responses to shortages of certain categories of health professionals has been to rely on immigration. The recruitment of foreign-trained doctors and nurses has been used in some countries as an adjustment variable, when the production of domestic doctors and nurses was not sufficient to respond to the demand. However, concerns about the "brain drain" of skilled doctors and nurses from low-income countries to high-income countries has led to the adoption of a Global Code of Practice on the International Recruitment of Health Personnel by the World Health Assembly in May 2010 (WHO, 2010). The Global Code encourages all countries to "strive, to the extent possible, to create a sustainable health workforce and work towards establishing effective health workforce planning, education and training, and retention strategies that will reduce their need to recruit migrant health personnel". To support countries in doing so, the Communiqué from an OECD Health Ministerial Meeting held in October 2010 mandated the OECD to work with countries to identify challenges and possible solutions to improve health workforce planning and management (OECD, 2010).

9. Several OECD countries have taken a number of steps in the past few years to improve their health workforce planning and management. Some countries (e.g. Australia and the United Kingdom) have set up new dedicated bodies to improve health workforce data, analysis, planning and management, while others have opted to rely on existing bodies to perform these tasks. It is timely to review recent developments to improve health workforce planning and projection models in different countries, and to identify persisting challenges. Health workforce planning, as any other attempt to project the future, is not an exact science, and there is a need for continuous improvement in methodology and data sources to improve the accuracy of the projections and their usability in testing different policy-relevant scenarios about the future.

1. See for instance Dumont et al. (2008) for a review of the Canadian experience from 1990 to 2007, and Cash and Ulmann (2008) for a description of the French experience from 1971 to 2006.

10. Traditionally, health workforce planning has been carried out mainly as a "demographic" exercise. On the supply side, the projections of the future number of doctors, nurses and other health care workers were mainly based on the age structure of the current workforce, and the main task was to assess the need to replace those who may be expected to retire in the coming years. On the demand side, the models were also based mainly (if not only) on demographic changes, at the most basic level taking into account only changes in population size, but at a slightly more advance level taking into account also changes in the population structure (and the greater demand that might arise from population ageing).

11. Current concerns about possible future shortages of doctors, nurses and other health professionals continue to be driven largely by these demographic evolutions. In many countries, a large number of doctors and nurses from the "baby-boom" generation are now approaching retirement age and the replacement need will be sizeable. On average across OECD countries, almost one in three physicians is above age 55 and thus likely to consider retirement in the coming ten years (OECD, 2012). Likewise, large shares of nurses are above 55 years old in several OECD countries, with a compounding problem being that many nurses leave their jobs well before retirement age.

12. Health workforce planning models that are based solely on demographic variables have one definite advantage: they are based on information that is easily available and known with a fairly high degree of certainty. But models that are based solely on demography also have several disadvantages (or limitations). The main one is that they generally assume the "status quo" on the supply side and demand side for all other non-demographic variables. On the supply side, they do not take into account possible changes in retention rates and retirement patterns. On the demand-side, they do not take into account a number of factors that might affect future demand including changes in population health needs, economic growth and health expenditure growth to pay for health services (and the workers providing them), productivity growth and changes in health service delivery models. Demographic-based models tend focus mainly (if not only) on student intakes in medical and nursing education programmes, while the inclusion of non-demographic variables can offer a broader range of policy options to address any projected gap between the demand and supply of different categories of health workers.[2]

13. Uncertainties are inherent in any projection exercise because the future is unknown and can be affected by many factors (including policy interventions to avoid any projected problems). All projections are based on a set of assumptions: even the "status quo" is an assumption, often a convenient one when there appears to be too much uncertainty about future directions.

14. On the supply side, some of the main uncertainties relate to questions such as: What will be the retirement patterns of doctors and nurses as they approach the "standard" retirement age? What may be the impact of any new policy interventions to increase retention rates of nurses throughout their career? What will be the evolution in the working time of different categories of health workers?

15. The uncertainties are even greater on the demand side. There is no doubt that population ageing will increase the number and share of the population aged 65 and over (and 80 and over) in OECD countries, but to what extent will this translate into growing needs for health services, and for what types of services and in what settings? Is there any compression of morbidity (which may help to reduce future health care needs) or is there an expansion of morbidity (which may further increase health care needs), or is there any sort of "dynamic equilibrium" with the incidence/prevalence of certain conditions going up but being offset by a reduction in the incidence/prevalence of others? How might changes in health risk factors

2. Canadian economist and demographer David Foot once wrote that demography explains "two-thirds of everything" in social and economic development (Foot and Stoffman, 1996). This might also be true perhaps in health workforce planning, but this still leaves room for non-demographic factors to affect the future demand and supply of providers to a certain extent.

over the past decades and in the future (e.g. reduction of smoking on the one hand, reduction in physical activity and rise in obesity on the other hand) affect the incidence/prevalence of various chronic diseases in the future and related health care needs? To what extent might improved training, technical progress and work re-organisation increase the productivity of health workers in the future (and therefore reduce the demand for providing a given level of services? What may be the impact of any new roles and responsibilities of different providers in any health service delivery models? At a more macro-level, what will be the future growth of the economy and national income and how might this translate into higher public and private spending on health and related health workforce requirements? How will all these demographic, epidemiologic and economic factors interact?

16. All these uncertainties on both the demand side and the supply side represent formidable challenges and complexities for health workforce planning. There have been renewed efforts in many OECD countries in recent years to improve the data sources and methodologies to address these complex issues, in order to try to provide better guidance and advice for decision-making.

17. This paper reviews 26 health workforce planning models that have been developed over the past few years in 18 OECD countries, focussing on doctors and nurses. Information about these models has been provided by national experts from the 18 countries involved in the OECD project on Health Workforce Planning and Management. This information has been complemented by additional literature search. The models include a mix of traditional approaches to health workforce planning mainly focussing on demographic variables (with some variants), as well as more elaborated models which try to take into account a broader range of supply-side and demand-side variables that might impact on future health workforce requirements. While most models focus on a single profession, a few models take a multi-professional approach, taking into account possible interactions of different providers in a more integrated way.

18. The second section of this paper provides a brief overview of the 26 models reviewed. The third section presents a broad analytical framework illustrating the range of variables that may be included on the supply side and the demand side of health workforce planning models. The fourth and fifth sections examine in more detail how some of the models incorporate different supply-side and demand-side variables. On the supply side, the focus is on models that attempt to look closely at the retention and retirement patterns of doctors and nurses. On the demand side, the review focuses in particular on the development of "needs-based" approaches to health workforce planning, which try to overcome the limitations of basic demographic or utilisation-based models. The review also includes a discussion of the few models which attempt to factor in the impact of projected GDP/income growth and health expenditure growth on health workforce requirements. The sixth section reviews the few models that have attempted to move from a uni-professional to a multi-professional approach. The seventh section reviews the evaluation criteria that can be used to assess health workforce planning models, and examples of a few formal evaluations. The eighth section provides some conclusions from this review. Annex represents a brief description of each of the 26 models reviewed in this paper, including their methodologies and some of the main results.

2. OVERVIEW OF THE 26 HEALTH WORKFORCE PLANNING MODELS REVIEWED

19. This section provides a brief overview of the 26 health workforce planning models that have been developed in 18 OECD countries and which are reviewed in this paper. The information about these models was collected mainly through a questionnaire administered to national experts involved in the OECD project on Health Workforce Planning and Management. This was complemented by desk research when needed. For the most part, the models are at the national level, although there are a few examples of models that have been developed at the sub-national level, particularly in federal states where responsibility for health workforce planning may be decentralised at the regional/provincial/state level. In several countries, different models exist alongside one another to project developments for different categories of health workers (doctors, nurses or other health professionals) or in a few cases for certain parts of the health system (e.g. ambulatory care, hospital care, long-term care). The models covered in these 18 countries are clearly not exhaustive, and many more models have been developed by academics or government authorities in many of these countries.

20. The projection models reviewed in this paper have been developed by diverse agencies and actors across OECD countries. While a number of countries have recently set up health workforce planning agencies, such as Australia or the United Kingdom, others, for example Japan has appointed ad hoc commissions that produced one-off reports to guide policy development at a particular point in time. Some other countries, for example France, Germany, Switzerland or Denmark, have tasked existing agencies, such as national statistical offices, national board of health or health observatories, or divisions in their health ministries with developing projection models. In the case of workforce planning for ambulatory care physicians in Germany, stakeholders (e.g. physicians, hospitals, dentists and representatives of the conference of health ministers of German *Länder*) carry out workforce planning according to government guidelines.

21. There are some variations in the time period covered in different models. In most models, the time frame covers a period of 15 to 20 years. Such a time period has the advantage of exceeding the usual length of training for doctors and nurses, without being overly long (which would further increase the uncertainties concerning the set of assumptions on the supply side and demand side).

22. Traditionally, many countries have focussed their health workforce planning models on doctors, given the time and cost it takes to train them. In some countries such as Chile and Switzerland, some projection models have targeted a particular segment of doctors that has been assessed to be of particular relevance. In Chile, the initial focus has been on specialists in public hospitals (World Bank and Ministry of Health, 2010). In Switzerland, one of the models has focussed specifically on ambulatory care physicians, mainly general practitioners (Seematter-Bagnoud et al., 2008). Other countries, for example, Belgium, Denmark and the Netherlands, have developed more comprehensive models for projecting possible future requirements for all types of doctors.

Table 1. Overview of 26 health workforce planning models reviewed

Country	Institution/Year	Coverage	Projection period	Annex No.
Australia	Health Workforce Australia (2012)	Physicians, nurses and midwives	2010 – 2025	A.1
Belgium	Federal Public Service (2009)	Physicians	2004 – 2035	A.2
Canada	Health Canada (2007)	Physicians	2000 – 2025	A.3
	Canadian Nurse Association (2009)	Nurses	2007 – 2022	A.4
	Ontario Ministry of Health and Long-Term Care and Ontario Medical Association (2010)	Physicians	2008 – 2030	A.5
Chile	Ministry of Health (2009)	Medical specialists in public hospitals	2009 – 2012	A.6
Denmark	National Board of Health (2010)	Physicians	2010 – 2030	A.7
Finland	Ministry of Employment and the Economy, Ministry of Education and Culture (2011)	Overall workforce	2008 – 2025	A.8
France	Ministry of Social Affairs and Health (2009)	Physicians	2006 – 2030	A.9
	Ministry of Social Affairs and Health (2011)	Nurses	2006 – 2030	A.10
Germany	Federal Statistical Office (2010)	Nurses in health care and long-term care	2005 – 2025	A.11
	Joint Federal Committee (2012)	Physicians in ambulatory care	Annual decisions about doctors authorise to open practice	A.12
Ireland	Training and Employment Authority (2009)	Physicians, nurses, and other healthcare workers	2008 – 2020	A.13
Israel	Ministry of Health (2010)	Physicians and nurses	2009 – 2025	A.14
Italy	Ministry of Health	22 health workforce occupations	Annual decisions about specialist training posts	A.15
Japan	National Commission on Social Security (2008)	Physicians, nurses, long-term care workers, pharmacists and other health workers	2007 – 2025	A.16
	Physicians Supply/Demand Expert panel, Ministry of Health, Labour and Welfare (2006)	Physicians	2005 – 2040	A.17
	Nurses Supply/Demand Expert panel, Ministry of Health, Labour and Welfare (2010)	Nurses	2011 – 2015	A.18
Korea	Korean Institute for Health and Social Affairs (2012)	15 health workforce occupations (including physicians and nurses)	2010 – 2025	A.19
Netherlands	Advisory Committee on Medical Manpower Planning (2010)	Physicians and dentists	2010 – 2028	A.20
Norway	Statistics Norway (2012)	Health care personnel	2010 – 2035	A.21
Switzerland	Swiss Health Observatory (2008)	Physicians in ambulatory care	2005 – 2030	A.22
	Swiss Health Observatory (2009)	Physicians, nurses and other healthcare workers	2006 – 2020	A.23
United Kingdom	Centre for Workforce Intelligence (2012)	Physicians in NHS England	2011 – 2040	A.24
United States	National Center for Health Workforce Analysis (forthcoming)	Physicians, Nurse Practitioners, Physicians Assistants	2010 – 2030	A.25
	University of North Carolina, Cecil G. Sheps Center (2012)	Physicians	Flexible	A.26

23. In other countries, concerns about current or future shortages of nurses have increased the interest and efforts to improve workforce planning for nurses as well. While many characteristics of the supply side and demand side of models for nurses are similar to those for doctors, there are also important differences. The first and possibly main one is the need to adequately take into account job retention throughout the working life in nurses' models, given that a large number of nurses tend to leave before retirement age. A second difference is that there tends to be less specialisation and sub-specialisation among nurses than doctors, although there has been a tendency in many countries over the past decade to create new categories of nurses, with different skill levels and specialties. A third difference relates to the use of different sources and methodologies to project the future demand for nurses.

24. Some of the models developed in some countries include more than one professional group – doctors, nurses and other health occupations (e.g. in Ireland, Japan, Korea, Norway). In many cases, these models use common underlying demographic and economic assumptions across the various occupation groups, over a consistent time period. The results may display different situations across occupational groups, for instance projected shortages in some occupations may come along with projected surpluses in others. This may create opportunities to discuss possible re-organisation of health services in response to changing needs and any projected imbalances. However, in most of these models, each professional group continues to be looked independently from other groups. Only a few more advanced models have begun to move away from a uni-professional approach to a multi-professional approach which tries to take into account the possible interactions and complementary/substitution of different providers in health service delivery (see section 6 for a further discussion of these models).

3. GENERAL FRAMEWORK TO ASSESS FUTURE SUPPLY AND DEMAND OF HEALTH WORKERS

25. This section presents a general framework to illustrate some of the main factors that may be taken into account in assessing the current and future supply and demand of health workers in health workforce planning models.

3.1 Supply of health workers

26. The current and future supply of health workers are affected by the "inflows" in each occupation and the "outflows" (exits), as well as the activity rates of the "stock" of health workers (working hours). The range of variables that is taken into account in practice in this "stock-flow" approach depends mainly on data availability and relevancy of different variables in particular countries or for particular occupations.

- *Inflows* include graduates from medical and nursing education, foreign-trained health professionals who immigrate, and people returning to work in the health sector after a temporary exit.

- *Outflows* include people who either leave the health sector to work in other sectors or leave the workforce altogether, health professionals who emigrate, and those who retire.

- The *stock* of health workers can be measured in headcounts or full-time equivalents (FTE). FTE is undoubtedly a better measure of the supply of the stock of health workers, as it adjusts for working hours and part-time work, but it requires detailed data on working hours (or other measures of activity) which may not be readily available for all health workers.

3.2 Demand for health workers

27. Many factors affect the current and future demand for health services and therefore for health workers. The main drivers are: 1) demography; 2) morbidity (or epidemiology); 3) health service utilisation (or health care needs in approaches that use a broader approach to measuring demand); 4) different health service delivery models (which may influence workforce requirements in primary care, hospitals and long-term care); and 5) economic growth and related growth in health spending (which will influence the ability to pay for health services from public or private sources). While future demographic changes are known with a high degree of certainty, all the other drivers of future demand involve a much higher degree of uncertainty and they are also all interrelated.

- *Demography* refers to the size and structure of the population by age and sex. Changes over time reflect the impact of changes in birth rates and death rates (increasing longevity), as well as changes in migration.

- *Morbidity* (or epidemiology) refers to the occurrence of diseases and injuries, the key driver of health service demand or needs. Changes over time reflect changes in the burden of different diseases (e.g. the rise in the prevalence of certain chronic diseases combined with the reduction in the prevalence of others), which can be linked to changes in risk factors (e.g. broad socioeconomic or environmental factors, or behavioural factors such as smoking, nutrition patterns, physical inactivity and obesity).

- *Health service utilisation* refers to the use of services by different population groups. Some models only include a breakdown by age and sex. More elaborated models also include additional breakdowns by setting (primary care, hospitals, long-term care at home or in institutions), by disease and by socioeconomic group. Some "needs-based" approaches do not accept the convenient assumption that the current use of health services reflects an optimal use, and that this can simply be projected forward. These models use additional information, for instance on "unmet health care needs", to come up with a broader measure of current and future requirements for health services and health workers to respond to all the estimated needs.

- *Health service delivery models* relate to how work is organised and the roles and responsibilities of different providers in primary care, hospitals, and long-term care. Different modes of organisation involve a different number and mix of health care providers. For example, whereas more hospital-centred systems may require more medical specialists and hospital nurses, a move towards more primary care-centred systems may require more GPs and primary care nurses, with the number and mix being affected by the scope of practice of different providers.

- *GDP and health expenditure growth* will generally influence the amount of public and private resources available to pay for health care and therefore the demand for health services and workers. The share of economic growth that may be allocated to additional health spending will depend on public and private priorities for such higher spending. GDP growth in the short and longer term is also hard to predict, and based on various assumptions about employment growth and productivity growth in the economy. Any health spending growth may be allocated to the recruitment of additional staff, or to higher pay rates and benefits, or to capital expenditure and other spending items.

- Other factors may also influence the demand for health workers, such as changes in the breadth and depth of health insurance coverage and other aspects of healthcare financing arrangements.

Figure 1. General framework to assess the future supply and demand of health workers

3.3 Challenges in implementing the framework

28. There are many challenges in incorporating in health workforce planning models all the different variables that might have an impact on the future supply and demand of workers that are illustrated in this general framework.

29. The first challenge is to get reliable data for the baseline year (the current situation) to be able to assess the 'starting point'. On the supply side, data on immigration of foreign-trained doctors and nurses, and even more so on emigration to other countries, are often not easily available or not reliable in many countries. Detailed information about the working time of various categories of health professionals to convert headcounts into FTEs is also often not readily available. The availability of data to measure in a precise way the transition from work to retirement for doctors and nurses is often lacking.

30. On the demand side, the situation is generally worse because there are a broader range of variables that needs to be taken into account, requiring more data or more estimation, as soon as the models are moving beyond a basic demographic approach of physician-to-population ratios or nurse-to-population ratios. While demographic data on the population structure is widely available, data on current utilisation rates of health services by age and sex -- let alone by diseases -- are often limited (e.g. to certain settings such as hospitals) and often require different types of estimation to obtain a more comprehensive coverage of the health system overall. Another challenge is to estimate how current health service utilisation patterns translate into health workforce requirements (i.e. need for physician services, nurse

services, etc.). For broader "needs-based" approaches, the main challenge is to estimate in a reliable way any potential inappropriate use of services (either over-use or under-use of certain services).

31. In addition, few health workforce planning models try to bring together the available information on the current supply and demand for different categories of health workers to assess whether there is any current "imbalances" in the labour market (shortages or surpluses). This may be due either to limitations in the availability or reliability of data to measure any such "imbalances", or difficulties in interpreting the available data or conflicting evidence (see Box 1).

Box 1. What is the "starting point" to assess gaps between the supply and demand of health care providers?

Despite concerns in many countries about current shortages of doctors, nurses or other health professionals, it is somewhat surprising that most health workforce planning models start by making the simple assumption that the current labour market is in balance (there is no shortage or surplus), and then depict the evolution over time of the gap between the projected supply and demand. But if there are any current shortages (or surpluses) of certain categories of health workers, this will affect the estimated gap in the baseline year and throughout the projection period.

One of the main difficulties in departing from the convenient assumption that the labour market is in balance is to define and measure properly what is a "shortage" (or surplus) of any category of health workers. At the most general level, the standard definition of a shortage is that the demand for a certain category of workers exceeds the supply at a certain point in time. One of the main measures of a shortage is vacancy rates, in particular hard-to-fill vacancies (which may be identified by employers reporting that they had difficulties filling the posts or the average number of weeks/months to fill the posts). Conversely, a standard measure of a surplus of certain categories of workers is unemployment or under-employment (people working part-time who would rather work fill-time). For self-employed workers (which is the employment situation of many doctors in several countries), some alternative measures of shortage or surplus may be required (such as the waiting times to get an appointment).

Very few models reviewed in this study have tried to estimate whether there was any current shortage (or surplus) of doctors or nurses. Those models that have tried to overcome the convenient assumption that the labour market is in balance have used different approaches, ranging from more simple to more advanced methods.

In the models used in some countries (e.g. Chile), a "shortage" is simply defined as the gap between the current physician-to-population ratio or nurse-to-population ratio and some "benchmark" (or target). The main issue then is to determine what should be the proper "benchmark" or target. Given that there are wide variations in the number of doctors and nurses per capita across OECD countries, the choice of any international benchmark is very large and the selection is necessarily arbitrary. Countries may focus on their own past experience, but given that the number of doctors and nurses per capita has increased over time in most countries, these ratios are "moving targets" and cannot provide any hard evidence of current "shortages" or future requirements.

The model used in Denmark has estimated the current shortage of doctors by using "hard" data on vacancies for physicians in the hospital sector (National Board of Health, 2010). Based on these data, the model estimated that there was a shortage of about 1,330 doctors in Denmark in 2010 (out of a total of 20,170 doctors). In the Netherlands, the Advisory Committee on Medical Manpower Planning considered vacancy rates as well as studies on the distribution of GPs in rural areas to determine some level of "unmet need" for doctors at 1% of the current supply in the baseline year (ACMMP, 2010). In Japan, a shortage of nurses was assessed by using a survey of employers (hospitals, private clinics and long-term care facilities) reporting having current difficulties in recruiting nurses as well as their views about the situation would evolve over the next 5 years (Expert Panel on Projection of Supply and Demand for Nurses, 2010).

Some "needs-based" approaches to health workforce planning in Canada have tried to assess current shortages of doctors or nurses by using information about "unmet care needs", either as reported by the population or as the gap between any current use of health services and the recommended use according to clinical guidelines. A model in Ontario (Canada) used information on the population reporting having difficulties finding a general practitioner and other measures of "unmet care needs" for a regular health exam and other services to estimate the current shortage of general practitioners and medical specialists (Singh et al., 2010). Another "needs-based" model of Registered Nurses in Canada has estimated the current gap between the supply and need for nurse services by using information on the size of the population with poor health who do not use health services as much as might be expected, and came up with an estimated shortage of about 11,000 Registered Nurses in 2007 (CNA, 2009).

32. One of the benefits of strengthening health workforce planning efforts is that they will often increase the need to improve the underlying data to assess the current health workforce situation. Without a reasonably accurate picture of the current situation, it is simply impossible to project the future accurately.

33. The following section describes some of the similarities and differences in how the main drivers of supply and demand are taken into account in health workforce projection models in different countries, focussing in particular on recent developments to take into account in a more elaborated way some of these supply-side and demand-side variables.

4. DRIVERS OF HEALTH WORKFORCE SUPPLY

4.1 Inflows

34. Virtually all health workforce planning models reviewed are based on stock-flow approaches on the supply side, including as the main inflow new graduates from education programmes and, in a fewer number of cases, the immigration of foreign-trained health workers where this is relevant and possible to gather reasonably reliable data.

4.1.1 Education

35. The most important driver of health workforce inflows usually comes from the domestic education system. Newly trained doctors and nurses are integrated into projection models either as they enter their professional education, upon graduation, and/or upon passing a license examination or registration with a designated professional body. In some instances, detailed educational pathways - from entry to education to specialization training and entering the labour market as a fully-trained professional – are taken into account based on the available evidence about dropout rates along the pathways.

36. As a first step, countries may use entry into education programmes as a measurement for future inflows from the education system. In Japan, a physician projection model, commissioned by the Ministry of Health, Labour and Welfare (Hasegawa, 2006) used the current and planned number of medical school students to project the future supply between 2005 and 2040. Since the entrance to medical schools is very competitive and only a very small minority of students drops out or fails to pass the licensure exam, the number of entries into medical schools provides *de facto* a good approximation of the number of newly trained physicians 6 years later.

37. A second approach to include inflows from the domestic education system -- used in most models -- is to consider the number of new graduates or newly licensed health professionals. For example, the model developed by Health Workforce Australia (2012) uses the number of graduates to measure the inflow in the medical profession, since the dropout rates between entry into medical education and licensure are very low, and assessing both entry and graduation from medical education does not yield much additional information.

38. A third approach that has been used in some countries involves a more in-depth analysis of education/training pathways. This is especially useful when there are significant proportions of new entrants to medical or nursing schools who do not graduate with the intended degree. For example, in France, the supply projection model for physicians developed by the Ministry of Health (Attal-Toubert and Vanderschelden, 2009b) includes a module on the education pathway of medical students. This module enables the development of scenarios on the evolution of intake into initial medical education and the uptake of different specialisations, weighing dropout rate as students proceed through their training. The projection uses registration data from medical schools on the number of students admitted into the second year of initial education (which is when selection takes place in French medical education) and data on the competitive exams that determine entry into specialisations. The model allows for a projection of graduates by specialty into the overall supply projection.

39. In some cases, projection models have to adjust for differences in the structure of the education system for medical or nursing programmes within the country. For instance, the medical education system in Belgium differs between the French and Flemish regions. In order to integrate these distinct characteristics, the Belgian physician model considers differently the current and future number of students entering into medical education and graduation rates (SPF, 2009).

40. Most projection models make the assumption under their baseline scenario (or "status quo") that current student enrolment or graduation rates remain constant over the projection period. However, some projection models take into account changes in enrolment rates that have already been decided but will be implemented in the future. For example, in Israel, the opening of an additional medical school is reflected in the assumed increase of graduate numbers from 393 between 2009-12 to 460 between 2013-15 and up to 510 from 2016 onwards (Ministry of Health, 2010).

41. In the model developed by Health Workforce Australia, the number of graduates acts as the "adjustment variable", with the model providing the estimates of how many new medical or nurse graduates would be needed to close the gap between supply and demand under different scenarios (HWA, 2012a). This is also the case in the Netherlands, where the number of students enrolling in medical studies and the number of medical graduates entering specialization training (which are controlled by government) act as the "adjustment variable".

4.1.2 Immigration

42. Another important inflow to the health workforce in some countries is through the immigration of health workers from other countries. However, with the adoption of the 2010 WHO Global Code of Practice on the International Recruitment of Health Personnel, all countries have been encouraged to improve the planning of their health workforce requirements and refrain from recruiting health personnel from countries that are suffering from acute shortages (WHO, 2010).

43. The conditions under which immigrants are allowed to enter into domestic labour markets vary a lot across countries. EU countries, where health professional qualifications are mutually recognised (European Commission, 2005), allow for a free mobility of health professionals across borders. Non-EU countries, however, still retain tools to control the size of immigration, through rules regarding immigration restrictions and the recognition of professional qualifications.

44. Various models take different approaches to handle immigration flows. Some models explicitly exclude immigration from their analysis for various reasons. Models that have been developed in countries with relatively high barriers for health professional mobility (e.g. a requirement to pass a national licensure examination test in its official language) often do not incorporate the size of immigrant health workers, because the annual flow is negligible. In other countries, such as Ireland, some of the models have deliberately been built on a "self-sufficiency" objective and do not consider immigration as one of the possible solutions to address any potential shortages (FÁS, 2009).

45. In Australia, the model developed by Health Workforce Australia (2012) uses three distinct immigration scenarios to assess how much the domestic education capacity needs to be increased in order to compensate for a decreasing reliance on foreign health workers. For example, the model estimated that if the current immigration rate were to be reduced by half, the number of graduates would need to increase by 30% for physicians and be doubled for nurses.

46. In Israel, where a significant share of doctors come from immigration, the model uses the average of the last few years to estimate the future inflow of immigrant doctors (Ministry of Health, 2010). In

Denmark, the model assumes a gradual decline in the number of foreign-trained doctors over time (National Board of Health, 2010).

4.2 Outflows

47. Exits from the health workforce can either happen due to retirement or at an earlier point in the working life either temporarily or permanently, for example due to family reasons, career changes, or emigration[3].

4.2.1 Retirement

48. All the models reviewed take into account retirement as a key outflow, although the underlying assumptions about retirement behaviours and the degree of sophistication in modelling the retirement patterns of doctors and nurses vary across models.

49. A common assumption in health workforce planning models is that doctors and nurses leave their job at the "standard" age of retirement in the country (e.g. 65 years). However, there is evidence in many countries that the retirement patterns of doctors in particular is a much more complex process than this convenient assumption and that a large number of physicians, especially those who are self-employed or in private practice, often work beyond the official retirement age. In Canada, CIHI (Pong, 2011) has examined the retirement patterns of physicians and found that the retirement process is often gradual. Doctors often begin to reduce their working time as they approach the standard retirement age, but many of them continue to practice beyond the official retirement age, albeit often working fewer hours. Attempts to model retirement as a gradual reduction in working time, rather than an abrupt end of service, can bring supply projections more in line with reality.

50. In Japan, the physician registry allows a careful monitoring of exit patterns of physicians at every age, including around retirement (Hasegawa, 2006). It confirms that physicians enter retirement gradually, often well above 65 (the standard age of retirement in Japan), especially those in private practice. The results from a physician survey carried out by the Ministry of Health, Labour and Welfare also indicate that many physicians continue to work significant hours well beyond 65 and up to the age of 80. These practice patterns are taken as a basis for modelling physician supply. Taking into account such gradual retirement allows the model to capture the significant contribution made by physicians above the official retirement age. Furthermore, the model estimates the probability of physicians moving to providing different types of services (e.g. from hospital-based services to ambulatory care services) after a certain age.

51. In the Netherlands, the Advisory Committee on Medical Manpower Planning estimates physician retirement patterns from their specialization using national registration data (ACMMP, 2010). The model takes into account that some doctors continue to practice beyond the standard retirement age to estimate the size of outflows over next 5, 10, 15 and 20 years.

52. In France, the projection model for doctors developed by the Ministry of Health also looked closely at the diverse retirement patterns of physicians. One of the tested scenarios is the potential impact of a gradual postponement of the retirement age of physicians by two years on the physician-to-population ratio between 2007 and 2030. The main result is that such a postponement of retirement might have the single biggest impact in mitigating the projected decline in the physician-to-population ratio in France over the next twenty years (Attal-Toubert and Vanderschelden, 2009b). In the same vein, the nurse projection model in France also developed by the Ministry of Health assessed the impact of a progressive

3. Emigration is not included in most of the models either because it is very difficult or impossible to obtain reliable data or because it is considered to be negligible.

postponement of the retirement age by two years on the supply of nurses. Such a policy change could increase the number of nurses by 3.5% over and above the projected increase under the baseline scenario, thereby contributing to a further rise in the nurse-to-population ratio between 2006 and 2030 (Barlet and Cavillon, 2011).

4.2.2 Retention/attrition rates

53. Most models take into account that some health workers leave their jobs before they reach retirement age for various reasons. Such pre-retirement exits are particularly relevant for analysing nurse supply, as attrition rates are significant in many countries. The projection models in some countries such as Australia and Germany have tried to take into account in different ways the temporary or permanent exit rates of nurses during their working life.

54. Health Workforce Australia examined the exit rates for nurses and midwives during the period 2001-2006 and 2007-2008. It found that the rates were significantly lower in 2007-2008 than in the earlier period. The assumption was made that this may be due to the impact of the global financial and economic crisis, which may have temporarily strengthen labour force attachment. In its projections, Health Workforce Australia applied the 2007-2008 lower exit rates until 2012 in order to incorporate the temporary impact of the crisis, and then reverted to the 2001-2006 higher exit rates until 2025 in its baseline scenario. An alternative scenario (called “workforce retention”) uses the 2007-2008 lower exit rates over the entire projection period. While the baseline scenario estimates a possible shortage of 109,500 nurses in Australia by 2025, if the exit rate can be reduced to the 2007-2008 level throughout the entire projection period, the shortage would fall to only 25,000 nurses (HWA, 2012a).

55. In Germany, the Federal Statistical Office (Afentakis and Maier, 2010) analysed the mobility of nurses and auxiliary nurses in and out of the nursing occupations. Based on data from the 2005 Microcensus, the analysis found that among people who were trained as nurses, 75% have stayed in a nursing occupation, while this figure is markedly lower for auxiliary nurses, with only half of them continuing to work as auxiliary nurses.[4]

4.2.3 Combined exit rates

56. Several models do not try to make any distinction for various reasons that may lead people to leave their occupation at various stages in life (career re-orientation, emigration, retirement, etc.), and simply use the available data on exit rates by age and sex.

57. For example, in Denmark, the outflow variables used in the models from the National Board of Health comprise retirement, death and temporary leave as a percentage of the total number of physicians (National Board of Health, 2010).

58. In Ireland, annual attrition is measured in head counts of workers leaving each occupation, based on the available evidence of the estimated loss. The possible re-entry of workers who had previously left their occupation is also considered where data is available (FÁS, 2009).

4. The analysis also found that 36% of currently practicing nurses in Germany (and 71% of auxiliary nurses) were initially trained in a different profession than nursing and re-trained at a later point in their career. This analysis draws attention to the importance of flexible training curricula to allow new recruits to come in the profession later in their working life.

4.3 Stock of health workers (head counts and full-time equivalents)

59. Most health workforce planning models are trying to measure both head counts and full-time equivalents (FTEs) in assessing the current and future supply of health workers. The conversion to FTEs clearly provides a more accurate measure of the current and future supply of labour as it takes account the working time of providers. However, in many countries, it is often difficult to measure FTEs in a precise way because of data gaps on the usual working hours of different categories of workers. There may also be various definitions of “full-time” work.

60. In Canada, one of the models uses a complex methodology to convert head counts into FTEs to try to compensate for data gaps on the working time of doctors. Data on the gross income per physician paid fee-for-service is used to provide an approximate measure of their workload. The 40th and 60th percentiles of nationally defined income distribution are used as the benchmarks within which to measure FTE as equal to one. For doctors whose gross income falls outside these benchmarks, FTE increases linearly with income until the 40th percentile and logarithmically after the 60th percentile (Gupta and Basu, 2007). This method, however, does not cover the growing number of physicians in Canada who are not paid by fee-for-service.

61. Some models include various assumptions about future trends in working time. In Belgium, the Committee of Medical Supply Planning used data on past trends to assume a gradual decline in working time per doctor, with an annual rate of reduction of 0.3%, although it recognises that this assumption is fragile and arbitrary (SPF, 2009). Health Workforce Australia (2012a) assessed the impact of an hypothetical reduction in physician working time in a scenario which sets a maximum number of hours worked by doctors at 50 hours per week. This reduction in working time is then converted to a headcount equivalent to indicate the number of additional medical graduates who may be required to fill the projected gap under that scenario (HWA, 2012a). In Germany, the Federal Statistical Office explored the impact of an hypothetical rise in working time of nurses in West Germany to the higher levels observed in East Germany, and compared this to the opposite scenario (a reduction of working time in East Germany), as well as to a baseline scenario of working time remaining unchanged in different parts of the country (Afentakis and Maier, 2010).

62. Different assumptions about the future working time of different health care providers are sometime interpreted as a measure of “productivity” (defined as outputs per worker), although many other factors may also affect their current and future productivity (Box 2).

Box 2. How to take into account "productivity" in health workforce planning models?

Some health workforce planning models assume that "productivity growth" may help to address any projected gap between the future demand and supply of health workers, but the sources of these productivity gains are often not well defined and vary across models. As pointed out by health economist Robert Evans, "the concept of 'productivity' is very simple in principle, but rather slippery to pin down in practice" (Evans, 2010). Following Evans, "at the most abstract level, productivity is a relationship between one or more inputs to a production process (in economic terms, 'factors of production') and one or more outputs from that process". In the health sector, the productivity of workers might therefore be measured by relating some volume of "inputs" (e.g. number of doctors in primary care or number of doctors, nurses and other workers in hospital) with some volume of "outputs" (e.g. number of doctor consultations or number of hospital discharges).

Put very simply, it is possible to distinguish two broad sources of labour productivity growth:

1) "working smarter", which means that the worker is able to produce more "outputs" per unit of time (e.g. an hour), for instance because of greater training or experience, better work organisation (e.g. a reduction in time spent doing administrative work and more time spent in clinical work) or technological progress (e.g. a reduction in operating time and the move to day surgery brought about by better techniques);

2) "working longer", which means that the worker is able to produce more "outputs" over a certain period of time (a day, a week or a year) because of longer working hours (e.g. a GP may be able to see 3 more patients for every additional hour of work).

In health workforce planning models, the first source of productivity gains ("working smarter") is reflected as a *reduction in demand* (because a smaller number of workers is required to provide a given level of services), while the second ("working longer") is reflected as an *increase in supply* (a greater number of working hours and FTEs).

Considering the "production function" in health service delivery: linking many inputs to outputs

The measurement of productivity and possible productivity growth in health service delivery is complicated by the fact that many outputs require more than one input (or factor of production). For example, a patient going to a primary care centre may first see a nurse or a physician assistant and then, depending on the severity/complexity of the case, may be referred to a general practitioner or another primary care doctor. A patient hospitalised will normally require the services of a range of people during his/her hospital stay (doctors, nurses, others) as well as "capital" inputs (beds, diagnostic or therapeutic equipment, etc.). The multiple inputs required in the production of health services is referred as "multi-factor productivity" and can be represented through a "production function", where different outputs such as the number of hospital discharges (Y) are a function of the number of doctors (D), the number of nurses (N), the number of other allied health professionals (A), and capital inputs (K) (HWA, 2012c):

$$Y = f(D, N, A, K)$$

Various combinations of these different inputs can influence the level of outputs. These include the roles and responsibilities of different health care providers, and the availability of different types of capital inputs. This production function recognises that the productivity of a particular health profession (doctors, nurses or other providers) is influenced by the availability and activity of other "inputs". It is useful to assess "technical efficiency" in health service delivery, that is, the extent to which more outputs may be produced by using the same quantity of inputs differently (or the same level of outputs can be produced by using less inputs).

Given the complexity and uncertainty surrounding the many factors that may be driving labour productivity growth in the future, nearly all health workforce planning models which incorporate this variable in their projections use an arbitrary assumption about future productivity growth. For example, in one of the alternative scenarios, Health Workforce Australia assumed a 5% productivity gain for doctors and nurses over the period 2010 and 2025, without specifying the sources of these productivity gains (HWA, 2012c). In Canada, a recent projection exercise commissioned by the Canadian Nurse Association assumed a 1% productivity growth per year over the period 2007 and 2022 (CNA, 2009).

5. DRIVERS OF HEALTH WORKFORCE DEMAND

63. The demand side of health workforce planning models is much more difficult than the supply side because there is a much greater number of potential factors that may affect future demand for health services (as illustrated in Figure 1) and there are a lot of uncertainties surrounding most of these factors. The approaches to modelling the future demand for doctors and nurses vary widely, ranging from simple approaches which only take into account the projected growth in population size to more sophisticated methods which involve estimating how different non-demographic factors may affect future demand for health services utilisation or health care needs by age and sex groups (taking into account morbidity or epidemiological factors), the potential impact of changes in health service delivery models to respond to changing demand, and the potential effect of future GDP growth and health expenditure growth on the demand for various providers.

64. At least five different approaches to modelling the demand side can be distinguished[5]:

1. The most basic approach to estimate future demand is to simply use some ratio of workers to population, with changes in population size being the only driver.

2. Future demand may be based on information about current health service utilisation patterns by sex and age groups, and how these translate into health workforce requirements, with the assumption that these patterns would remain constant in the future. Changes in the population structure are therefore added as another driver of demand, while maintaining utilisation rates constant.

3. A third approach is to go beyond the convenient assumption of constant health service utilisation rates and estimate current and future health care needs by using additional information on current unmet needs and changing morbidity patterns (e.g. the rise or decline in certain chronic diseases), which may result in greater or lower need for health services by age and sex groups.

4. Some models also attempt to estimate the impact of possible changes in health service delivery models (such as strengthening the role of GPs or possible changes in the roles and responsibilities of different providers in primary care) on the future demand for different categories of health workers.

5. Finally, some models include directly the projected growth in the economy and in health spending as a key driver of future demand for health services and health workers.

5. A sixth approach can also be identified, the incorporation of some labour productivity growth. As mentioned in Box 2, nearly all health workforce planning models that include this approach end up making some arbitrary assumptions regarding future productivity growth which may help to close the gap between future demand and supply, given the difficulties of assessing with any degree of precision how productivity growth might evolve over time.

Table 2. Overview of demand drivers in the reviewed models

Country	Institution	Population Size	Population Structure: Current Utilisation Patterns	Population Structure: Changing Utilisation Patterns (e.g. need-based)	Changes in Health Service Delivery	GDP/ Health Expenditure Growth
Australia	Health Workforce Australia (2012)	x	x			
Belgium	Federal Public Service (2009)	x	x			
Canada	Health Canada (2007)	x	x			
	Canadian Nurse Association (2009)	x		x		
	Ontario Ministry of Health and Long-Term Care and Ontario Medical Association (2010)	x		x		
Chile	Ministry of Health (2009)	x				
Denmark	National Board of Health (2010)	*	*			
Finland	Ministry of Employment and the Economy, Ministry of Education and Culture (2011)	x	x	x		x
France	Ministry of Social Affairs and Health (2009)	x				
	Ministry of Social Affairs and Health (2011)	x				
Germany	Federal Statistical Office (2010)	x	x	x		
	Joint Federal Committee (2012)	x	(x)			
Ireland	Training and Employment Authority (2009)	x				
Israel	Ministry of Health (2010)	x	x			x
Italy	Ministry of Health	x				
Japan	National Commission on Social Security (2008)	x	x		x	
	Physicians Supply/Demand Expert panel, Ministry of Health, Labour and Welfare (2006)	x	x	x		
	Nurses Supply/Demand Expert panel, Ministry of Health, Labour and Welfare (2010)	x	(x)			
Korea	Korean Institute for Health and Social Affairs (2012)	x		x		
Netherlands	Advisory Committee on Medical Manpower Planning (2010)	x	x	x	x	
Norway	Statistics Norway (2012)	x	x	x	x	x
Switzerland	Swiss Health Observatory (2008)	x	x	x	x	
	Swiss Health Observatory (2009)	x	x	x	x	
United Kingdom	Centre for Workforce Intelligence (2012)	x	x	x		x
USA	National Center for Health Workforce Analysis (forthcoming)	x	x	x	x	x
	University of North Carolina, Cecil G. Sheps Center (2012)	x	x	x		

*Denmark: The demand scenarios are based on simple assumptions of 0.5, 1.0, and 1.5 % annual growth rate, which are assumed to take account possible changes in the population size and health service utilisation rates due to changing population structure.

5.1 Population size

65. All models take into account projected changes in the population size to assess the future demand for health services and health workforce requirements. In some models which have not developed further the demand side, this is the only indicator of changes in demand that is taken into account, with the ratio of health workers to population taken as the main indicator. This is the case in the models reviewed in a number of countries (Chile, France, Ireland and Israel). This approach has the advantage of being very simple to implement, and based on population projections which are known with a fairly high degree of certainty, but it does not take into account the many other factors beyond population growth which might influence the future demand for doctors or nurses. In addition, these models often cannot provide a clear response to the question of what is the appropriate doctor-to-population ratio or nurse-to-population ratio, unless additional information about any current or future "imbalances" (shortages or surpluses) is considered.

66. In Germany, the guideline of the Federal Joint Committee (2012) for physician staff planning in the ambulatory sector follows a doctor-to-population ratio approach, with the ratio in West Germany in 1990 taken generally as a benchmark. However, in planning districts where utilisation patterns exceed the national average over a certain period (four consecutive quarters), the age composition and service utilisation rates by age groups are also included in the demand estimate.

5.2 Current health care utilisation

67. Most of the models go a step further than a basic population growth approach and incorporate the effects of changes in population structure to estimate the future demand for health workers. The traditional approach in these models is to use information on health care utilisation rates by age and sex (and in different settings) and to convert these utilisation rates in health workforce requirements. The assumption is then made that the utilisation rates by age and sex and the related health workforce requirements will remain constant over the entire projection period. In the "baseline scenario" of these models, changes in the demand for health workers is driven by changes in population size and in population structure (population ageing).

68. For example, in Belgium, the projection of future demand for doctors is estimated based on changes in population structure, assuming that utilisation rates would remain constant (SPF, 2009). The model uses some "population consumption rates" to represent different level of health service utilisation by age and sex. The rates are determined on the basis of information about medical expenditure: the age/sex groups with the highest spending level are assigned the value of 1 while other age/sex groups are adjusted proportionally. Medical expenditure is taken as a proxy for health service utilisation and human resources requirement, and allows a straightforward projection of demand based on changes in population structure.

69. In Canada, one of the models developed by Health Canada uses current physician billing data to project the future demand for doctor services. Each service item in the billing data is linked to patient characteristics by age and sex, as well as to the physicians' specialty. Assuming that utilisation rate by age group would not change over time, this information is used to project future demand for physicians based on changes in the population structure alone (Gupta and Basu, 2007).

5.3 Changing utilisation patterns (including needs-based approaches)

70. In addition to, or instead of assuming constant health service utilisation rates over time, some models incorporate possible changes in the demand by using different methods. It is possible to distinguish two different approaches: 1) utilisation-based approaches; and 2) needs-based approaches. The main

difference between these two approaches is that there may be gaps between utilisation and needs for health services.

71. Under both approaches, the factor that is most often included in the models that are considering possible changes in the demand, utilisation or needs for health services is changes in population health status (morbidity or epidemiology). This typically involves using any evidence of past trends in health risk factors and the incidence/prevalence of a number of diseases by age and sex, and making assumptions that these past trends will either continue in future years or that they will stabilise (e.g. at their current level). The use of available data is also often complemented by expert consultations to seek views on the most probable scenarios in terms of morbidity in the years ahead. Given the large number of risk factors to health (which may move in opposite directions) and the even larger number of diseases (with the burden of some decreasing while others may be increasing), this approach requires a large amount of information from administrative sources, disease registries and/or population-based surveys. Certain models end up making the convenient assumptions that there may be some compression of morbidity or expansion of morbidity, and simply build their projections of health workforce requirements based on these arbitrary assumptions.

72. For example, in Germany, a projection of the supply and demand for nurses makes the optimistic assumption that there may be a compression of morbidity, and the onset of morbidity would be delayed for successive cohorts (Afentakis and Maier, 2010). Under the baseline scenario (no change in morbidity), the demand for nurses (measured in FTE) would increase by 27.3% between 2005 and 2025. However if population health status improves according to the “compression of morbidity” scenario, the increase would be reduced to less than 20% over the same period.

73. In Switzerland, the models developed by the Swiss Health Observatory have tested different assumptions about the future evolution of population health status. The model focussing on the future needs for physicians in the ambulatory care sector assumes both an optimistic scenario of a compression of morbidity among elderly people and a pessimistic scenario of an expansion of morbidity (whereby the onset of morbidity starts at an earlier age and people live more years with one or more chronic conditions). Under the baseline scenario (no change in morbidity and in utilisation rate by age and sex), the model projected that the demand for primary care doctor consultations would be around 40 million by 2030. Under the optimistic scenario, the demand would be reduced by more than 10% (to 35 million consultations), while under the pessimistic scenario the demand would be increased by 10% (to 44 million consultations) (Seematter-Bagnoud et al., 2008).

74. The other model developed by the Swiss Health Observatory to assess the future demand for hospital care, nursing homes and home-based care only tested a more optimistic scenario, which was taken as the baseline scenario (the most realistic scenario). Under this baseline scenario, the model assumed a reduction in the demand for nursing home care and home-based care based on an assumption of steady improvements in the health status of the population aged 65 and over. It also assumed a reduction in the demand for hospital care following the introduction of the DRG payment systems. The alternative scenario in this case was based on the “status quo” assumption of constant service utilisation rates. Under the baseline scenario, hospital-based services (measured by hospital days) would increase by only 2.4% between 2006 and 2020, while the needs for nursing home services would increase by 31% and home-based services by 20%. Under the alternative scenario, the demand would obviously be greater, with the needs for hospital-based services rising by 16% between 2006 and 2020, the needs for nursing home services by 42%, and home-based services by 22%. This would translate in a requirement for 48 000 additional staff in these settings in 2020 compared with 2006 (a 25% increase), compared with 25 000 additional workers under the more optimistic baseline scenario (Ruedin et al., 2009).

75. In the Netherlands, the ACMMP projection model incorporates possible future changes in population health status by using data on epidemiological trends and experts guidance on socio-cultural development and unmet care needs (ACMMP, 2010). Based on epidemiological trends and expert judgements, the ACMMP model estimated for instance that changes in the prevalence of diabetes, cancer, alcohol abuse, people with dementia and other chronic diseases may increase the demand for general medicine services by 0.3% to 0.6% per year over the projection period (2010 to 2028). While these estimations are based on expert judgements, a review of the evidence in the next planning cycle is expected to provide further opportunity to assess the accuracy of these assumptions.

76. “Needs-based” models have also been developed in some countries such as Canada to try to overcome the limitations of assuming that current health care utilisation rates are appropriate and should be held constant over time. These models first try to assess any current gap between utilisation rates and health care needs by using information about unmet care needs as reported for instance in population-based surveys and/or by using available evidence on gaps between current use and recommended use according to existing clinical guidelines (e.g. having an annual medical check-up). While in theory these “needs-based” models may also identify a possible overuse of certain health services (which may be defined as services that provide little if any benefits to patients), in practice they tend to focus more on the underuse of certain services, which are then often attributed to an under-supply of certain health care providers.

77. In Ontario (Canada’s largest province), the Ministry of Health and Long-Term Care has developed on a needs-based model to assess the need for doctors over a 20-year period (Singh et al., 2010). The model takes into account population health needs in two ways that differ from standard assumptions about constant utilisation rates. First, the model considers any unmet care needs in the baseline year, taking into account the percentage of the population who do not have a regular general practitioner (GP), those who reported some unmet primary care needs and referral ratio from GPs to specialists. Second, the model also takes into account trends in the incidence/prevalence of the top ten diseases which, according to a survey of the Ontario Medical Association, were taking most of physicians’ time. The analysis also includes ten important risk factors to health, which were selected based on a literature review, expert opinions and analysis of survey data. Some disease “weights” are used to link the incidence of each of the top ten diseases with the risk factors; these disease weights were also determined by expert opinions.[6] Combining population changes by sex and age with assumptions of constant risk factors by sex and age and constant disease weights provides estimates of the future incidence/prevalence of the top ten diseases. The results point toward a gradual increase in the incidence/prevalence of some of these diseases over the 20-year projection period. These adjustments to the need side of the model therefore increase the requirements for doctors compared to a traditional model assuming constant utilisation rate. Nonetheless, the model still projects a surplus in the number of GPs and total specialists in Ontario due to even larger increases of supply. However, certain specialties and areas of the province are projected to continue to experience shortages.

78. In Canada also, a needs-based model has been developed to assess the future requirements for registered nurses (RNs), under a project commissioned by the Canadian Nurses Association (CNA, 2009). The model includes several components to determine the current and future needs for RNs, including: the size and demographic structure of the population; the health status of the population by age and sex; and the levels of health services required for people with different levels of health status. Regarding the measurement of health status, the model uses a scenario based on trends over the past ten years according to national health survey data which are projected in the future. Regarding service provision, in the absence of any independent “gold standards” for the services required for individuals with different levels of needs,

6. For example, the disease weight of the risk factors affecting the incidence of lung cancer were as follows: 1) 75% smoking, 10% exposure to second-hand smoking, 3% consumption of fruits and vegetables, and 11% other factors.

the model uses as a baseline the existing average levels of services within each sector of care (acute care, long-term care, home care and community care) by age group, sex and health condition. The results from the baseline scenario indicate a shortage of about 11,000 RNs in the baseline year (reflecting estimates of unmet needs for nurse services in 2007), increasing to about 60,000 RNs by 2022 because the estimated increase in supply is less than the estimated increase in demand over this 15-year period.

5.4 Changes in health service delivery models

79. Another factor that will be affecting the demand for different categories of health workers is any changes in health service delivery models. Any re-organisation in health service delivery can be expected to have an impact on health workforce requirements, requiring a different number and mix of health care providers. For example, the policy priorities in many countries to re-orient activities away from hospitals by strengthening primary care, home-based care and long-term care in institutions (when required) are likely to have an impact on the number and mix of providers required in different settings. Health workforce planning models in some countries have tried to incorporate the possible impact of certain changes in health service delivery on health workforce requirements. These models require plausible assumptions about the future direction and magnitude of possible reforms.

80. In Japan, the model developed by a National Commission on Social Security in 2008 focussed on the objective of reducing average length of stays in hospitals for patients no longer needing acute care, and the health workforce requirements of developing further community-based care and home-based care (National Commission on Social Security, 2008). In the Netherlands, the model for general practice has assessed the possible scope for task substitution between general practitioners and physician assistants as a possible option to reduce the expected growing demand for GPs, based on the assumption that there would be a continued transfer of tasks from doctors in hospitals to GPs (ACMMP, 2010). In Switzerland, the projection model focussing on doctors in the ambulatory care sector has considered both the implications of strengthening a “gate-keeping” system on the demand for GP and medical specialist consultations, as well as the possibility of greater task sharing between GPs and advanced practice nurses in reducing the future demand for GPs (Seematter-Bagnoud et al., 2008). The approach and main results from these models are described in more detail in section 6 below on the integration of multiple professional groups within certain health planning models.

5.5 GDP and health expenditure growth

81. Future economic growth is also likely to have an important effect on the future demand for health services and health workers (or their remuneration level), by increasing the public and private resources available to pay for these health services.[7] However, surprisingly, future GDP growth and health expenditure growth is not included in most health workforce planning models. Only a few models have tried to incorporate as an additional component future growth in GDP and health spending on the demand side.

82. In Norway, GDP growth and its impact on the demand for physician services is considered by assuming that economic growth will create higher expectations and utilisation of services beyond the impact of demographic changes alone. In a country where more than 80% of health spending is publicly funded, the model recognises that the growth in health and social spending will largely depend on policy decisions whose outcomes are uncertain. Nonetheless, the model assumes that opportunity for further growth in public sector spending beyond GDP growth may be considerably less than in the past and the

7. This was demonstrated *a contrario* by the impact of the recent economic crisis which, in many European countries, led to a reduction in health spending and at least a temporary reduction in the employment of certain categories of health workers or their remuneration.

growth in health spending may not exceed by a wide margin economic growth. Under the baseline scenario, a total growth of 10.5% in health spending over and above the estimated impact of demographic changes is assumed for the whole projection period from 2010 to 2035 (which is equivalent to an additional 0.4% annual growth), while a higher growth rate of 23% (or an additional 0.9% annual growth) is assumed under an alternative scenario. Under the baseline scenario, the gap between supply and demand would increase to 1 400 physicians and 28 200 nurses in 2035, while the gap under the higher spending growth rate scenario would of course be larger (5 900 physicians and 44 700 nurses in 2035) (Roksvaag and Texmon, 2012).

83. In Finland, where health workforce projections are part of a wider exercise in projecting workforce requirements and training needs in all sectors, the baseline scenario assumed an average GDP growth rate of 1.7% per year between 2008-2025, while a "target" scenario (more optimistic) assumed an average annual growth rate of 2.3% during this period (Ministry of Education and Culture, 2011). The model assumes that the more optimistic GDP growth scenario will be accompanied with health service reforms and improved productivity in health care, which would help reduce the demand for health workers compared to what it would otherwise be.

84. In Israel, the Planning Commission for Medical and Nursing Personnel (2010) assumes that GDP growth would lead to a similar increase in the demand for health services (income elasticity of health spending close to 1). However, the Committee also assumes that GDP growth would reflect productivity growth in all sectors; therefore it is assumed that an increase in health worker productivity would absorb the additional demand for services arising from economic growth (Ministry of Health, 2010).

85. In the United Kingdom, a recent analysis of the Centre for Workforce Intelligence has tried to assess the potential impact of different scenarios about future GDP growth and public health spending growth on NHS employment over the projection period, based on a series of simplifying assumptions regarding changes in salaries and other non-salary costs (Box 4).

Box 3. How to take into account remuneration levels in health workforce projections models?

Remuneration levels play an important role in determining the number of workers that can be employed at any point in time, particularly in countries that have global budgets for public spending on health. Since wages (or fees for services for self-employed workers) represent a large part of health spending, wage settlements will influence health spending, while at the same time the wage levels will influence the number of workers that can be employed under different budget constraints.

According to conventional economic theory, the remuneration of workers in the health sector or in any other sector should be linked to their productivity, and productivity growth (measured for instance as greater outputs per working hour or per worker) should be associated with a pay raise (per hour or worker). However, many characteristics of wage setting in the health sector differ from the convenient assumption of free market and perfect competition underlying this conventional economic theory. One of the main distinguishing characteristics of wage setting in the health sector is the existence of a "monopsony" labour market for many categories of workers, in the sense that there may be only one major employer (e.g. the NHS at the national level or an hospital at the local level) which negotiates wages and other benefits with staff or with their union representatives. Recent cuts in wages or fees for doctors, nurses and other health workers in countries such as Iceland and Ireland that were hard-hit by the recession provide examples that the "monopsonist" position of the employer may allow them in certain circumstances to dictate the wage levels of workers, without any link to their productivity (Morgan and Astolfi, 2013).

With only one exception, the models reviewed in this paper do not include the remuneration of health workers as a factor affecting the current or future demand for health workers. This may be due to a lack of reliable data on current pay levels for certain categories of health workers, but also to the difficulties of making any reasonable assumptions about the possible future evolution of pay rates which will largely be determined through negotiations whose outcomes are highly uncertain.

The only attempt to take into account the impact of remuneration levels and more broadly health expenditure growth on the future demand for health workers is the 2012 report from the Centre for Workforce Intelligence (CfWI) in the United Kingdom, which was designed to inform policy decisions on medical and dental student intakes. A new component to the modeling approach analysed how different growth rates in public spending on health might impact on the future ability to employ doctors in the NHS over the projection period (2011-12 to 2039-2040). The starting point for this analysis was three scenarios proposed by the Institute of Fiscal Studies for English NHS spending between 2015-16 and 2017-22: 1) spending may be frozen in real terms (extending the current Spending Review freeze); 2) spending may grow in line with national income (i.e. constant share of GDP); 3) spending may grow in line with the long-run average for the UK (around 4% per year since 1950-51) (Institute for Fiscal Studies, 2012). The CfWI extended these three scenarios to 2040 and revised them using the most recent Office for Budget Responsibility long-term economic growth projections (Office for Budget Responsibility, 2012). In extending these projections, it didn't seem realistic to assume a freeze in real health spending up to 2040 (as this would imply that the share of public spending on health would halve from around 7% of GDP now to only around 3.5% in 2040). Hence, the CfWI chose as its central projection the mid-point between the second and third scenario (which would mean that the share of public spending would grow moderately to 8% of GDP by 2040). This central projection would translate in a growth rate of 129% in public spending on health between 2010-11 and 2039-40 in real terms (from just over 100bn pounds in 2010-11 to almost 250bn pounds in 2039-40 in constant prices). The CfWI then made a number of assumptions to assess the possible impact of this projected growth in public spending on health on the ability of the NHS to employ additional staff. Two of the main assumptions were that NHS non-wage costs would rise in line with overall price trends in the economy and that pay increases for staff would be equal to the Office for Budget Responsibility's most recent central projections for public sector average earnings growth (which forecast nominal pay growth to remain weak at less than 1% per year through to 2017-18, and then pick up to average 2¼% per year from 2021-22 onwards). After adjusting for price increases, public sector pay in real terms is projected to rise by a total of 60% by 2039-40. Taking into account these projected real pay growth, and based on a number of simplifying assumptions, the CfWI estimated that projected health expenditure growth could accommodate increases in NHS staff of around 41% over the projection period under its central scenario. While the supply of GPs under the CfWI baseline scenario is projected to increase by 29% between 2010-11 and 2039-40, the supply of hospital doctors is projected to increase by 64%, exceeding by a wide margin the additional staff that the NHS may be able to recruit over that period. One of the conclusions from this analysis was that it may be advisable to reduce medical intakes in general (by a few percentage points) and to reduce the training of hospital doctors more specifically (CfWI, 2012).

6. INTEGRATION OF DIFFERENT PROFESSIONAL GROUPS: MOVING FROM UNI- TO MULTI-PROFESSIONAL PROJECTIONS

86. Traditionally, health workforce projection models were developed independently for each professional group, without considering possible interactions between different providers. However, in a context where health reforms in many countries are designed to improve efficiency ("doing more with less") and to re-organise service delivery away from acute care hospitals towards greater primary care and home-based care, the current "silo" approach to health workforce planning hampers the possibility to analyse health workforce requirements in a more integrated way, taking into account possible new roles and responsibilities of different providers.

87. Several models cover more than one professional group, although the level of integration of the different professional groups varies. It ranges from a low level of integration, to an intermediate level and to aspirations towards a higher level of integration. Some models analyse a wide range of occupational groups, but the only links across the various groups is a set of common demographic and economic assumptions which are expected to affect the future demand of each group. While these models may be useful to assess the future labour market situation of different professional groups (and may point towards possible shortages in certain occupations along with projected surpluses in others based on various demographic and economic scenarios), each professional group nonetheless continues to be looked at independently from the others. Finland provides an example of a projection model which is very broad in scope (including in fact all occupations in all sectors of the economy), based on the same macro-economic assumptions driving the demand for workers in different occupations, but without incorporating any interactions and possible substitutions between different occupational groups (see Box 5). An intermediate level of integration is illustrated by those models that are looking at the demand for different providers by taking into account some possible task sharing and substitutions between different providers (e.g. between doctors and "mid-level" providers such as nurse practitioners or physician assistants, or between nurses and auxiliary nurses). However, often these models do not involve a full integration of the projected demand and supply of all the health care providers considered. Examples of this intermediate approach to integrating different professional groups include the physician model in the Netherlands (ACMMP, 2011) and the ambulatory physician model in Switzerland (Seematter-Bagnoud et al., 2008). A higher level of integration requires taking more fully into account both the current and possible future demand and supply of different providers, based on alternative scenarios on the demand side (e.g. some re-organisation in health service delivery) and on the supply side (e.g. student intakes and retirement patterns of the different provider groups). None of the model reviewed here has reached such a high level of integration, although one of the models under development by the National Center for Health Workforce Analysis in the United States aims to move in this direction (NCHWA, forthcoming).

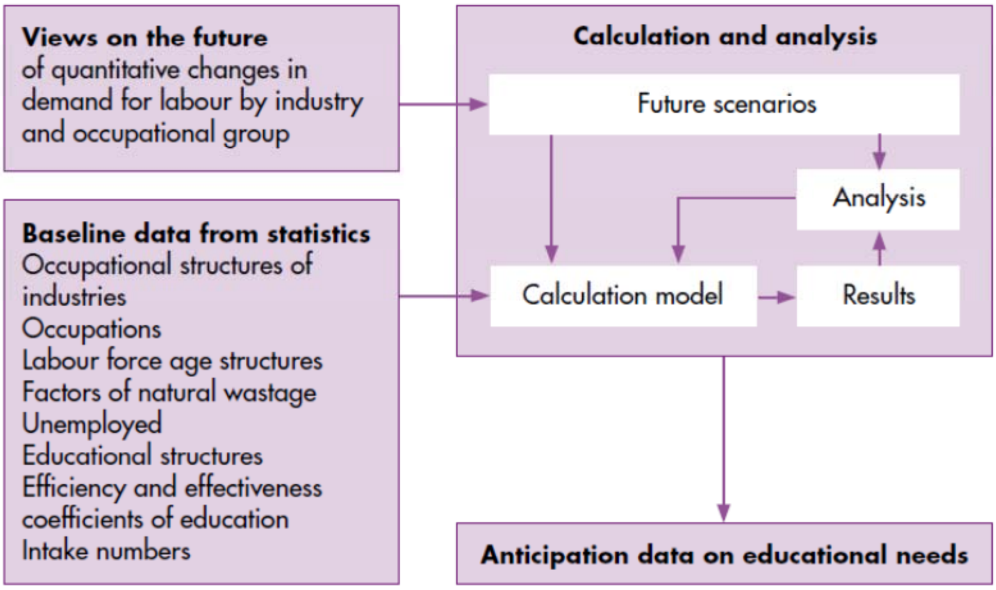
Box 4. Economy-wide workforce planning in Finland

In Finland, health workforce planning is part of an economy-wide workforce planning exercise, rather than a sector-specific or occupation-specific exercise. The main objective of overall workforce planning is to provide advice on the number of student intake in tertiary education and upper secondary vocational education and training, in order to achieve a better balance between future workforce supply and demand.

Workforce planning is done in two related parts. In the first part, long-term forecasts of workforce demand in different sectors and occupations are produced by the Government Institute for Economic Research, working in collaboration with four ministries: Ministry of Employment and the Economy, Ministry of Finance, Ministry of Education and Culture, Ministry of Social Affairs and Health. Based on these long-term forecasts, in the second part, the National Board of Education (under the Ministry of Education and Culture) produces forecasts of educational needs and proposals for student intake targets. The Ministry of Education and Culture appoints a group of experts to provide expertise from different sectors and occupations to assess future educational needs (see figure below). Entrant targets are adopted by the Government every four years as part of the development plan for education and university research. The present long-term forecasts on workforce demand cover the period 2008-2025, while the entrant targets have been adopted for the period 2011-2016.

The model uses health expenditure forecasts (linked to GDP growth projections) to forecast the future growth of employment in the health sector. Health and social care expenditure forecasts are based on EU or Ministry of Social Affairs and Health projections. The model uses a baseline (central) scenario for economic growth over the projection period as well as a more optimistic scenario. In addition, the recent projections included a third scenario which is based on expenditure projection by the Ministry of Social Affairs and Health. On the basis of these different scenarios, the model provides a range of estimates of the new students required to meet the expected future demand in the health sector. In a first stage, the model forecasts the demand for new workers by sector. In the second stage, it considers the breakdown by occupation in each sector, based on more in-depth analysis of the occupational structure by sector.

Anticipation of quantitative needs for vocational/professional education and training



Source: Hanhijoki, I. et al. (2009), Education, *Training and Demand for Labour in Finland by 2020*, Finnish National Board of Education, Helsinki.

The total demand for new labour (measured in the number of job openings) is obtained by summing up changes in demand and exits (due to retirement and other reasons) over the forecasting period. It also takes account current unemployment rate and any projected unemployment rate. Entrant targets are adopted by the Government every four years as a part of this overall workforce planning, and student intakes in universities, polytechnics and vocational institutions are defined in accordance with national targets.

88. It is also possible to distinguish two types of integration in health workforce planning models: horizontal integration and vertical integration. Horizontal integration focuses on the interactions between different specialties within the same occupational group (e.g. different specializations among physicians), while vertical integration assesses the interactions across different occupational groups (e.g. physicians, nurses, physician assistants). Some models may include some forms of both horizontal and vertical integration.

6.1 Horizontal integration

89. Different approaches have been used in health workforce planning models to consider that there is a certain degree of interactions between different specialties within the same professional group (referred here as "horizontal integration"). The most frequent approach has been to assess the potential effect of strengthening the primary care sector on the demand for different categories of doctors (e.g. general practitioners and medical specialists, or primary care doctors and hospital doctors).

90. In Switzerland, a model developed by the Health Observatory assessed the impact of introducing a "gate-keeping" system as one of the alternative scenarios in projecting the future demand for physicians in ambulatory care between 2005 and 2030. Using results from the literature on randomised trials in other countries, this projection model estimated that the introduction of a gate-keeping system might increase the total number of doctor consultations by 2% by the end of the projection period compared with the "status quo" scenario. This increase would be driven by a rise of 5% in GP consultations, combined with a slight reduction in the number of specialist consultations (Seematter-Bagnoud et al., 2008).

91. In the Netherlands, the model for general practice assumed a continued transfer of tasks from doctors in hospitals to general practitioners over the projection period (2010 to 2028). This was assessed by experts as a plausible scenario, taking into account factors such as a continued reduction in lengths of stay in hospitals and a rise in the number of people with chronic diseases who should be treated outside hospitals. The results from the 2010 workforce planning exercise foresaw an increase in the demand for GP services of 0.5 to 1% per year over the projection period (ACMMP, 2010).

92. A model developed at the University of North Carolina in the United States has taken a different approach to integrate different medical specialties (including general practice/family medicine) and their interactions in health service delivery at the local level. The model recognises that there is some heterogeneity in the scope of services provided by different medical specialties, and allows the possibility that physicians may adjust to a certain extent their service portfolio to current or changing demand and supply for doctor services at the local level. This flexibility provides another possible form of "horizontal substitution" to any gap for doctor services (Box 6).

Box 5. Concept of "plasticity" as an adjustment mechanism: The example of a model to project the future supply and demand of different medical specialties in the United States

One frequent criticism of existing approaches to physician projection models is their tendency to assess supply and demand of physicians in rigid professional "silos", not taking into account that the services provided by certain doctors may overlap with services provided by others. Different categories of doctors play a role in treating patients with many different health conditions, and there is a certain degree of overlap in the conditions that different types of doctors manage. A research centre at the University of North Carolina has developed a dynamic model for projecting physician demand and supply, incorporating such overlap by looking at the "plasticity" of service provision. This unique feature of the model recognises that physicians have varying service portfolios across and within specialties. The model makes interactions between different specialties possible by mapping service utilisation by patient conditions to different types of doctors and allowing each one to adjust their service portfolios to their local conditions.

The following table is a simplified illustration of the type of data used to construct this model. Each row represents aggregate utilisation rates for patients with certain health conditions. As expected, the bulk of services for some specific conditions are provided by a single specialty: for example, 96% of pregnancy-related services are provided by Obstetricians and Gynaecologists. But the data also shows that services for other conditions (such as circulatory or respiratory problems) can be provided by different categories of doctors. As expected, family practice physicians have much more varied portfolios of services. By allowing physicians to adjust their service portfolio in response to local demand, the model builds in a certain degree of adjustment to changing demand and supply conditions.

		Illustrative matrix: supply of services by specialty			
		Cardiology	**Family practice**	**Gynaecology/ obstetrics**	**Internal medicine**
Health conditions	**Circulatory**	23,684,068	26,485,370	496,124	18,097,752
		34%	38%	1%	26%
	Respiratory	593,326	19,943,025	17,533	5,496,049
		2%	76%	0%	21%
	Pregnancy	898	1,264,030	29,821,750	32,315
		0%	4%	96%	0%

Source: The Cecil G. Sheps Center for Health Services Research (2012). *Developing an Open-Source Model for Projecting Physician Shortages in the United States*, University of North Carolina (p.5, Figure 3)

6.2 Vertical integration

93. Some models have also begun to consider the current or possible future interactions and task sharing across different professional groups, and their potential impact on future health workforce requirements under different scenarios. The most frequent approach has been to assess the impact of a delegation of certain tasks from physicians to "mid-level providers" such as physician assistants (PAs) or nurse practitioners (NPs), with a view to allow doctors to spend less time on administrative tasks or clinical tasks that may equally be performed by these "mid-level providers". Models that have included these possible task sharing vary in terms of the coverage of different health care providers and the assumptions made about the relative contribution that different professional groups may be able to make in service provision.

94. In the Netherlands, the possibility of greater task sharing between physicians and advanced practice nurses and/or with physician assistants is included under the scenarios developed by the Advisory Committee on Medical Manpower Planning (ACMMP). The Advisory Committee has assessed the potential impact of at least two different types of task sharing: 1) from medical specialists to nurse specialists and/or physician assistants; and 2) from GPs to general practice assistants (GPAs). One of the main challenges is to assess the possible size of the "substitution effect" that determines how much of the demand for physicians may be re-allocated to advanced nurses or physician assistants.[8] Based on the available evidence and expert judgement, the Advisory Committee estimated that less than 1% of the total demand for medical specialists each year may be transferred to nurse specialists and/or physician assistants (the variations across different specialisations is also very small, ranging from 0.5% to 0.6% depending on the specialisation). The demand for GPs may be reduced by 0.6% to 1.2% per year by making a greater use of GPAs. In projecting future demand, the 2010 report estimated that between 2010 and 2028, approximately 11% of the estimated demand for GPs may be substituted by GPAs (ACMMP, 2010).

95. In Switzerland, a model developed by the Health Observatory considers the possible effect of greater task sharing between physicians and nurses as one possible future scenario to assess the future requirements for physicians in ambulatory care (Seematter-Bagnoud et al., 2008). Based on a number of experimental studies in clinical practice environments, the model estimated that the delegation of certain tasks from physicians to advanced practice nurses may reduce the number of doctor consultations in

8. Using administrative data, the ACMMP model estimates for example that one advanced practice nurse may provide services that free up 0.58 FTE of a specialist in geriatric medicine.

primary care by 10%. Under such a scenario of greater task sharing with advanced practice nurses, the number of GP consultations would only increase by 2% between 2005 and 2030, compared with 13% under the "status quo" scenario (no changes in health service delivery).[9]

96. In the United States, the National Centre for Health Workforce Analysis is in the process of developing some projection models which combine different professional groups providing similar or complementary types of services. The model will integrate, for instance, physicians, nurse practitioners and physician assistants (NCHWA, forthcoming).

97. In Japan, a different approach has been used to determine future health workforce demand, taking into account different forms of vertical integrations. In 2007 and 2008, a National Commission on Social Security developed a vision and action plan to improve health and long-term care delivery models, as well as other social services (National Commission on Social Security, 2008). The proposed changes to health service delivery models followed consultations with various stakeholders (e.g. providers, patients, academics), and built on previous studies about the future supply and demand for physicians (Hasegawa, 2006) and nurses (Expert Panel on Projection of Supply and Demand for Nurses, 2005). The projections from the Commission were based on the assumption that new health service delivery models should help move patients from tertiary-level hospitals to community care, by improving the efficiency of acute care services in hospital and expanding the availability and quality of community care. It also assumed that some task sharing from physicians to nurses, and from nurses to less qualified occupations, may be possible to better respond to needs in different settings. Under the baseline scenario (no change in the delivery system), the projection results estimated that Japan would need 50,000-75,000 more physicians between 2007 and 2025, 300,000-400,000 additional nurses, and 1 million additional other long-term care workers. Under the most ambitious reforms in health service delivery (which foresee more intensive service provision in community care and home-based care), there would be a need for slightly fewer physicians (about 2,000 less), combined with a larger increase in the number of nurses (600,000-700,000) and long-term care workers to provide more services outside hospitals.

98. Health workforce planning models that take into account such possible changes in health service delivery and a certain re-allocation of tasks among different providers offer a broader range of options to respond to changing and growing health care needs. However, the proper integration of different occupational groups under the same model also brings significant challenges. First, it compounds all the methodological challenges and data limitations that the "silo" approach (based on each occupation) faces. Second, the integration of multiple professions requires a detailed description of the current scope of practice of each professional group, and an assessment of the possible scope for a re-allocation of tasks (as well as an assessment of the productivity of different providers in performing these tasks). This requires a lot of additional information about health service delivery, and may raise sensitive issues about the roles and responsibilities of different providers, thereby adding complexity and potential controversy to health workforce projection exercises.

9. Recognizing the complexity in managing chronic diseases among elderly patients, the Swiss model also used a conservative estimate to limit the effect of any task shifting to only 5% for the population above 65 years old.

7. EVALUATION OF HEALTH WORKFORCE PROJECTION MODELS

99. Health workforce projection models should be evaluated in light of their main objectives. At the broadest level, the main objective of health workforce projections is to inform policy makers about likely future developments in demand and supply and to help them identify possible policy options to avoid any undesirable outcomes. To be more specific, as already noted, most health workforce projection models have been designed mainly to guide policy decisions on student intakes in medical, nursing and other health-related education programmes. Fewer models have been designed to assess the possible impact of reforms in health service delivery on health workforce requirements. Regardless of what their main objective has been, there have been very few formal evaluations of health workforce projection models.

100. In theory, it is possible to identify at least three criteria to evaluate health workforce projection models, based on approaches used for health and social policy projection models generally: 1) the process of model development (including the choice of the underlying conceptual framework and variables); 2) the performance of the model (including its predictive accuracy); and 3) the impact of the model (including its acceptability by the various stakeholders, its actual use in policy-making and the achievement of the desired outcomes) (Kopec et al., 2010).

101. Evaluating the process of model development involves assessing the conceptual framework underlying the model and the choices of variables and parameters. The model needs to be suitable to answer the policy questions that it is designed to address (validity of the model). The conceptual framework, the set of variables, the parameter values and their assumptions need to be supported by existing theory and empirical evidence, and the decisions and reasoning behind the selection need to be displayed (transparency). The implementation of the projection also needs to be clearly explained, so that users of the model can understand how it works and other modellers can replicate the results (tractability).

102. Evaluating the performance of the model usually focuses on the question of whether the model has projected the future correctly (or simulated the past accurately when using the model retrospectively) (Astolfi, Lorenzoni and Oderkirk, 2012). Given that one of the main purposes of the projections is to influence policymakers to take different actions, evaluating the projection accuracy needs to take into account the extent to which different policy actions have been taken on the supply side or demand side. Rather than focusing only on the accuracy of the final estimates, other criteria can also be used to judge the performance of a projection model. Plausibility (or face validity) can be assessed by examining whether the assumptions and the results are realistic and make intuitive sense (Kopec et al., 2010; Don and Verbruggen, 2006). Internal consistency can also be tested by assessing functional and logical relationships between different variables. The overall performance of the model can also be examined by comparing the results with other existing projection models to verify consistency or divergence in results, and to examine the reasons for any significant divergence.

103. The impact of the model is another important evaluation criterion. The impact of a model can be assessed first by reviewing whether its results have been accepted and used in the policy decision-making process and, if so, whether it has helped to achieve the intended outcomes (i.e. a balance between the supply and demand of the different categories of workers considered). With respect to health workforce planning models that are designed to guide decisions about training capacity, one additional evaluation criteria may be to assess to what extent the model has contributed to avoiding large variations in annual student intakes in medical and nursing education, given that such large variations (upward or downward) involve adjustment costs for universities/training institutions and may also results in cyclical imbalances in the labour market for certain categories of health workers.

104. An evaluation of a health workforce projection model has recently been carried out in the Netherlands, focusing in particular on planning for general practitioners (Van Greuningen et al., 2012). This evaluation was conducted by NIVEL (the Netherlands Institute for Health Services Research), which also played an important role in developing and maintaining the model evaluated. Ideally, formal evaluations should be conducted by third parties. Nevertheless, the evaluation used many of the assessment criteria described above as well as others to evaluate the model for general practitioners (GPs). The evaluation was based on six criteria previously proposed by the Dutch Bureau for Economic Policy Analysis for assessing projection models in general: 1) qualitative plausibility, 2) quantitative plausibility, 3) broad correspondence with the results of empirical studies, including time series analysis, 4) good match with recent data, 5) good simulation characteristics of the model as a whole, and 6) suitability of the model for the analysis in question (Don and Verbruggen, 2006). Key indicators used in the evaluation included evidence on trends in unmet demand for GP services and vacancy for GP positions (which were interpreted as evidence of possible shortages), physician employment rate, and the stability of physician density over a 10-year period (from 2000 to 2010). The evaluation also assessed whether the recommendations derived from the model were accepted by stakeholders and implemented by the Ministry. The evaluation concluded that the projection model was both comprehensive and parsimonious in including all the relevant factors affecting the supply and demand for GPs, that the results in terms of student intakes had been generally accepted by stakeholders and implemented by government, and that this had helped maintain a good balance between supply and demand, with little evidence of any lasting shortage or surplus. Nonetheless, the evaluation noted that several improvements were still possible. Notably, one of the recognised weaknesses of the model is that it was not yet fully able to include substitutions between different professions to allow planning from a broader "skill mix" perspective.[10]

105. In Finland, the Ministry of Education and Culture commissions a mid-term review of its 5-year plan for student intakes in universities and other training institutions, to assess whether the different assumptions underlying the projections of future demand of workers in different sectors and occupations remain valid or whether there might be a need to revise the assumptions and estimates. Workforce development in the health sector is monitored by the National Institute for Health and Welfare. The Finnish Medical Association and Dental Association also collect information on physician and dentist shortages at the municipal level in collaboration with local government employers, and local government employers also make an assessment of the shortage of other professionals in the health and social sector. In addition, every four years, the Ministry of Social Affairs and Health has to produce a report on the health status of the population and whether there are sufficient numbers of health workers to respond to health care needs, and this information is also used to review policies on student intakes in health-related fields.

10. Some progress in assessing different skill mix (or occupational mix) has been achieved in a recent projection exercise in the Netherlands led by the ACMMP (which is building on the NIVEL model) and which assessed the possible impact of "vertical substitution" between GPs and "medical care assistants" and "nurse specialists" (see Annex 1.20).

8. CONCLUSION

106. The importance of proper health workforce planning and management is likely to remain high in OECD countries in a context of changing health care needs due to population ageing and the growing burden of chronic diseases, and tight constraints on health budgets in many countries. The continuous development of tools and models to support policy decisions is needed not only for setting the "numerus clausus" (the quantitative limits to intakes in medical and nursing education programmes), but also to assess a range of possible options around health service delivery models that may influence both the supply and the demand for different categories of health workers. Health workforce planning has to move beyond being merely a demographic exercise focused on assessing the "replacement needs" for different categories of health workers (i.e. assessing the number of newly-trained doctors and nurses who may be required to replace those who may be expected to retire) to assessing the potential impact of other non-demographic factors which may also be amenable to different policy interventions.

107. This review of 26 health workforce planning models from 18 OECD countries has identified some interesting developments in the models that have been developed in different countries to better take into account a range of factors that may affect the future supply and demand for doctors and nurses, although many models continue to be based on a fairly traditional and narrow approach focusing mainly on demographic variables. There is plenty of room to broaden the scope of health workforce planning models in many countries to take into account a broader range of factors that may affect the future supply and demand of health workers. Broadening the scope of health workforce planning exercises necessarily means adding more complexity and uncertainty. These additional complexities and uncertainties can be managed by making plausible assumptions about the future (based as much as possible on consultations with key stakeholders) and presenting in a transparent way the results of alternative scenarios based on these different assumptions. The exchange of new and innovative practices across countries can help to foster continuous improvements in health workforce planning models in each country.

108. On the supply side, health workforce planning models have traditionally focused on the inflows of newly-trained doctors and nurses from the domestic education and training system and also, in some cases, from the immigration of foreign-trained health professionals. Regarding the outflows, many models continue to make the convenient assumption that all doctors and nurses may retire at the "standard" age of retirement. The relatively few models that have paid closer attention at recent trends in the retirement patterns of doctors and nurses, or have considered alternative scenarios around retirement age, have come up with interesting results, which often modify considerably the future outlook. For example, in France, the main result from the scenario that tested the potential impact of a gradual postponement of the retirement age of physicians or nurses by two years is that this would have a huge impact in mitigating the projected decline in the physician-to-population ratio and increasing further the nurse-to-physician ratio in France over the next twenty years (Attal-Toubert and Vanderschelden, 2009c; Barley and Cavillon, 2011). In a context where a large number of doctors and nurses are approaching the "standard" retirement age in many OECD countries, health workforce planning models need to pay a greater attention to work-to-retirement patterns of doctors and nurses, and to test the potential impact of different plausible scenarios.

109. The demand side continues to pose the biggest challenges to health workforce planning models, because of the wide range of factors that might affect the future demand for different health services beyond demography. There is a high level of uncertainty surrounding most of these factors, with different assumptions often leading to opposite results. One of the main examples of such high level of uncertainties

relates to whether there may be a "compression of morbidity" or "expansion of morbidity" in the future. Those models that make the "optimistic" assumption that there may be a compression of morbidity (i.e., a postponement in the incidence/prevalence of diseases to older ages so that a smaller share of life may be lived in ill-health) inevitably come up with the result that the future requirements for doctors or nurses may be less than under the "status quo" assumption, while those models which make the "pessimistic" assumption of an expansion of morbidity come up with the opposite result. The available evidence in many countries does not provide strong support for one hypothesis or the other. The practical approach used in the baseline scenario of many models is to assess the future demand for health services based on current utilisation rates by age and sex (in different settings), making the convenient assumption that these utilisation rates may remain constant in the future. Recent developments of "needs-based" models in countries such as Canada are trying to go beyond this convenient assumption and use additional information to assess any potential gaps between current utilisation rates and needs (such as unmet care needs as reported by the population or gaps between the actual use of certain services and the recommended use according to clinical guidelines). These models also use information on trends in risk factors to health and the possible future incidence/prevalence of different diseases to estimate future needs for different services by age and sex. This "new wave" of needs-based models face the difficult challenge of coming up with reliable estimates of current and future health care needs, which are subject to normative judgments about what care is really needed now and high uncertainties about the future.

110. While most health workforce planning so far has tended to be based on a "silo" approach and to look at each professional group in isolation, there have been a few attempts in some countries to move towards a more integrated multi-professional approach to health workforce planning. It is possible to distinguish different levels of integration among those models that have moved in this direction, ranging from: a low level of integration (e.g. models only using a common set of demographic and macro-economic projections, while treating the different occupations separately); an intermediate level of integration (e.g. models taking into account some potential re-allocation of tasks among different professions, without incorporating fully all these professional groups in the planning exercise); a higher level of integration (e.g. taking into account the interactions between different providers and the impact of any possible re-organisation in health service delivery on the demand and supply of the different categories of providers). The models reviewed here fall mainly in the first and second categories (low level and intermediate level of integration). Those models that have achieved an intermediate level of integration have often considered different scenarios around the strengthening of primary care and home-based care, including a possible re-allocation of tasks between doctors and "mid-level" providers (such as physician assistants and nurse practitioners). Such models have been developed, for example, in the Netherlands and Switzerland. While these models are necessarily more complex than uni-professional models, and require more data on health service delivery and may raise sensitive issues around the scope of practice of different providers, they indicate that a certain degree of substitution between different providers may help to reduce any projected gap in the supply of doctors (e.g., GPs). More research and experimentation in health service delivery would help to strengthen some of the key assumptions made in these models concerning the scope for a possible re-allocation of tasks between different providers, and any difference in the productivity of different providers in delivering these services.

111. Economic growth and health expenditure growth can be expected to play an important role in determining the future demand for health workers and their pay rates, but only a few models reviewed here have tried to link health workforce projections with GDP and health expenditure growth projections. This may be due at least partly to uncertainties about future growth in GDP and health spending, as well as how such growth may be allocated between the recruitment of additional staff, increases in pay rates and other benefits, or allocated to capital expenditure and other items. Those models that have tried to build such links between health expenditure and workforce projections in countries such as Norway and the United Kingdom show that various health expenditure growth scenarios can lead to very different conclusions about the future demand for health workers and the extent of possible future shortages or surpluses.

Table 3. Overview of innovative features in the reviewed models

Country	Institution/Year	Current labour market imbalance	Flexible retirement patterns	Productivity (based on arbitrary assumption)	Needs-based	GDP and health spending growth	Integration across specialties and occupations
Australia	Health Workforce Australia (2012)	(x)[1]	x	x			
Belgium	Federal Public Service (2009)		x				
Canada	Health Canada (2007)		x				
	Canadian Nurse Association (2009)	x		x	x		
	Ontario Ministry of Health and Long-Term Care and Ontario Medical Association (2010)	x		x	x		
Chile	Ministry of Health (2009)	x					
Denmark	National Board of Health (2010)	x					
Finland	Ministry of Employment and the Economy, Ministry of Education and Culture (2011)				x	x	
France	Ministry of Social Affairs and Health (2009)		x				
	Ministry of Social Affairs and Health (2011)		x				
Germany	Federal Statistical Office (2010)		x		x		
	Joint Federal Committee (2012)	x					
Ireland	Training and Employment Authority (2009)						
Israel	Ministry of Health (2010)					x	
Italy	Ministry of Health						
Japan	National Commission on Social Security (2008)			x			x
	Physicians Supply/Demand Expert panel, Ministry of Health, Labour and Welfare (2006)		x		x		
	Nurses Supply/Demand Expert panel, Ministry of Health, Labour and Welfare (2010)	x					
Korea	Korean Institute for Health and Social Affairs (2012)			x	x		
Netherlands	Advisory Committee on Medical Manpower Planning (2010)	x	x	x	x		x
Norway	Statistics Norway (2012)		x	x	x	x	x
Switzerland	Swiss Health Observatory (2008)		x	x	x		x
	Swiss Health Observatory (2009)			x	x		x
United Kingdom	Centre for Workforce Intelligence (2012)		x		x	x	
United States	National Center for Health Workforce Analysis (forthcoming)		x	x	x	x	x
	University of North Carolina, Cecil G. Sheps Center (2012)		x	x	x		

1. Included as an arbitrary assumption under alternative scenarios for projecting gaps in the future supply and demand for nurses and physicians (for specialist physicians, the models incorporated an assessment of the current situation, based on consultations with key stakeholders).

112. Health workforce planning has never been – and will never be – a perfect science. Continuous improvements are needed to broaden the scope of health workforce planning models and to improve the methodology, underlying data sources and assumptions. Improvements in health workforce planning are more likely to occur if this is an ongoing activity, with proper resources, rather than as a one-off exercise.

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ANNEX: HEALTH WORKFORCE PLANNING MODELS REVIEWED

Annex 1 Australia: Health Workforce 2025

Background

Health Workforce Australia (HWA) was established in 2009 to improve national-level health workforce planning and training arrangements. The first reports on health workforce projections, covering all physicians and nurses, were released in April 2012, followed by a report focusing on medical specialty projections in November 2012. These health workforce projections are expected to be updated regularly.

Objectives

- Project future workforce demand and supply through scenario modelling and identify gap between supply and demand
- Develop options to close the gap between supply and the demand

Projection Method

Projection Period: 2010-2025

Coverage: Physicians, nurses and midwives

Disaggregation: Physicians (all physicians and by specialties), nurses (all nurses, and by categories of registered nurses including midwives and enrolled nurses)

The HWA projections are based on a stock-flow model on the supply side and a utilisation-based model on the demand side. In 2012, there was 1 model for all physicians, models for 26 categories of medical specialties, 3 models for nurses (registered nurses, enrolled nurses and all nurses which is the aggregation of all registered and enrolled nurses), and 1 for midwives. The 2012 reports recognise the importance of health workforce planning by jurisdiction and sectors, but the work focussed on the aggregate level of demand and supply for Australia. HWA uses information from the general Labour Force Survey (conducted by the Australian Bureau of Statistics) and the more specific Medical and Nursing and Midwifery Labour Force Survey (conducted by the Australian Institute of Health and Welfare).

The supply of health workers is measured in both head counts and FTE. In the baseline scenarios (referred as the comparison scenarios), the supply and demand of health workers are assumed to be in "balance" in the reference year (2010) for the projection models related to all physicians and nurses. However, the projection models for the different medical specialties incorporated an assessment of the labour market situation in the reference year, based on the assessments of key stakeholders and using information about waiting times and vacancy rates. These assessments were put in three categories: 1) no current perceived shortages, 2) some level of expressed demand exceeding supply, and 3) perceived current shortages.

In addition to the baseline (comparison) scenarios, seven alternative scenarios were developed to explore the potential impact of different interventions for the models related to all physicians and nurses (for medical specialties, four alternative scenarios were tested). These are categorised in three groups based on the nature of policy options: 1) innovation and reform, 2) immigration, and 3) other impact scenarios. Table 4 and 5 provide more information on the assumptions underlying these seven scenarios.

Supply

Table 4: Supply variables and assumptions for baseline/comparison scenario, Australia

	Variables	Measurement Approach	Assumptions (Baseline/Comparison Scenario)
Inflow	Education	Number of graduates	Medical graduates: planned increase up to 2015 and held constant thereafter. Nurses/midwives: growth until 2012 and held constant thereafter. Enrolled nurses held constant at 2009 level.
	Immigration	International graduates	Constant at 2009 level
Stocks	Number of Health Workers	Head count	
	Working Time	FTE calculation	
Outflow		Exit rates calculated separately for each medical specialty, nursing area of practice and midwifery, by each five year age/sex cohort	Physicians: the 2007-2009 exit rates, constant over projection period Nurses/Midwives: the 2007-2009 exit rates apply from 2010-2012, then revert in equal increments to the 2001-2005 exit rates level. From 2016 onwards, the 2001-2006 rates apply fully.

Source: Adapted from HWA (2012a)

Demand

Table 5: Demand variables and assumptions for baseline/comparison scenario, Australia

Variables	Measurement Approach	Assumptions (Baseline/Comparison Scenario)
Population	Population	Population projection estimated by Australian Bureau of Statistics (ABS 2008)
Utilisation	Physicians: combination of information: discharges from hospitals, Medicare item numbers, and in-/out-hospital physicians activity Nurses/Midwives: combination of information depending on nurses' specialty: number of bed days, attendances, utilisation data	Based on the growth in activity over the period 2006-2009. Constant linear growth applied to the various age/sex cohorts

Source: Adapted from HWA (2012a).

Main Results

In the baseline (comparison) scenario, Australia is expected to have a shortage of 2 701 physicians and 109 490 nurses by 2025. These HWA projection models explore three different categories of scenarios that may mitigate or exacerbate these baseline scenarios based on different policy options: 1) innovation and reform, 2) immigration, and 3) other impact scenarios. The first category of innovation and reform scenarios include changes that can improve models of care, scope of practice and improved practice (e.g. productivity gain, reduced demand through prevention, and workforce retention). The second category investigates the impact of different levels of reliance on immigration of health workers on the future supply in Australia. The third category assesses the impact of other possible scenarios (e.g. capped working hours for physicians, current undersupply of physicians and nurses). In each scenario, the number of graduates from domestic medical and nursing education programmes is treated as the "adjustment variable" (the numbers that are required to achieve a balance between projected supply and demand).

Table 6 presents the summary results of these projections. It shows among other things that if the productivity of health workers in Australia increases somehow or if the demand for their services decreases, the projected shortage under the baseline (comparison) scenario would disappear. On the other hand, if there is a sharp reduction in the number of immigrant doctors and nurses or if the demand for their services increases, the current number of medical graduates (3 570 annually) would not be sufficient to close the gap. For nurses, the situation is worst: all scenarios indicate a substantial shortage for nurses in the future, requiring significant expansions of education and training capacity in Australia.

Table 6: Results of different projection scenarios for Physicians and Nurses 2010-2025, Australia

		Physicians			
		Supply (FTE)	**Demand** (FTE)	**Gap in 2025** (FTE)	**Graduates Needed**[1]
	Current number of graduate				3 570
	Comparison scenario	109 225	111 926	(2 701)	3 950
Innovation/ Reform	Productivity gain: 5% increase over projection period	109 225	106 413	2 812	3 170
	Low demand: 2% below comparison scenario	109 225	90 536	18 689	900
Immigration	Medium self-sufficiency: reduced to 50% of baseline	102 626	111 926	(9 300)	4 636
	High self-sufficiency: reduce to 5% of baseline	96 686	111 926	(15 240)	5 248
Other Impact Scenarios	High demand due to changing community expectation and other factors	109 225	135 349	(26 124)	7 300
	Undersupply of 5% in the initial year of projection	109 225	117 615	(8 390)	4 770
	Capped working hours to 50 hours per week	106 781	111 926	(5 179)	4 265
		Nurses			
		Supply (FTE)	**Demand** (FTE)	**Gap** (FTE)	**Graduates Needed**[1]
	Graduate levels				12 603
	Comparison scenario	280 442	389 932	(109 490)	23 552
Innovation/ Reform	Productivity gain: 5% increase	280 442	370 435	(89 993)	21 602
	Low demand: 2% below comparison scenario	280 442	311 797	(31 355)	15 738
	Greater workforce retention	367 240	*392 086*	(24 846)	15 088
Immigration	Medium self-sufficiency: reduced to 50% of baseline	260 114	389 932	(129 818)	25 383
	High self-sufficiency: reduce to 5% of baseline	241 819	389 932	(128 616)	27 031
Other Impact Scenarios	High demand due to changing community expectation and other factors	280 442	473 565	(193 123)	31 915
	Undersupply of 5% in the initial year of projection	280 442	402 997	(122 555)	24 859

[1] The number of graduates required annually for the workforce to be in balance in 2025. The increase begins from 2016 for all nurses and from 2018 for physicians.
Source: Adapted from HWA (2012a)

The results for the projections related to different medical specialties are presented in Table 7. The assessment of the current gap in the demand and supply is presented in three categories as described above. The net workforce movement represents a combined change in supply and demand for each specialty. For example, for general practice (GP), the growing supply is projected to exceed the demand by 57 physicians between 2010 and 2025. However, this does not mean there will be a surplus of GPs in 2025, since a perceived shortage currently exists. In order to consider the future health workforce situation, both existing workforce position and net workforce movement need to be considered together.

Table 7. Results of projection scenario for different medical specialty in 2010-2025, Australia

Medical specialty	Existing workforce position	2009 workforce supply	Net workforce movement 2025
Anaesthesia	Some level of expressed demand exceeding available workforce	3 476	130
Dermatology	Some level of expressed demand exceeding available workforce	420	-31
Emergency medicine	Some level of expressed demand exceeding available workforce	1 134	-40
General practice	Perceived current shortage	26 389	57
Intensive care	No current perceived shortage	517	35
Obstetrics and gynaecology	Some level of expressed demand exceeding available workforce	1 562	-142
Ophthalmology	Some level of expressed demand exceeding available workforce	843	-162
Anatomical pathology	Some level of expressed demand exceeding available workforce	728	-182
Other (clinical) pathology[1]	Some level of expressed demand exceeding available workforce	400	-34
Cardiology	No current perceived shortage	790	232
Endocrinology	Some level of expressed demand exceeding available workforce	442	29
Gastroenterology and hepatology	No current perceived shortage	683	110
General medicine	Perceived current shortage	818	137
Geriatric medicine	Some level of expressed demand exceeding available workforce	397	13
Medical oncology	Perceived current shortage	363	82
Nephrology	Some level of expressed demand exceeding available workforce	369	-18
Neurology	No current perceived shortage	411	43
Paediatrics and child health	Some level of expressed demand exceeding available workforce	1 296	39
Psychiatry	Perceived current shortage	2 981	-452
Radiology	Some level of expressed demand exceeding available workforce	1 478	-366
Radiation oncology	Perceived current shortage	245	-57
General surgery	Some level of expressed demand exceeding available workforce	1 181	519
Orthopaedic surgery	No current perceived shortage	1 168	148
Otolaryngology	No current perceived shortage	442	180
Plastic surgery	No current perceived shortage	306	70
Other surgery[2]	No current perceived shortage	866	179

1 Comprised of chemical pathology, microbiology, haematology, immunology, oral pathology and genetics
2 Comprised of cardiothoracic surgery, neurosurgery, paediatric surgery, urology and vascular surgery.
Source: Adapted from HWA (2012d) (Table 2.1 pp.30-31)

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HWA (2012d), *Health Workforce 2025 - Medical Specialties – Volume 3*, Adelaide, https://www.hwa.gov.au/sites/uploads/HW2025_V3_FinalReport20121109.pdf.

Annex 2 Belgium: Belgian Harmonised Mathematical Planning Model

Background

The Belgian Planning Commission is responsible for the planning of several health professions, including physicians, dentists, nurses and physiotherapists. It has tasked the Federal Public Service (Service Public Fédéral Santé Publique, Sécurité de la Chaîne Alimentaire et Environnement) to develop a health workforce projection model. Following the development of separate models for different professions, a 'harmonised' model was developed in 2008, which applied a common methodology and approach to planning for all professions, while maintaining the necessary specificity for each one. The model is available through a web application, so that the members of the Planning Commission and other interested users can have easy access and test various hypotheses. The details and results of the physician projection model were published in a 2009 technical report (SPF, 2009).

Objectives

- To assess potential shortages or surpluses of physicians in the future
- To determine quota for post-graduate medical training

Projection Method

Projection Period: 2004-2034 (SPF, 2009)

Coverage: Physicians

Disaggregation: GPs and Specialists, for the Flemish and French Community

This Belgian projection model uses a standard stock-flow model on the supply side, using available information on age, sex, and location of practice of the current stock of physicians. The model also uses several other information and assumptions on the inflow and outflow (Table 8). Future demand for physicians is driven by changes in the size and structure of population, taking into account differential patterns of health service expenditure by sex and age as a proxy for health workforce needs. Weights for health workforce (physicians) needs are assigned to each age/sex group. These weights are used to calculate the size of the increase in the demand for physicians in the future (Table 9).

Supply

Table 8: Supply variables and assumptions for projections

	Variables	Measurement approach	Assumptions
Inflow	Education	Population of 18 years	Population projection
		Attractiveness rate: proportion of medical school enrolment out of the number of 18 year olds	Constant at 2007 level Flemish: 0.0125 (due to strict entrance examination in the first year) French: 0.0340 (selection after first year only)
		Graduation rate	Constant at 2007 level Flemish: 0.875 French: 0.344
		Breakdown of specialty	Average of last 5 years, constant
		Quota for post-graduate training[1]	Up to 2015: already determined From 2016 onwards : 1230, constant
		Quota breakdown by community	French/Flemish community: 40/60
	Immigration	Immigration	Average of last 3 years, constant
Stocks	Number of Health Workers	Head count of all qualified physicians	
	Working Time	FTE calculation[2]	Reduction in working time: 0.3% per year
Outflow	Mortality	Five-year mortality rates by sex, community	Constant
	Emigration	Emigration	0

[1] The quota system is applied at the end of core training (7 years) and limits the number of trainees to specialize in GP or other medical specialties (Stordeur and Léonard, 2010).

[2] The calculation of FTE includes all physicians with the required qualification to work in Belgium. It includes those who work full or part-time as well as physicians who do not particpate in the labour market (e.g. retired physicians) who count as zero.

Source: SPF SPSCAE (2009)

Demand

Table 9: Demand variables and assumptions for projections

Variables	Measurement Approach	Assumptions
Population	Population by age/sex	Population projection
Utilisation/Need	Differential utilisation patterns by age/sex, proxied by health service expenditure data (with weights for health workforce needs assigned to each age/sex group)	Constant utilisation rate by age/sex

Source: Adapted from SPF SPSCAE (2009)

Main Results

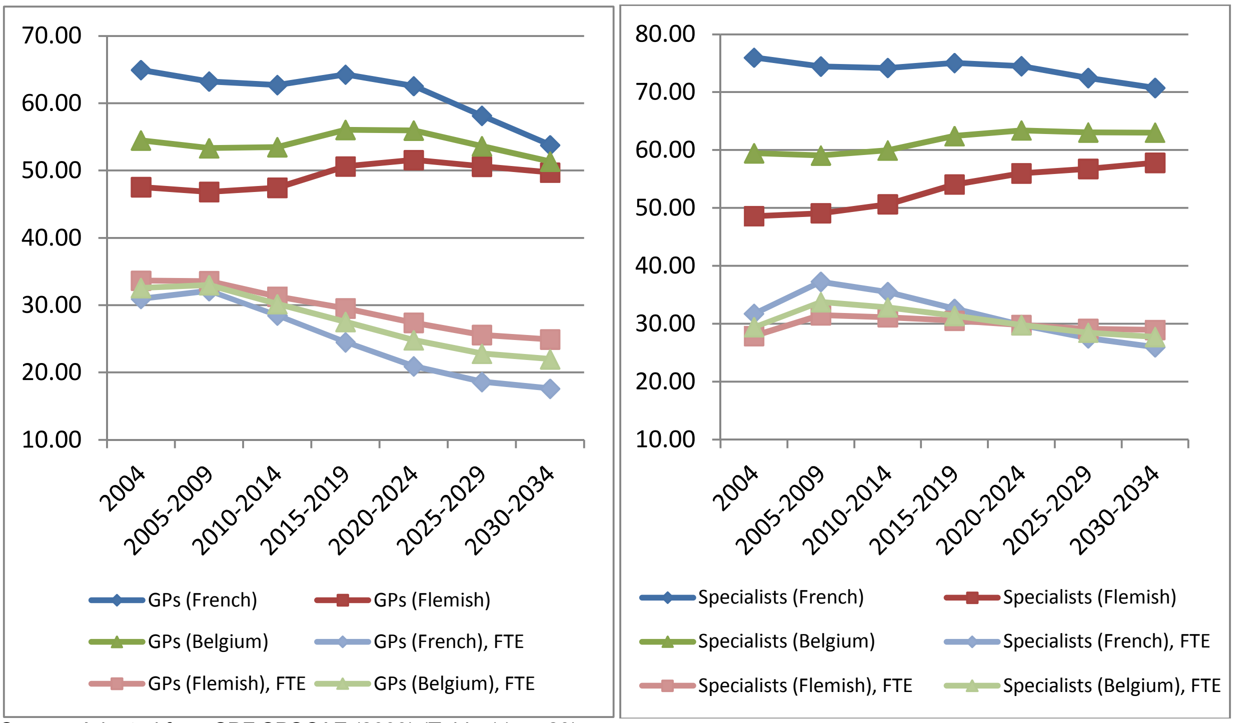
Table 10 and Figure 2 indicate that the weighted density of GPs (taking into account changes in population structure), in head counts, is expected to decrease in Belgium under the baseline scenario from 54.49 per 10 000 population in 2004 to 51.35 in 2030-2034, while the density of specialists is expected to increase from 59.47 per 10 000 population to 63.03 over the same period. However, once the head count numbers are converted to FTE, and assuming that the working time of GPs and specialists will gradually fall (by 0.3% per year), the weighted density of both GPs and specialists is expected to fall by 2030-2034, unless some counter-measures are taken to avoid such a reduction.

Table 10. Number of physicians, head count and full-time equivalent with reduced working time, per 10,000 population (weighted), Belgium, 2004-2034

Weighted density		2004	2005-2009	2010-2014	2015-2019	2020-2024	2025-2029	2030-2034
Number of physicians	GPs (French)	64.95	63.25	62.72	64.27	62.56	58.16	53.79
	GPs (Flemish)	47.56	46.84	47.45	50.62	51.57	50.61	49.71
	GPs (Belgium)	**54.49**	**53.33**	**53.50**	**56.06**	**55.97**	**53.63**	**51.35**
	Specialists (French)	75.97	74.46	74.19	75.06	74.50	72.47	70.74
	Specialists (Flemish)	48.60	49.10	50.65	54.07	56.00	56.75	57.82
	Specialists (Belgium)	**59.47**	**59.09**	**59.95**	**62.43**	**63.41**	**63.05**	**63.03**
Full-time equivalents (assuming reduced working time)	GPs (French)	30.95	32.11	28.47	24.51	20.92	18.61	17.61
	GPs (Flemish)	33.65	33.57	31.28	29.53	27.40	25.59	24.93
	GPs (Belgium)	**32.57**	**32.99**	**30.17**	**27.53**	**24.81**	**22.80**	**21.99**
	Specialists (French)	31.75	37.27	35.48	32.63	29.79	27.51	25.97
	Specialists (Flemish)	27.89	31.48	31.14	30.54	29.78	29.13	28.94
	Specialists (Belgium)	**29.43**	**33.76**	**32.85**	**31.38**	**29.79**	**28.48**	**27.74**

Source: Adapted from SPF SPSCAE (2009) (Table 11, p. 29)

Figure 2. Number of physicians, head count and full-time equivalent with reduced working time, per 10,000 population (weighted), Belgium 2004-2034



Source: Adapted from SPF SPSCAE (2009) (Table 11, p. 29)

References

SPF SPSCAE (2009), *Perspectives d'avenir de la Commission de Planification- Offre médicale: Rapport scénario de base Médecins 2009 (Numéro du scénario S_000040),* Bruxelles.

Stordeur, S. and C. Léonard (2010), "Challenges in physician supply planning: the case of Belgium", *Human Resources for Health*, 8(28), http://dx.doi.org/10.1186/1478-4491-8-28.

Annex 3 Canada: Health Human Resource Model

Background

Health workforce planning is primarily a provincial and territorial responsibility in Canada. Health Canada, working in collaboration with provinces, developed a few years ago a model to assess the future supply and demand for physicians and nurses, and this model was applied to the case of the province of Nova Scotia.

Objectives

- Understand and quantify different factors that affect the supply and demand for physicians and nurses.
- Calculate possible shortages in the future and identify possible policy levers to close potential gaps (such as increasing student intakes and immigration, delaying retirement, and increasing productivity).
- Develop policy scenarios to address future health workforce challenges.

Projection Method

Projection Period: 2000-2025

Coverage: Physicians and nurses

Disaggregation: Specialties for physicians (e.g., general practitioners, medical specialty and surgical specialty) and different functions for nurses (e.g., medical/surgical, psychiatric/mental health, paediatric, maternal/newborn, oncology, critical care, operation room/recovery room, rehabilitation, ambulatory care and home care)

Health Canada's projection model utilises a stock-flow approach on the supply side and a utilisation-based approach on the demand side.

The physician model produces headcounts and can be converted to full-time equivalent (FTE). Gross income per physician is used to measure workload, and in turn FTE. The 40^{th} and 60^{th} percentiles of fee adjusted, nationally defined payment distribution was chosen as the benchmarks within which to measure full-time equivalence as equal to one. FTE increases linearly with income until the 40^{th} percentile and logarithmically after the 60^{th} percentile. The National Physician Database (NPDB) microdata was used to construct a table of average FTE by province, gender and specialty and this is used to convert from head counts to FTE. For the nurse model, the headcounts of registered nurses were provided by full-time and part-time and by nursing functions. In order to take into account only the time spent in providing direct care, it is assumed that a full-time RN contribute equivalent of 0.9 FTE and a part-time RN contribute 0.6 FTE RNs for clinical care.

The model uses physician's billing data and population projection to estimate the demand for physicians by most responsible diagnosis, in-hospital/out-hospital status, age and sex, assuming constant incidence rates of different diseases as in the base year. For nurses, discharge data was used to determine the utilization patterns by patients characteristics (age, sex, and most responsible diagnosis), and this is linked with the relative need for nursing care.

Variables and assumptions used for baseline scenario are described in Table 11 (for supply) and 12 (for demand). These assumptions are hypothetical and can be changed depending on the intended use of the model

Supply

Table 11: Supply variables and assumptions for baseline scenario

	Variables	Measurement approach	Assumptions (baseline scenario)
Inflow	Education	Physicians: New entrants to medical schools	 Constant
		Drop-out before getting MD title	3%, constant
		Drop-out before finishing specialization	1%, constant
		Drop-out before completing their first five years of practice	3%, constant
		Nurses: used number of first-time takers of the RN examinations to determine number of new entrants to labour market	Based on 1999 data
	Immigration	Physicians: includes those who returned from abroad based on registration data and foreign doctors based on immigration data Nurses: used foreign nurses based on immigration data	Based on 1999 data
Stocks	Number of health workers	Head counts	
	Working time	FTE calculation Physicians: based on income data Nurses: converted from full-/part-time status	
Outflow	Exit	Physicians: probability of retirement at each age starting from 40 is calculated based on the assumption that the average retirement is 63, based on retirement patterns of entire labor force using 1976 to 1999 labour force surveys. Additionally mortality rate of general population were applied to calculate the probability of death. Nurses: 10% drop-out rate for 1st year of practice, 5% for 2nd year of practice; probability of retirement and death were calculated using the same methodologies as for physicians.	

Source: Gupta and Basu (2007)

Demand

Table 12: Demand variables and assumptions for baseline scenario

Variables	Measurement approach	Assumptions (baseline scenario)
Population	Population by age and sex	Statistics Canada's population projection
Utilisation	Physicians: Most responsible diagnosis (MRD), in/out-hospital status Nurses: Discharge data by patient characteristics (age, sex and MRD)	Incidence rates of difference diseases remain the same as in the base year

Source: Gupta and Basu (2007)

Illustrative Results

In order to demonstrate what the projection model can do, the model was used to produce illustrative results for the province of Nova Scotia. The demand for doctors and nurses in the province of Nova Scotia was expected to increase faster than population growth between 2000 and 2025 due to population aging. The demand for registered nurses was expected to increase particularly rapidly for medical and surgical activities in hospitals, while the demand for doctors was expected to rise substantially for the treatment of ageing-related diseases, such as cancer.

Reference

Gupta, A. and K. Basu (2007), "Building Policy–relevant health Human Resource Models", in Ann Harding (ed.) *Modelling Our Future: Population Ageing, Health and Aged Care* (International Symposia in Economic Theory and Econometrics, Vol 16), Emerald Group Publishing Limited, pp. 321-342. Additional information and updated analysis provided by the author.

Annex 4 Canada: Need-Based Simulation Model for Registered Nurses in Canada

Background

The Canadian Nurses Association has developed a national planning model, focusing on registered nurses (RNs) providing direct clinical care, which estimates the supply and requirement for RNs in Canada over a 15-year period. This model is aligned with federal, provincial and territorial policy, which calls for population health needs-based health human resource planning

Objectives

- Estimate the future requirements for RNs' services based on the size, distribution and levels of health care needs of the population
- Estimate the future supply of RNs' services based on the size, characteristics of the current workforce as well as trends in entries and exits from the workforce
- Assess the effects of different policy options on the supply and requirements for RNs in the short, medium and long term

Projection Method

Projection Period: 2007-2022

Coverage: Registered Nurses (RNs) in Canada (excluding nurse practitioners)

Disaggregation: By sector: acute care, long-term care, home care and community care

The supply side of the model is based on a stock-flow approach, considering entry (education and in-migration) and exit (retirement, death, and out-migration). The stock of RNs takes into account the total number of license holders, the proportion of nurses who provide direct clinical care (participation rates) and their working hours (activity rates) to calculate full-time equivalents (FTEs) (Table 13).

In order to determine the current and future needs for RNs, four distinct components were considered: 1) the demographic profiles of the population (size and structure), 2) the level and distribution of health and illness, 3) the quantity and mix of health services required for individuals at different level of health and illness, and 4) productivity, measured as the amount of health services produced per FTE RN per year.

In order to determine the level of needs, the model used a combination of data on self-reported health status (from population-based surveys) and health service utilisation indicators for each sector. Self-reported unmet health care needs were taken into account to estimate the total needs for nurses in 2007. Indicators used for need assessments in each sector are described in Table 14. Projections in the future were based on past trends between 1994 and 2005, although the availability of data varies for different indicators.

Supply

Table 13: Supply variables and measurement approach

	Variables	Measurement Approach	Assumptions (baseline scenario)
Inflow	Education	Enrolments	13,000 in 2007, increased by 900 starting in 2010-2011(due to funding increase announced in several provinces)
		Program length	Constant at 3.6 years, the average length of RN education programs in Canada (weighted by program size)
		Program attrition: proportion of entrants who leave the program before completion	Constant at 28%, based on data from 17 schools from 7 provinces
		Graduate out-migration: proportion of new graduates who do not enter practice as RNs in Canada	Constant at 5%, based on data from 3 provinces (British Columbia, Ontario and Saskatchewan)
		New graduates	Determined by enrolment, program length, attrition and graduate out-migration.
	Migration		Constant at 1 023, based on the number of international students who passed the Canadian RN exam in 2007
Stocks	Number of Health Workers	Head counts: number of RNs in Canada *potentially* available to provide nursing services	Number of RN license holders, excluding those who are licensed as nurse practitioners.
	Participation	Participation rate: proportion of all licensed RNs employed in direct clinical care	Constant, at 81%
	Working Time	FTE calculation, based on hours in direct clinical care	Constant, based on data for acute-care RNs in three provinces (New Brunswick, Nova Scotia and Ontario)
	Productivity	Number of service performed per FTE RNs per year, separately estimated for acute care, long-term care, home care and community care.	Constant
Outflow	Retirement and Attrition	Exit rates, by age-specific rates at which RNs cease renewing their licensure	Constant, based on provincial/territorial-level of non-renewal rates (adjusted for interprovincial/territorial migration)

Source: CNA (2009)

Demand

Table 14: Demand variables and assumptions for projections

Variables	Measurement Approach	Assumptions (Baseline Scenario)
Population	Size and distribution of population by age and sex	Statistics Canada's population estimates
Needs	Acute care: combination of rates of injury and number of chronic conditions, and self-assessed unmet needs Long-term care: combination of 1) individuals already in long-term care facilities, 2) individuals in hospitals waiting for beds in long-term care facilities, and 3) individuals living alone and unable to perform personal care in their homes without help Home-care: combination of met and unmet needs based on self-reported data Community care: distribution of self-assessed general health status	Trends based on past data (e.g. survey data from 1994 to 2005).
Level of Service	The amount of services a person requires by level of need (based on existing level of services) Acute care: combination of 1) the distribution of hospitalization by chronic conditions and injuries, 2) current hospitalization rates by age and sex based on hospital data as well as self-reported data Long-term care: days of care in long-term care per patient per year For home-care and community care**:** TBD	

Source: CNA (2009)

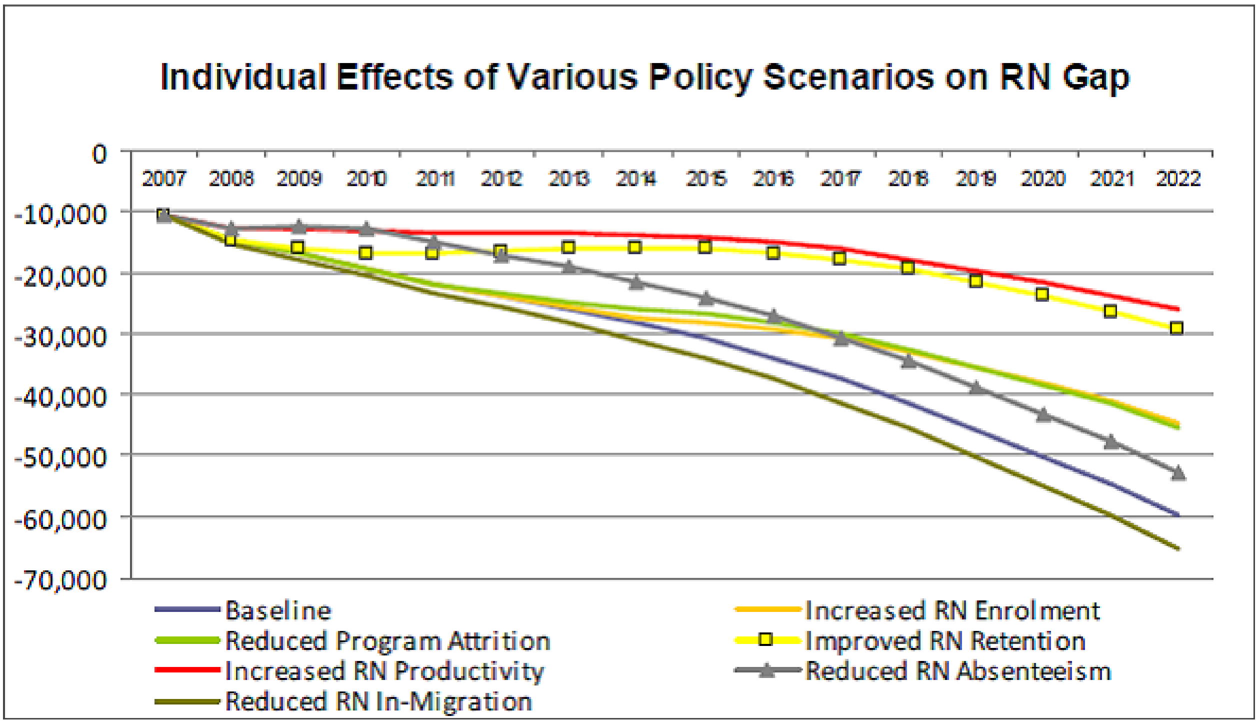
Main Results

Taking into account the estimated needs for different types of nursing care, the model estimated that there was a shortage of about 11 000 RN FTEs in Canada in 2007, which includes a shortage of 4 500 RN FTEs in hospitals, 4 500 RN FTEs in long-term care, 700 RN FTEs in home care and 900 RN FTEs in community care. Under the baseline line scenario (status quo), the shortage of RNs in all settings was projected to increase to approximately 60 000 FTEs in 2022.

The model also examined the impact of different policy options that might be used to close the projected gaps between the need and supply of RNs: 1) increased RN enrolment by an additional 1 000 students per year from 2009 to 2011 (for three years), 2) improved retention of student nurses by reducing the loss rate from 28% to 15% over three years (between 2009 and 2011) , 3) improving retention of practising RNs by gradually reducing the exit rates to 2% for all RNs under 60 year old and to 10% for RNs age 60 and over, 4) reducing RN absenteeism to 7 days per year on average (compared with 14 days in 2007), 5) increasing RN productivity by 1% per year (measured by the amount of services provided by RNs per unit of time). The model also assessed the impact of reducing in-migration of foreign-trained RNs by 50% to increase self-reliance (although this would obviously have the impact of increasing the projected gap).

Figure 3 shows the individual effects of different policy scenarios on the projected gap between the needs and supply of RNs in Canada. Reducing reliance on foreign-trained RNs would, as expected, widen the gap by about 10% by the end of the projection period (2022). The other five scenarios would have varying impacts in closing the gap. Scenarios 3 (improving retention) and 5 (increase productivity) would reduce the gap by 50% or more, while scenario 1 (increase enrolment) and 2 (increase retention of students) would decrease the gap by about 25%. Scenario 4 (reduction of RN absenteeism) would have a more modest effect (reducing the gap by about 12%). The analysis suggested that none of these policy initiatives taken alone would be sufficient to close the expected gap, but a combination of policies would have the potential to do so.

Figure 3: Individual effects of different policy initiatives to reduce the gaps between supply and needs for Registered Nurses in Canada, 2007-2022



Source: CNA (2009) (p.35, Figure 26).

References

CNA (2009), *Tested Solutions for Eliminating Canada's Registered Nurse Shortage*, report prepared by Tomblin Murphy, G. et al., Canadian Nurses Association, Ottawa, http://www.nursesunions.ca/sites/default/files/rn_shortage_report_e.pdf (accessed 8 March 2013)

Tomblin Murphy, G. et al. (2012), "Eliminating the shortage of registered nurses in Canada: An exercise in applied needs-based planning", *Health Policy*, 105: 192-202.

Annex 5 Canada: Ontario Population Needs-Based Physician Simulation Model

Background

The Ontario Ministry of Health and Long-Term Care, in collaboration with the Ontario Medical Association, developed a Population Needs-Based Physician Simulation Model for Ontario (the largest Canadian province). The project begun in 2007 and a report was published in 2010. The main feature of the model is that it placed a particular emphasis on trying to determine "population needs", using information about current unmet care needs, as well as future incidence and prevalence of key diseases based on population projections and certain assumptions about various socio-economic and lifestyle risk factors.

Objectives

- Analyse the potential impacts of changes in population health on the need for physicians
- Assess any potential gaps between projected supply and need for physicians

Projection Method

Projection Period: 2008-2030

Coverage: Physicians in Ontario, Canada

Disaggregation: 27 specialities, by 14 Local Health Integration Network (LHIN) in Ontario

The supply side of the model is based on a stock-flow approach, considering medical schools training capacity and specialization positions, migration of physicians (after completion of residency training and while in active practice), retirement and attrition, and physician productivity (measured by the impact of various factors such as non-physician clinicians on the number of patients seen by a physician practice over a specific time period) (Table 15).

Population needs for physician services were determined by combining three different components: 1) population demographics; 2) disease incidence and prevalence; and 3) risk factors. The model focussed on the top ten ICD-10 disease categories which, according to a survey of the Ontario Medical Association, were taking the most of physician time. It also included 10 important risk factors to health, which were selected based on a literature review, expert opinions and analysis of existing survey data (e.g. alcohol consumption, consumption of fruits and vegetables, obesity, physical inactivity, perceived stress, etc). Disease "weights" were introduced to link the incidence of each of the top ten diseases with the risk factors. These disease weights were determined by expert opinion.[11] Combining population changes by sex and age with assumptions of constant risk factors by sex and age and constant disease weights provided some estimates of the future incidence and prevalence of the top ten diseases. The estimation of the total need for physicians services was based on the assumption that the physicians' time spent treating each disease would remain unchanged (Table 16).

11. For example, the disease weight of the risk factors affecting the incidence of lung cancer were as follows: 1) 75% smoking, 10% exposure to second-hand smoking, 3% consumption of fruits and vegetables, and 11% other factors.

Supply

Table 15. Supply variables and assumptions for projections

	Variables	Measurement Approach	Assumptions
Inflow	Education	Current and planned student intakes for both undergraduate enrollment and post-graduate residency training for Canadian Medical Graduates and International Medical Graduates	952 students entering undergraduate medical schools by 2011: 1 247 ministry-funded residents entering training by 2014, 43% family medicine and 57% specialists.
	Migration	Net migration after completion of residency training and from other provinces/countries	Average net migration after training over past 3 years (the annual net migration of trained physicians is quite low; less than 0.1% of total stock)
Stocks	Number of Health Workers	Head count of physicians currently in post-graduate training and in practice	
	Working Time	FTE calculation based on hours worked	No change in working time
	Productivity	Total number of patients seen by a physician over a specific time period	40% productivity gain for inclusion of nurse practitioners in family physician practice
Outflow	Retirement and Attrition	Retirement data obtained from Ontario Physician Database and attrition data obtained from National Physicians Survey	3-year average retirement rate

Source: Singh et al. (2010)

Need

Table 16. Need variables and assumptions for projections

Variables	Measurement Approach	Assumptions (Baseline Scenario)
Population	Population by age and sex	Population projections
Epidemiology	Disease incidence/prevalence (top 10 ICD-10 diseases taking most of physicians time)	Incidence/prevalence gradually increasing over 2008-2030 (because risk factors prevalent in a growing share of the population)
	Risk factor prevalence	Constant over time by sex and age group
	Disease weights (to link risk factors and disease incidence/prevalence)	Constant over time

Source: Singh et al. (2010)

Scenarios

The first step in this model was to assess the *current* situation in terms of the labour market situation of physicians in Ontario. Five different approaches were used to estimate current mismatches between supply and needs (Table 17). The first approach (Base case 0) simply assumed that there was in the baseline year (i.e. 2008) a perfect match between supply and demand. The other four approaches assumed that there was some under-provision of services for certain population groups (e.g. those who do not have a regular family doctor, referred as the “unattached population”) or certain services (e.g. a periodic health exam).

Table 17. Assessment of current gaps between the supply and need for physicians in Ontario, based on alternative approaches/assumptions

Base Case	Approaches/Assumptions	Family Doctors	Specialists
0	Perfect balance between current supply and need for physicians	0	0
1	Based on the recommended level of services for patients (i.e. periodic health exam by family doctors) and gap in the current level of services	-1 559	-902
2	Provide care to Ontario's unattached population (upper bound of 950,000 Ontarians) at the same level of attached population	-672	-488
3	In addition to base case 2, provide additional care to attached population: improve services to 7% of the population reporting health access difficulties	-803	-564
4	In addition to base case 2, provide additional care to Attached Population: improve services to 9% of the population reporting health access difficulties	-840	-586

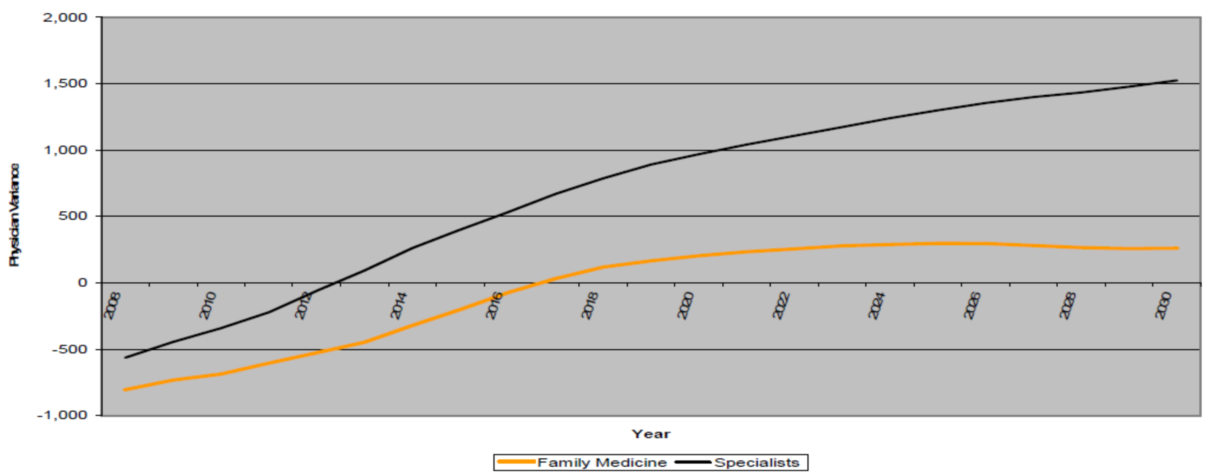
Note: The "unattached population" refers to people who do not have a regular family doctor

Source: Singh et al. (2010)

Main Results

Figure 4 below presents the projection results based on the objective of improving access to doctors for the unattached population and the proportion of the attached population reporting that they had some access difficulties in 2008 (base case scenario 3). The results indicate that there was a shortage of 565 specialists and 803 family doctors in 2008, but these shortages were expected to gradually disappear by 2014 for all specialists combined and by 2017 for family doctors, followed by a growing surplus in particular for specialists up to 2030. However, the results show that certain specialties and certain geographic areas in the province will continue to experience shortages in the future (not shown here).

Figure 4: Simulation of projected gaps between the supply and need for physicians in Ontario under Base Case Scenario 3, 2008-2030



Source: Singh et al. (2010) (Figure 4, p.18)

Reference

Singh, D. et al. (2010), *Ontario Population Needs-Based Physician Simulation Model*, Ministry of Health and Long-Term Care and the Ontario Medical Association, Toronto.

Annex 6 Chile: Assessment of Specialist Requirement in Public Sector

Background

One of the main concerns regarding the health workforce in Chile over the past few years has been the shortages of medical specialists in public hospitals. With the collaboration of the World Bank, Chile's Ministry of Health has conducted an assessment of medical specialists in public hospitals and produced projections of the supply and demand using a specific model developed for this purpose. The model allows generating various types of scenarios, by setting up different assumptions on retirement age and recruitment patterns.

Objectives

Estimate gaps between the supply and demand of medical specialists in the public health sector for the period 2009-2012

- Explore alternative scenarios for reducing or closing the gap.

Projection Method

Projection Period: 2009-2012 (the model allows a selection of any projection periods)

Coverage: Specialists in public hospitals

Disaggregation: 34 specialties, by geographic regions

The supply side of the model is based on a stock-flow approach, using simple assumptions on the recruitment to public sector hospitals, working hours and exit rate (Table 18).

Current and future shortages of specialists were estimated in comparison to two benchmarks:

- Physicians-to-population ratio of Spain, with adjustment for economic development differences and health indicators using variables such as GDP per capita and healthy life expectancy in Spain and Chile (so that it was estimated that the "equivalent" requirement for specialists in Chile would be 36.7% the availability in Spain)
- Physicians-to-population ratio of Chile in 2008 (average across all regions)

The model does not take into account any region that might have an "excessive" number of specialists. Only regions with deficit in the number of specialists contribute to national shortage estimates.

Supply

Table 18. Supply variables and assumptions for projections

	Variables	Measurement Approach	Assumptions
Inflow	Entry to labour market	Entry to the public sector only	• 22 000 additional hours per week added in 2009 (equivalent of 500 new physicians), none in 2010-12 (baseline scenario) • 22 000 hours per week of service added in 2009, 8,000 per week in each year between 2010 and 2012 (alternative scenario)
Stocks	Number of Health Workers	Head count	
	Working Time	FTE calculation: based on past trends (public sector physicians can have contracts to work between 11 to 44 hours per week)	Constant
Outflow	Exit	No data available. 3% exit rate assumed	Constant

Source: World Bank and Ministry of Health, Chile (2009)

Main Results

The initial gap between the supply and demand in 2008 using the adjusted Spanish physicians-to-population ratio was 69 499 hours per week. The gap was lower (62 416 hours per week) if it is based on the 2008 average Chilean physicians-to-population ratio. In addition to different benchmarking of physicians-to-population ratio, the following scenarios were explored and the main results are presented in Table 19.

- Annual growth in demand beyond population growth (no growth vs. 1 % annual growth)
- Changes in recruitment patterns
  - Expansion only in 2009 of additional 22 000 hours per week by hiring 500 specialists, without any additional recruitment after 2010
  - Continuous recruitment: in addition to recruitment in 2009 (22 000 hours), additional 8,000 hours per week each year between 2010 and 2012

The results show that in the most favourable conditions (Scenario 2.2), where current Chile's physicians-to-population ratio is used, there is no growth in demand beyond population growth, and there is continuous recruitment over 4 years, the gap would only be reduced by 12 000 hours. In the least favourable scenario (Scenario 1.3), using the adjusted Spanish ratio, with a 1% annual increase in demand over and above the increase in population growth, and additional recruitment only occurs in 2009, the gap would grow by 25% (Table 19).

Table 19: Main results, gaps (hours per week)

	Scenarios: Demand Growth	Changes in Recruitment	Gaps (hours) 2008	Gaps (hours) 2012
Spanish Ratio, adjusted	1.1 No growth in demand	22 000 additional hours added in 2009, none in 2010-12	-69 499	-70 387
	1.2 No growth in demand	22 000 hours of service added in 2009, 8 000 in each year between 2010 and 2012	-69 499	-56 348
	1.3 Annual growth of 1% in demand	22 000 additional hours added in 2009, none in 2010-12	-69 499	-86 775
	1.4 Annual growth of 1% in demand	22 000 hours of service added in 2009, 8 000 in each year between 2010 and 2012	-69 499	-72 944
Chile ratio	2.1 No growth in demand	22 000 additional hours added in 2009, none in 2010-12	-62 416	-68 188
	2.2 No growth in demand	22 000 hours of service added in 2009, 8 000 in each year between 2010 and 2012	-62 416	-50 469
	2.3 Annual growth of 1% in demand	22 000 additional hours added in 2009, none in 2010-12	-62 416	-76 138
	2.4 Annual growth of 1% in demand	22 000 hours of service added in 2009, 8 000 in each year between 2010 and 2012	-62 416	-58 516

Source: World Bank and Ministry of Health, Chile (2009)

Reference

World Bank and Ministry of Health (2010), Estudio de Brechas de Demanda y Oferta de Médicos Especialistas en Chile. Informe Final [Study of the gaps between supply and demand of medical specialists in Chile, Final report]. Ministry of Health, Santiago, http://www.minsal.gob.cl/portal/docs/page/minsalcl/g_general/elementos/estudio_bco_mundial.pdf

Annex 7 Denmark: Forecasts of Physician Supply

Background

The National Board of Health is responsible for conducting studies and providing advice concerning the current and future size and distribution of the health workforce across regions in Denmark and new student intakes in medical and dental education programmes (National Board of Health, 2010). Projection work for physicians is achieved by the Forecasting Committee, which is reporting to the National Council for Postgraduate Medical Education, which in turn provides advice to the National Board of Health. The intake of medical and dental students, upon the advice by the National Board of Health, has to be approved by the Minister of Science, Technology and Development.

Objectives

To forecast the future supply of physicians based on different assumptions

Projection Method

Projection Period: 2010-2030

Coverage: Physicians (and dentists)

Disaggregation: 40 medical specialties

The projection model for physicians focuses on the supply side, based on different assumptions (Table 20). The demand side of the model has not been extensively developed yet due to high uncertainty concerning the various factors that will influence future demand. In order to assess any future imbalance between the supply and demand for physicians, the model uses different assumptions concerning the growth rate for the demand of GPs and medical specialists: 0%, 0.5%, 1% and 1.5% growth per year over the 20-year period. These growth rates are designed to take into account population growth and other factors affecting future demand (upward or downward). The model determines the current gap (shortage) using vacancy data for physicians in the hospital sector from ESVAT (*electronic job and vacancy count*). Given that this source only covers physicians in the hospital sector, it is viewed as a minimum estimate of the overall shortage.

Supply

Table 20. Supply variables and assumptions for the projections

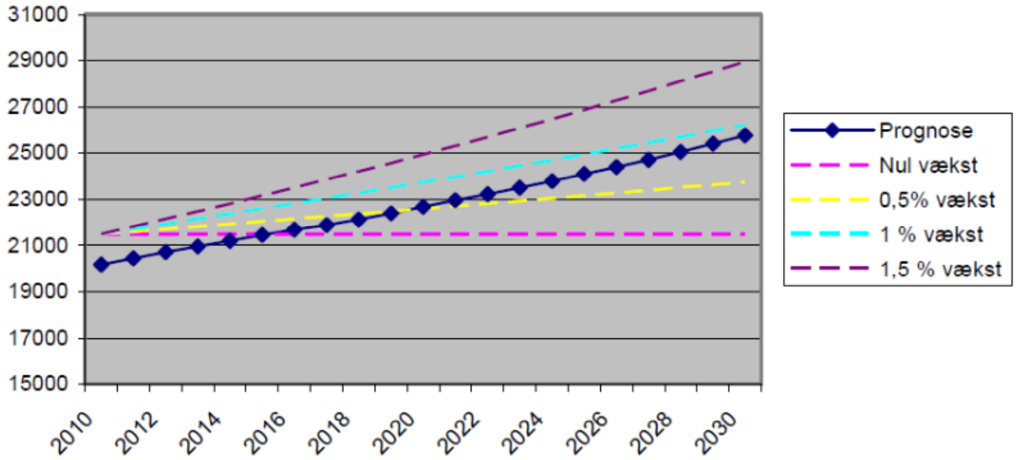
	Variables	Measurement Approach	Assumptions
Inflow	Education	Number of Graduates	The number of graduates up to 2009 was estimated from the number of authorised medical students from three universities. The number of graduates after 2009 was determined based on estimates from the Ministry of Science, Technology and Innovation.
	Immigration		Gradual decline: 2010-2014: 100 physicians 2015: 92 physicians 2016 onwards: 60 physicians
Stocks	Number of Health Workers	Head count	
Outflow	Mortality	• Age-gender specific mortality	
	Retirement	• Pension take-up patterns or • Exclusion of all physicians 70 years old and older	
	Exit	Percentage of exit in a given year	Percentage of exit during the 2004-2007 period projected throughout the 2010-2030 period

Source: National Board of Health (2010)

Main Results

The total number of medical doctors is expected to increase by 28% between 2010 and 2030, based on the assumptions concerning graduation rates from medical education programmes, immigration rates and exit/retirement rates. The growth rate in the number of medical specialists (36%) would exceed greatly the growth rate in the number of GPs. This would represent an annual increase of approximately 1% for all physicians, 0.8% for GPs and 1.2% for specialists. Depending on the growth rate on the demand side, this growing supply may either result in a surplus or shortage of GPs and specialists.

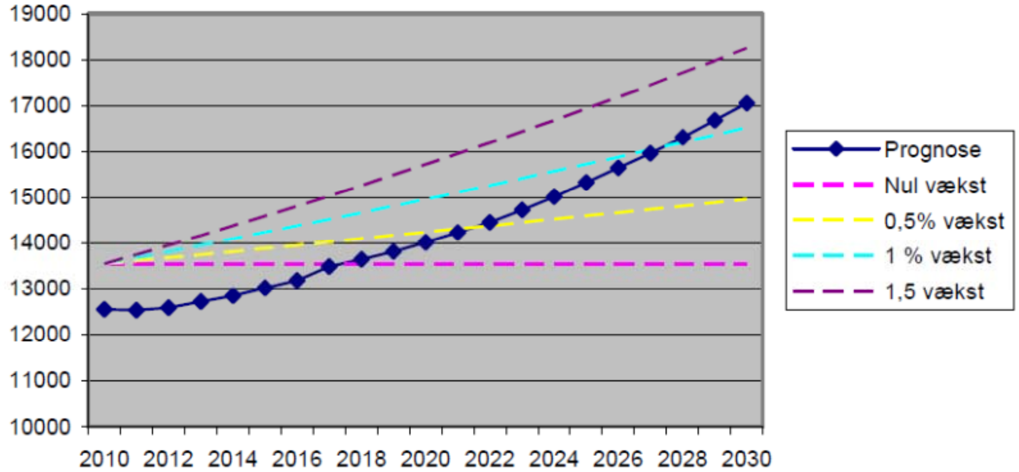
Figure 5: Projections of the supply and demand for all physicians, 2010-2030*, Denmark



*Prognose shows the supply forecast; the dotted lines indicate different demand projections according to different growth scenarios (0, 0.5%, 1% and 1.5%).

Source: National Board of Health (2010) (p.17, Figure 9).

Figure 6: Projections of the supply and demand for specialists, 2010-2030[1], Denmark



[1]Prognose means the supply forecast; the dotted lines indicate different demand projections according to different growth scenarios (0, 0.5%, 1% and 1.5%).

Source: National Board of Health (2010) (p.17, Figure 10).

Reference

National Board of Health (2010), *Lægeprognose for udbuddet af læger i perioden 2010-2030 [Forecast of physician supply, 2010-2030]*, Copenhagen, http://www.sst.dk/publ/Publ2010/EFUA/Prognose/Laegeprognose2010-2030.pdf

Annex 8 Finland: Economy-Wide Workforce Planning

Background

Health workforce planning in Finland is conducted as part of an economy-wide workforce planning exercise.

Objectives

- Advise on the number of entrants in tertiary education and upper secondary vocational education and training to achieve a better balance between the supply of education/training and workforce demand
- Provide all young people (ages between 16 and 21) with an opportunity to apply for vocational/professional education and training.

Projection Method

Projection Period: 2008-2025 for workforce demand. Entrant targets for tertiary education are set for 2011-2016 based on workforce demand forecast.

Coverage: Whole economy

The Government Institute for Economic Research, under the Ministry of Finance, takes a lead responsibility in forecasting long-term workforce demand. The forecasts are produced within a general equilibrium macroeconomic model. This work is commissioned by four ministries: Ministry of Employment and the Economy, Ministry of Finance, Ministry of Education and Culture, Ministry of Social Affairs and Health. The main driver of the demand model is GDP growth, with assessment of the trend in each sector and occupation.

Within the general equilibrium model, the main drivers of health workforce demand are the health expenditure scenarios that come from EU projections or projections done by the Ministry of Social Affairs and Health. Both EU and the national projection models use data on current health expenditure and health service use by sex and age, demographic forecasts, as well as assumptions on health service productivity and GDP growth. The baseline scenario assumed an average GDP growth rate of 1.7% per year between 2008-2025, while a “target” scenario (more optimistic) assumed an average annual growth rate of 2.3% during this period (Ministry of Education and Culture, 2011). The model assumes that the more optimistic GDP growth scenario will be accompanied with health service reforms and improved productivity in health care, which would help reduce the demand for health workers compared to what it would otherwise be (Table 21).

Based on the estimated future demand, the National Board of Education, under the Ministry of Education and Culture, forecasts educational needs and proposes student entrance targets in different fields. Educational targets are set through consultation with a group of experts. The entire process of anticipating student intake needs is described in Hanhijoki et al. (2009).

Table 21. Number of employed people, natural wastage and job openings under different scenarios, 2008-2025

Occupational Groups	Number of employed people	Natural wastage	Basic scenario		Target scenario	
			Change	Job openings	Change	Job openings
	2007	2008-2025	2008-2025	2008-2025	2008-2025	2008-2025
Practical nurses	72 080	36 470	29 850	66 320	16 990	53 460
Nurses and other health care professionals	88 990	41 680	36 880	78 560	24 980	66 660
Medical doctors and other health professionals	24 950	11 830	7 130	18 950	5 050	16 880

Note: The target scenario assumes a high GDP growth rate than the basic scenario, but it also assumes health services reforms and greater productivity.
Source: Ministry of Education and Culture (2011) (p.73, Appendix 1)

Main Results

The results of the projection model in 2009 estimated that new entrants in tertiary education and upper secondary vocational education and training within the broad field of "social services, health and sports" should be increased by 7% between 2011-2016 compared to the number of students in 2009 to respond the expected increase in demand (Ministry of Education and Culture, 2012).

The analysis is further divided into different types of occupations within the field of "social services, health and sports", and the level of education (upper secondary vocational education and training, polytechnic education and university education) for each occupation.

Based on the projected demand, the number of student intakes in medical education programmes was expected to increase by 150 between 2009 and 2016, rising from 619 in 2009 to a target of 770 in 2016 (Ministry of Education and Culture, 2012). The graduation rate in medical education is estimated to be around 92% (i.e. there is a dropout rate of about 8%).

Regarding nursing education, the number of student intakes is expected to increase from 3300 in 2006 to 3900 in 2011 and up to a target of 4150 in 2016 (Ministry of Education and Culture, 2012). The graduation rate in nursing education is estimated to be around 78% (i.e. there is a dropout rate of about 22%).

References

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Annex 9 France: Demographic Projection of Physicians 2030

Background

The French Ministry of Health has developed a model to project the future supply of physicians, led by the Directorate for Research and Evaluation (DREES) and with the assistance from the Directorate of Hospitalization and Healthcare Organisation and the National Observatory of Health Professions (ONDPS).

Objectives

- To project the supply of physicians in the future and their characteristics (sex, age, speciality, region, mode and area of practice)
- To provide information on inflows and outflows of the medical workforce during the projection period
- To simulate various scenarios to examine the potential effects of policy changes

Projection Method

Projection Period: 2006-2030

Coverage: Physicians

Disaggregation: 23 medical specialties, by region, mode of practice (self-employed, hospital employee, non-hospital employee, and mix) and area of practice (urban area with a teaching hospital, urban area without a teaching hospital, urban periphery, and predominantly rural areas).

The supply-side analysis uses micro-simulation technique, taking into account different characteristics of physicians. It builds on careful examinations of their career paths (from entry to medical education to exit) (Table 22). Four modules exist to depict career paths: 1) entry to undergraduate medical studies to completing specialist training, 2) entry into the labour market, 3) changes in the region, mode and area of practice, and 4) exit patterns. The model reflects the current education systems and labour market participation patterns as much as possible. The baseline scenario is mainly based on the assumption that the behaviours of medical students and physicians will remain constant in the future, with alternative scenarios testing other assumptions.

The model uses a basic physician-to-population ratio on the demand side, based on population projection estimates from INSEE (2006).

Supply

Table 22. Supply variables and assumptions for projections

	Variables	Measurement Approach	Assumptions (Baseline Scenario)
Inflow	Education	Numerus clausus	7 100 in 2007 7 300 in 2008 7 600 in 2009 7 800 by 2010 8 000 between 2011 and 2020 Decrease by 100 per year between 2021 and 2030, to reach 7 000 in 2030
		Probability of "survival" through medical school education	Constant
		Ratio between the number of vacancy and the number of candidates who takes National Exam which determines ranking for specialist training	At 2007 level (0.953), constant
		Proportion of GP in total number of physicians in training	55%
	Entry to Labour Force	Percentage of medical graduates who do not go into medicine	3%, constant
		Percentage of graduates who enter the workforce during the year they graduated	Constant
	Immigration	Foreign students who enrolled in French medical schools	Constant
Stocks	Number of Health Workers	Head counts of practicing physicians (no attempt to do FTE conversion)	
Outflow	Exit	Retirement	Constant
		Death	
Mobility	Changes of region mode and area of practice	Probability of mobility (changes of region, mode and area of practice) depending on individual characteristics	Constant

Sources: Attal-Toubert, K. and M. Vanderschelden (2009a) (p.7, Figure 1).

Main Results

The baseline scenario, assuming a continuation of past trends in medical education and labour force participation patterns of physicians, indicates that the absolute number of physicians in France would not come back to its peak of 2007 before 2030. In terms of physician-to-population ratio, the ratio would not come back to its 2007 level before 2040 under the baseline scenario. However, after that, the impact of sustaining large numbers of entry into medical education between 2010 and 2030 would result in physician-to-population ratio that would far exceed the previous peak.

The projections vary across different specialties, with the reduction in the number of generalists per capita over the next two decades being less marked than for certain medical specialties. The model also shows large variations in the evolution of the physician-to-population ratio across different regions.

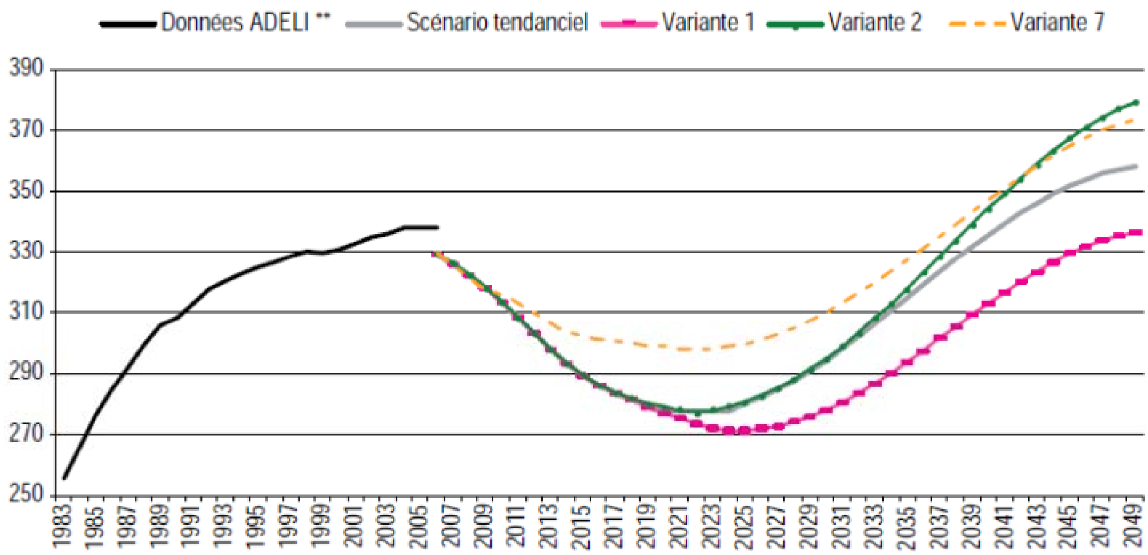
The micro-simulation model developed by DREES analysed the potential impact of 14 different scenarios (Attal-Toubert and Vanderschelden 2009). Three of these 14 scenarios are summarised and illustrated in Table 23 and Figure 7 below. The scenario that has the biggest impact in mitigating the projected reduction in the physician-to-population ratio over the coming two decades is the postponement of the age of retirement by two years (including a gradual phase-in).

Table 23. Alternative scenarios/assumptions around the future supply of physicians in France

Scenarios	Assumptions
Scenario 1	Lower numerus clausus than the baseline scenario: 7 100 in 2007, 7 300 in 2008, 7 300 in 2009, 7 100 in 2010 and 7 000 from 2011
Scenario 2	Higher numerus clausus after 2021 (maintained at 8 000 per year)
Scenario 7	Two-year postponement of retirement age (gradual phase-in; the probability of retiring is lagged by one year only between 2010 and 2015)

Source: Attal-Toubert, K. and M. Vanderschelden (2009b)

Figure 7. Physician density (per 100,000 population) in France, baseline scenario and scenarios 1, 2, and 7, 2007-2050



Source: Attal-Toubert, K. and M. Vanderschelden (2009b) (p.7, Figure 1)

References

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Annex 10 France: Demographic Projection of Nurses 2030

Background

The Directorate for Research and Evaluation (DREES) in the French Ministry of Health has developed a projection model for nurses (Barlet and Cavillon, 2011). The projection method shares some similarities with the physicians model also developed by DREES (Attal-Toubert and Vanderschelden, 2009).

Objectives

To project the supply of nurses in the future and their characteristics

- To provide information on inflows and outflows of nurses during the projection period
- To test the impact of different policies on the future supply of nurses

Projection Method

***Projection Period*: 2006-2030**

Coverage: Nurses who reside and practice in France

Disaggregation: By region and mode of practice (independent, employed by public or private hospitals, employed by retirement homes, or employed by non-hospital establishment).

A micro-simulation model was used to consider the graduate transition patterns and the geographic and professional mobility of nurses, building on the results of a previous study that showed differential patterns in education and career paths of practice (Barlet and Cavillon 2010). It does not take into account foreign nurses entering the French labour market. The model uses a basic nurse-to-population ratio approach on the demand side, based on population projection estimates obtained from INSEE. The model provides an assessment of the future supply and demand for nurses at both the national and regional level.

Table 24. Supply variables and assumptions for projections

	Variables	Measurement Approach	Assumptions (Baseline Scenario)
Inflow	Education	Training capacity/student intake	2010 level, constant
		Regional distribution of training quota	Constant
		Gap between the number of graduates and the quota for each region	Average level of 2006-2008, constant
	Entry to Labour Force	Nurse graduates who never enter to labour force	2%, constant
		Timing of entry to labour market	Constant, 99% of those entering will enter in the same year of graduation, 1% in the following year
Stocks	Number of nurses	Head counts (no attempt to do FTE conversion)	
Outflow	Exit	Exit rate for nurses were measured separately for three groups of nurses	• Independent nurses: constant at the level of 2005-2008 • Nurses employed in public or private hospitals: constant at 2007-2008 • Nurses employed outside hospitals: Same exit rate as nurses employed in private hospitals
Mobility	Mid-career changes	Proportion of nurses changing region or mode of practice	Constant at the average of the last years observed (2005-2009)

Source : Barlet and Cavillon (2011)

Main Results

The baseline scenario is based on the assumption of constant behaviours of nurses and government policies over the entire projection period. It projects that there would be a continuous increase in the number of nurses, from 480 200 nurses in 2006 to 657 800 in 2030. The projection model also explores a wide range of alternative scenarios; two of the main scenarios are presented in Table 25.

These two scenarios focus mainly (in the first scenario looking at the impact of the 2010 reform of the employment status of nurses) or only (in the second scenario looking at the 2010 retirement reform) at the impact of a postponement in retirement age. The impact of the 2010 reform of the employment of nurses (which increases the age at which public hospital nurses may be able to draw on their pension benefits from 55 to 60 for all newly-trained nurses and leave a choice for currently working nurses to either remain on the "old" contract or move to the new contract which includes a pay raise in exchange for working longer) would be to increase the number of public hospital nurses by 7.3% by 2030 (the impact on other nurses working in other settings would be much more limited). The impact of the 2010 retirement reform (which increases the minimum legal age of retirement from 60 to 62 by 2018) would be to increase the supply of nurses in public hospitals and in all settings by 3.5% by 2030.

Table 25: Number of professionally active nurses according to different scenarios, 2006-2030, France

		Self-employed	Public hospitals	Private hospitals	LTC	Other	Total
Scenario: employment status reform	**2006**	57 800	237 200	66 000	19 200	100 000	480 200
	2030	117 000	361 400	107 000	27 200	71 500	684 100
	Baseline, 2030	116 100	336 800	106 800	27 000	71 100	657 800
	Difference, 2030	0.8%	7.3%	0.2%	0.7%	0.6%	4.0%
Scenario: Retirement Reform	**2006**	57 800	237 200	66 000	19 200	100 000	80 200
	2030	121 900	348 700	108 900	27 800	73 600	681 000
	Baseline, 2030	116 100	336 800	106 800	27 000	71 100	657 800
	Difference, 2030	5.0%	3.5%	2.0%	3.0%	3.5%	3.5%

Source : Barlet and Cavillon (2011)

References

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Barlet, M. and M. Cavillon (2011b), "Projection of the supply of nurses in France: a microsimulation model", paper presented at the *3rd General Conference of the International Microsimulation Association*, Stockholm, 8th-11th June, http://www.scb.se/Grupp/Produkter_Tjanster/Kurser/_Dokument/IMA/Cavillon_Paper_IMA_2011.pdf

Annex 11 Germany: Forecasting Nursing Professions

Background

Projections of the future supply and demand for different nursing professions in Germany were conducted in 2010 under the German Federal Statistical Office and the QuBe project, in cooperation with the Federal Institute for Vocational Education and Training (BIBB) and the Federal Institute for Labour Market and Occupational Research (IAB). The objective of the QuBe project is to simulate complex interrelations and effects of political decisions and social measures on the national education system and the labour market. In addition to the analysis and results described below, occupational mobility was measured for the occupational field 'health care professions without license to practice medicine' and assigned to the nursing professions and its effects were assessed.

Objective

- Identify possible actions to effectively tackle projected changes in demand for nursing professions

Projection Method

Projection Period: 2005-2025

Coverage: Nurses and midwives (qualified nurses) and auxiliary nurses, geriatric nurses and auxiliary geriatric nurses (nurse aids) working in hospitals, patients' home or (semi-) stationary nursing homes.

The supply side of the model takes carefully into account the occupational mobility of nurses (differences between initial qualifications and current posts) and different working patterns between regions (Table 26). The demand side builds on two earlier studies by the Federal Statistical Office on the expected number of hospital cases and the number of persons needing long-term care in different settings (German Federal Statistical Office 2010).

Main Data Sources: Microcensus 2005 (Labour force survey), Health Personnel Accounting, population projection by the Federal Statistical Office, and the projection of hospital and long-term nursing cares by the German Federal Statistical Office and the Federal Regional Statistical Offices.

Supply

Table 26. Supply variables and assumptions for projections

	Variables	Measurement Approach	Assumptions (Baseline Scenario)
Inflow	Education	Those with highest formal vocational qualification in nursing and semi-skilled workers with different vocational backgrounds	Projected upwards based on past education trends and future demographic development. Assumes an increase in the highest qualification attainment that will slow down over the projection period
Stocks	Number of Health Workers	Head count	
	Working Time	FTE calculation	Constant at the current level of • Whole Germany • West Germany • East Germany
Outflow	Exit	Measured by participation rates	
Mobility	Mid-career changes	Comparison between initial vocational training and current posts	Constant

Source: Afentakis and Maier (2010)

Demand

Table 27. Demand variables and assumptions for projections

Variables	Measurement Approach	Assumptions (Baseline Scenario)
Population	Population projection by age and sex	Central scenario
Utilisation/Need	Probability of being hospitalised and number of people needing nursing care in other settings depending on age and sex	Constant age-sex specific rates of hospitalization or people needing care in other settings

Source: Afentakis and Maier (2010)

Main Results

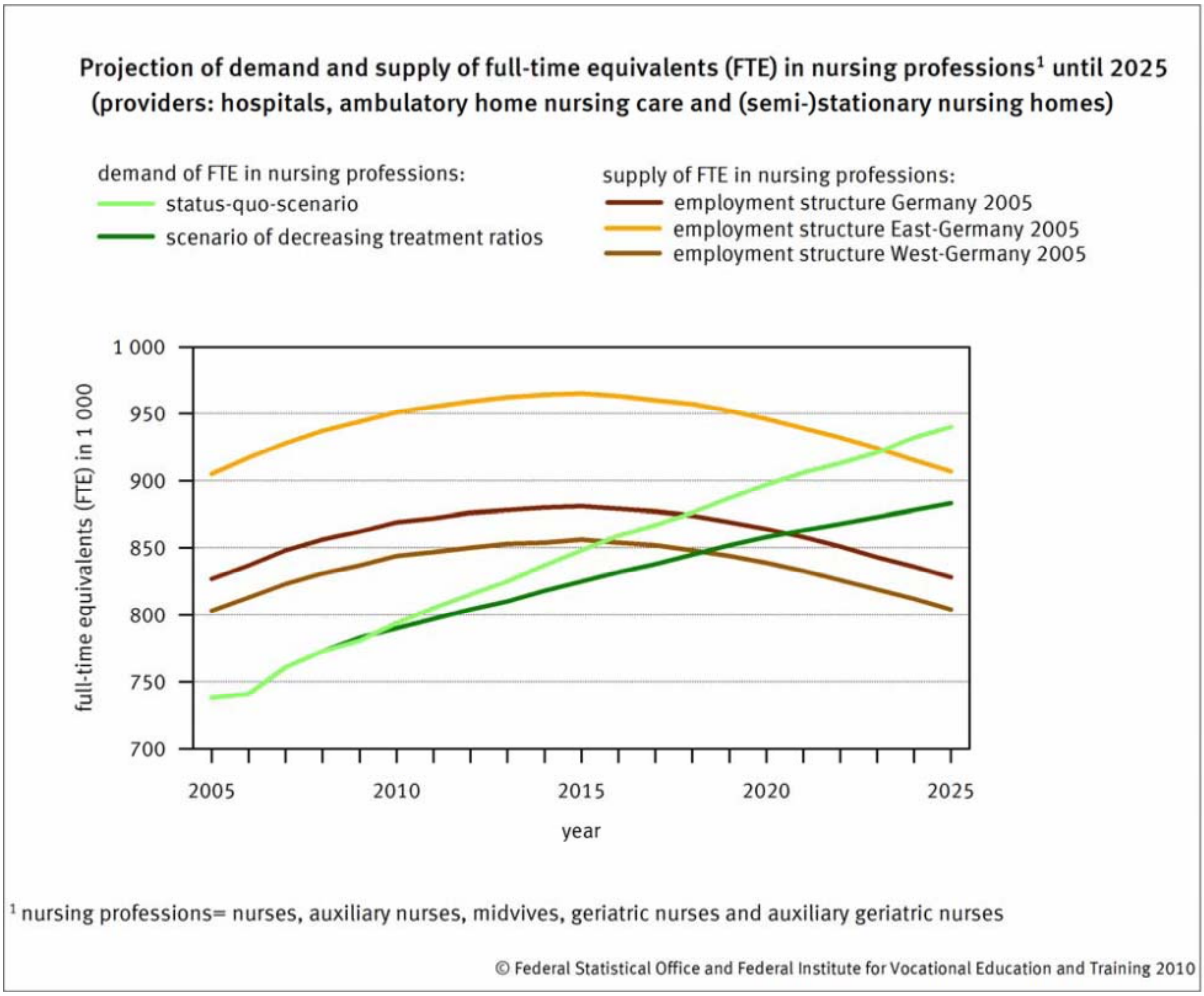
This model explored two main scenarios: (1) different evolutions in working patterns and (2) changes in demand (Table 28). Scenario 1 focuses on the differences in the current working patterns between nurses in West and East Germany (nurses in East Germany are more likely to work full-time, and even when they work part-time, they tend to work more hours than in West Germany). Scenario 2 considers an alternative scenario to the "status quo" regarding future demand, that is, a reduced demand (called "falling treatment scenario") where people remain healthy for a longer period as life expectancy increases. The results related scenarios 1 and 3 are shown in Figure 8 below.

Table 28. Alternative scenarios concerning the future supply and demand of nurses in Germany, 2005-2025

	Scenarios
Supply	Constant to the average across all Germany in 2005
	Work patterns are like the ones in West Germany in 2005
	Work patterns are like the ones in East Germany in 2005
Demand	Status-quo: constant age/sex specific hospital diagnoses rates
	Reduced demand: calculated by shifting the current age/sex specific hospital diagnosis or care probability into higher age groups

Source: Afentakis and Maier (2010)

Figure 8. Hypothetical gap between the supply and demand for nursing professions, based on different scenarios, Germany, 2005-2025



Source: Afentakis and Maier (2010) (p. 998, Figure 9)

References

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Annex 12 Germany: Planning Guideline for Ambulatory Care Physicians

Background

Staff planning for ambulatory care is conducted by the 17 Associations of Statutory Health Insurance Physicians (ASHIPs) and the state (*Länder)* associations of statutory health funds on the basis of the national guideline developed by the Joint Federal Committee. This guideline applies only to self-employed physicians and it determines the number of physicians who can be reimbursed by the statutory health insurance. The Federal Joint Committee is made up of representatives of statutory health insurance physicians, hospitals, statutory health insurance dentists, and two representatives of the conference of health ministers of the German *Länder*. Organisations that represent patients, chronically ill or disabled persons also have a right to participate in deliberations.

Objective

- Achieve sufficient number and proper distribution of physicians (general practitioners and specialists), dentists and psychotherapists across Germany and its 395 planning districts.

Projection Method

***Coverage*:** Ambulatory care physicians

Disaggregation: 14 medical specialists

The Federal Joint Committee is involved in health workforce planning only through controlling the number of additional practices that can be opened in each district. It does not have any further responsibility beyond this lever. The guideline is used to assess immediate needs. The Committee has no authority to close any existing practices, however.

The needs for doctors are determined primarily based on the physician-to-population ratio in the 395 planning districts. These districts are separated in three broad groups (urban, metropolitan areas and rural areas), with a further division into seven sub-groups on the basis of population density. The ratio of physicians to population in West Germany in 1990 is generally taken as the target level (though for certain specialties there may be exceptions).

For those planning districts where utilisation (as measured by statutory health insurance refund points) has been above the national average for four consecutive quarters, a demographic factor is taken into account in order to adjust the appropriate level of physician density. This demographic factor includes the demography of physicians (% over 65 years of age and % under 60), the demography of the population they serve (% under 65 and over 65), the utilisation of health services as measured in health insurance refund points for the population groups, and the comparison of all of these variables with the national average. The unit of measurement is headcount.

Reference

Federal Joint Committee (2012), *Planning guideline of the Federal Joint Committee,* Federal Ministry of Justice, http://www.g-ba.de/downloads/62-492-666/BPL-RL_2012-12-20_BAnz.pdf.

Annex 13 Ireland: A Quantitative Tool for Workforce Planning in Healthcare

Background

The Skills and Labour Market Research Unit of the Training & Employment Authority (Foras Áiseanna Saothair, FÁS) was asked by the Ministry of Health and Children in 2007 to develop and apply some quantitative models to project the future supply and demand for different categories health workers. The final report from the project was released in June 2009.

Objectives

- To develop quantitative model which can be used by government as a tool to assess different policy scenarios for health workforce planning.
- To apply the model to assess the balance between the expected future supply and demand for different categories of health workers under various scenarios.

Projection Method

Projection Period: 2008-2020

Coverage: 26 health occupations, covering both the public and private sectors

Disaggregation: The 26 health occupations included 9 medical specialties and GPs, physiotherapists, psychologists, 6 categories of nurses and midwives, health care assistants and other occupations

The projection models used, to the extent possible, a common set of variables and assumptions for all the 26 occupations covered, although there was flexibility in how these were applied for each occupation (depending on data availability and the relevancy of different variables and assumptions) (Table 29). The assessment of future supply and demand was conducted independently for each occupation. Hence, the model did not include any interaction between occupational groups (e.g. to explore possible complementarity/substitution).

On the supply side, particular attention was paid to gender composition in each occupation and differential labour force participation behaviours, if the data was available. The demand side of the model only took into account population growth in the baseline scenarios (the model used the scenario which only considers the natural increase in population, with zero net migration).

Main Data Sources: National Skills Database (SLMRU), Health Service Personnel Census (Health Service Executive, HSE), Survey of private hospitals and clinics, Survey of independent voluntary agencies providing services to people with disabilities and employ nurses directly, Survey of Catholic Voluntary Nursing Homes.

Supply

Table 29. Supply variables and assumptions for projections

	Variables	Measurement Approach	Assumptions
Inflow	Education	Enrolments	Assumed that medical student enrolment would be increased from 305 to 725 by 2010. Due to budget cut decision, nursing school enrolment is reduced from 1 880 in 2008 to 1 570 in 2009, and it is assumed that the reduction in nursing school enrolment would be maintained to this lower level throughout the projection period
		Attrition during education	
		Graduation rates	
		Transitional loss from graduation to the health labour market	
	Immigration	Annual inflow	0 (self-sufficiency)
Stocks	Number of Health Workers	Head count	
	Working Time	FTE: calculated for each occupation if data on working hours is available. If no data on working hours is available, part-time workers are counted as half of full-time workers	Constant over the projection period
Outflow	Exit	Exit rates from different occupations for different reasons (occupational change, retirement, etc.), based on available data and estimations	"Replacement demand"(assuming constant behaviours in different occupations over the projection period)

Main Results

The model assumed that all occupations were in balance in 2008 (there was no shortage or surplus), so the estimated gap (or imbalance) by 2020 is due either to a projected faster growth in demand than supply (in the case of shortages) or faster growth in supply than demand (in the case of surplus or oversupply).

Table 30 shows the main results of the assessment of the potential future gaps for all occupational groups according to the baseline scenario, as well as the alternative scenario for the 9 medical specialist groups based on the National Taskforce Targets for consultants.

Table 30: Assessment of gap between the future supply and demand for different health occupations in Ireland, under a baseline scenario and an alternative scenario for medical specialists, 2008-2020

		Baseline scenario (Population Growth only)		Alternative Scenario (National Taskforce Targets for consultants)	
	Occupation	Density per 100,000 (2008)	Assessment of gap, 2009-2020	Density per 100,000(2020)	Assessment of gap, 2009-2020
Consultant	Medicine (internal)	15	Oversupply	23	Shortage
	Obstetrics and Gynaecology	3	Oversupply	5	Shortage
	Paediatrics	3	Oversupply	5	Oversupply
	Pathology	5	Oversupply	7	Oversupply
	Surgery	11	Oversupply	16	Shortage
	Anaesthesia	8	Oversupply	11	Shortage
	Radiology	5	Oversupply	7	Shortage
	Emergency Medicine	1	Oversupply	2	Oversupply
	Psychiatry	10	Oversupply	15	Shortage
	General Practitioners	58	Shortage		
	Speech and language therapists	119	Oversupply		
	Physiotherapists	51	Oversupply		
	Specialists in public health medicine	1.5	Shortage		
Nurses and Midwives	Nurses & Midwives	1 265	Shortage		
	General	943	Shortage		
	Children's	38	Oversupply		
	Psychiatric	156	Oversupply		
	Intellectual disability	40	Oversupply		
	Midwives	38	Oversupply		
	Public health nurses	50	Oversupply		
	Clinical psychologists	19	Balance		
	Home helps	468	Balance[1]		
	Health care assistants	609	Balance[1]		
	Social care workers	182	Oversupply		
	Medical physicists	4	Oversupply		
	Radiation Specialists	4	Oversupply		

1 Assume unlimited supply due to no mandatory qualification requirement
Source: FÁS Skills and Labour Market Research Unit (2009) (p.14, Table 1.1)

Reference

FÁS Skills and Labour Market Research Unit (2009), *A quantitative tool for workforce planning in healthcare: example simulations,* FÁS, Dublin http://www.fas.ie/NR/rdonlyres/9ABC5EE1-CF20-4AA5-ACA4-C5B81DD9FE5E/792/SLMRU_FAS_EGFSN_Final_Version_Report_AQuantitative.pdf.

Annex 14 Israel: Planning Committee for Medical and Nursing Personnel

Background

In 2009, the Director General of the Ministry of Health appointed an internal committee to examine the health workforce situation, particularly medical and nursing personnel, to identify any current or future shortages and possible ways to fill the gaps.

Objectives

- Identify current and future shortages of physicians and nurses
- Provide policy recommendations to address any shortages

Projection Method

***Projection Period*: 2009-2025**

Coverage: Physicians and nurses

Disaggregation: 54 specialists

The supply side of the model is based on a stock-flow approach, using data from the education systems, labour market trends, as well as experts' opinions (Table 31). The model assumes that a significant part of the inflow of new physicians will continue to come from immigration (assuming a constant number of annual inflow of immigrant doctors over the projection period), although the relative importance of this source of inflow is projected to diminish as the number of graduates from domestic medical schools is expected to increase. For nurses, the model assumes zero immigration, as the current number of foreign-trained nurses migrating to Israel is very low.

The demand side of the model is driven solely by population growth, with the main measure being physician-to-population ratio and nurse-to-population ratio.

Main Data Sources: Personnel surveys (Central Bureau of Statistics), Files of License Holders (Ministry of Health)

Table 31: Supply variables and assumptions for baseline scenario

	Variables	Measurement Approach	Assumptions (Baseline Scenario)
Inflow	Education	Physicians: Medical graduates from 4 medical schools	393 between 2009-12; 460 between 2013-15; 510 from 2016 onwards
		Nurses: New licensure	approx. 1 000 per year between 2009-14; 1 700 from 2015 onwards
	Immigration	Physicians: Number of licenses awarded to oversee graduates	Constant, average of last 4 years (285 physicians per year)
		Nurses: Number of immigrant nurses is insignificant	Constant, at 0%
Stocks	Number of Health Workers	Head count	
Outflow	Exit	Physicians: • Working up to age 65 • 5-6% of physicians of working age do not practice • Annual 0.2% loss due to death and emigration • Attrition 0%: Early retirement and working beyond retirement age cancel out each other	Constant
		Nurses: • Working up to age 60 • Annual 0.2% loss due to death and emigration	Constant

Main Results

Regarding physicians, under the baseline scenario (which assumes some increase in the number of medical graduates, stable immigration and unchanged patterns of exits), the projection shows that the physicians-to-population ratio in Israel would significantly decline between 2008 and 2025 (from 3.46 physicians per 1,000 population in 2008 to 2.60 in 2025) because the inflow of new physicians will not be sufficient to replace those who are expected to retire and to keep up with population growth.

For nurses also, the projection shows that the expected increase in the number of new graduates and new licensed nurses starting in 2015 would not be sufficient to maintain the nurses-to-population ratio by 2025. The number of nurses per 1 000 population would slightly decline from 5.51 in 2009 to 5.07 in 2025.

All the alternative scenarios explored in the projection work were based on different assumptions concerning the domestic training capacity. According to the scenario were the number of medical graduates would increase further to reach 950 per year by 2023, the physicians-to-population would still decline between 2008 and by 2025, but the reduction would be smaller (there would be 2.91 physicians per 1 000 population in 2025 instead of 2.60 under the baseline scenario). If the training capacity for nurses was further increased to reach 3,000 newly licensed nurses per year by 2019, the ratio of nurses to population would no longer decrease by 2025, but rather increase to 6.46 per 1 000 population.

Table 32: Alternative scenarios concerning the increase in the number of medical graduates

Scenarios	Description
Scenario A	Same as baseline scenario until 2014; **510** in 2015; **555** in 2016 and 2017; **600** from 2018 onwards
Scenario B	Same as baseline scenario until 2014; **510** in 2015; **605** in 2016; **650** in 2017; **700** from 2018 onwards
Scenario C	Same as baseline scenario until 2014; **510** in 2015; **605** in 2016 and 2017; **700** between 2018 and 2019; **800** in 2020 and 2021; **900** in 2022; **950** from 2023 onwards

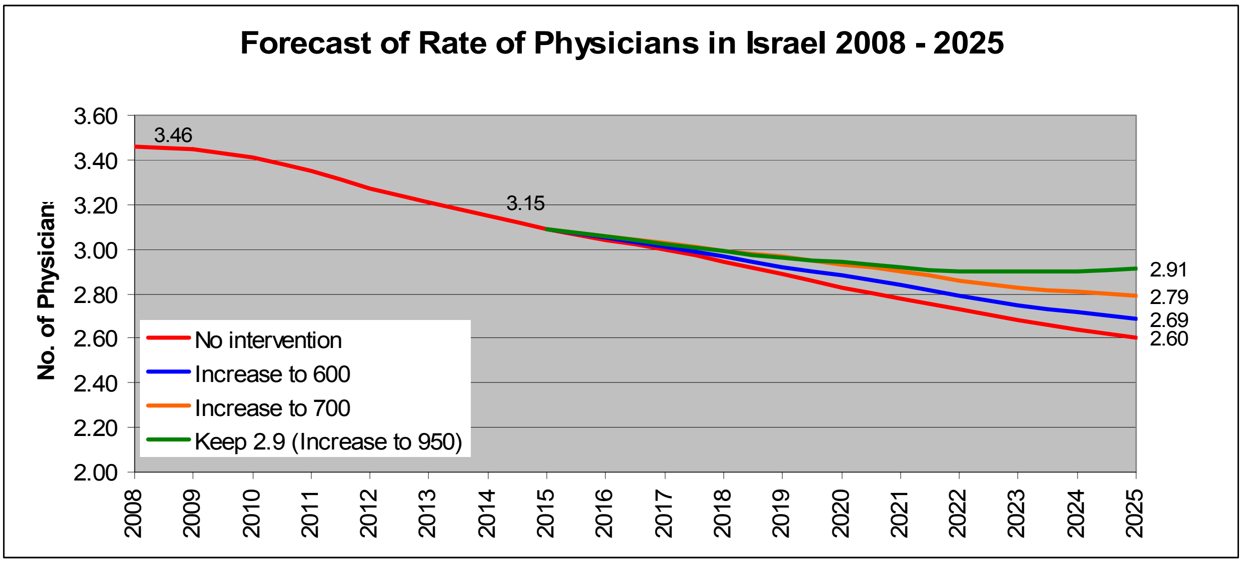
Source: Ministry of Health (2010)

Table 33. Alternative scenarios concerning the increase in the number of newly-licensed nurses

Scenarios	Description
Scenario A	Same as baseline scenario until 2014; **2 100** in 2015; **2 300** from 2016 onwards
Scenario B	Same as baseline scenario until 2014; **2 300** in 2015; **2 600** in 2016; **2 800** in 2017; **2 900** in 2018; **3 000** from 2019 onwards

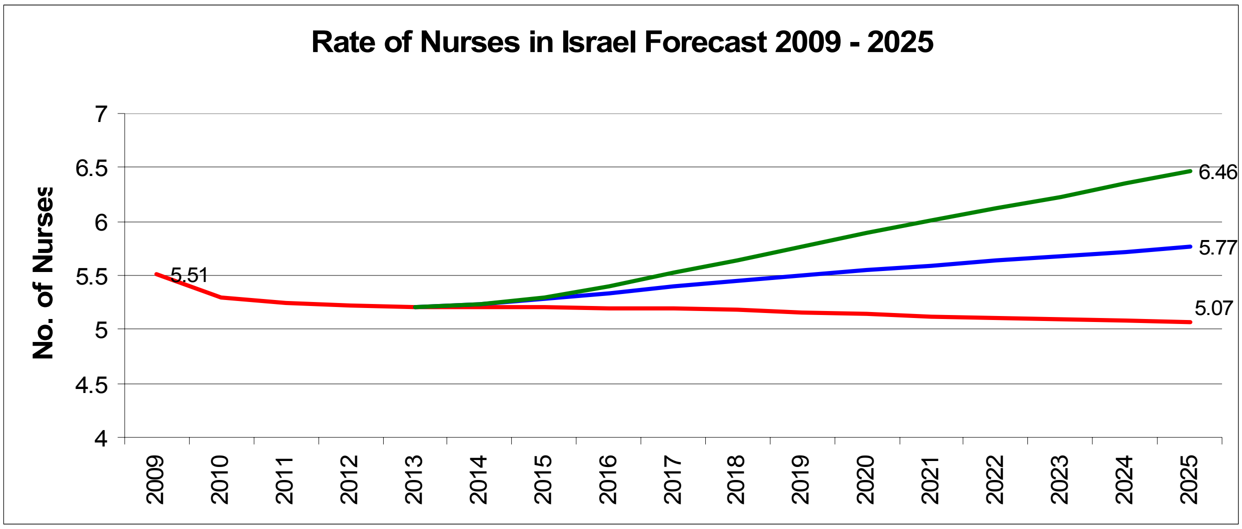
Source: Ministry of Health (2010)

Figure 9: Forecast of ratio of physicians per 1 000 population according to different scenarios on graduation rates from domestic medical schools, Israel, 2008-2025



Source: Ministry of Health (2010) (p.29, Graph 7).

Figure 10: Forecast of the rate of nurses per 1 000 population according to different scenarios on graduation rates from domestic nursing schools, Israel, 2009-2025



Source: Ministry of Health (2010) (p.40, Graph 14).

Reference

Ministry of Health (2010), *Report of the Planning Committee for Medical and Nursing Personnel in Israel*, Jerusalem, http://www.health.gov.il/PublicationsFiles/mp_june2010.pdf.

Annex 15 Italy: Allocation of Specialists Training between Regions

Background

The responsibility for health workforce planning in Italy is primarily at the regional level. The Unit for health professions and human resources in the National Health Services within the Ministry of Health brings together the data and forecasts developed at the regional level, and analyses and validates the results to make appropriate recommendations to the Ministry of Education concerning entry in medical, nursing and other health-related education programmes.

Health workforce planning and projections are done in each region, and the models and approaches can vary. However, a national regulation states that health workforce planning should consider a number of factors, including the objectives and essential level of care indicated by the Health National Plan, and service delivery models.

Objectives

- Ensure a suitable number of healthcare professionals to satisfy the demand and avoid workforce imbalances in the National Health Services
- Assess future needs so that the Ministry of Health and the regions can agree on the number of students to enter related education and training programmes.

Projection Method

Projection Period**:** Varies by region

Coverage: 22 recognised health professions

Disaggregation*:* 55 medical specialties

The Ministry of Health conducts independent assessment on medical specialization, considering factors such as demography, morbidity and service delivery models and determine the allocation of contracts to postgraduates' schools for each medical specialty. The total number of contracts that can be awarded is set at the national level taking into account budgetary constraints. This is usually lower than the total number of new specialist training places requested by the regions.

The number of contracts awarded for each specialty is calculated using the following successive steps:

1. Determine turnover rate of different NHS specialists
2. Identify specialties with shortage by considering the determined turnover rate from (1) and the number of contracts awarded for a given academic year
3. A number of contracts equal to the turnover from NHS would be attributed to specialties in (2)
4. If contracts in (3) exceed the number of contracts assigned the previous year by more than 25%, the number of contracts is capped at a 25% increase
5. For the other specialties (not mentioned in the previous points), the number of contracts will be equal to the number of contracts in the previous year less a proportional reduction based on the new weights in the total number of planned contracts
6. Contracts in (5) should not be less than the NHS turnover. Otherwise the turnover rate is attributed to the specialty
7. Contracts may be further decreased in order to meet the total number of planned contracts

8. Emergency medicine and radiotherapy are excluded from the algorithm and the number of new contracts for those specialties remain the same as the previous year

The number of contracts calculated using the above-mentioned algorithm is further refined by taking into account the situation of each graduate school and future evolution of the health system.

Reference

Ministry of Health (2010), Metodologia di ripartizione del numero di contratti per le specializzazione mediche anno accademico [Methodology for allocating the number of contracts for specialised medical academic year 2010/2011], Rome.

Annex 16 Japan: Assessing Future Demand for Health Workers

Background

The National Commission on Social Security was established in 2008 to develop a future vision of the appropriate modalities of social security systems (including issues related to employment, pension, health care, long-term care, welfare services, child care and work-life balance) and the role of government in addressing these issues. One of the three sub-committees of the Commission dealt with service provision, mainly in health, long-term care and other welfare services. This sub-committee outlined some proposals about the re-organisation of health and long-term care (LTC) services and the necessary resources (financial and human resources) to do so. With respect to health workforce projections, the Committee focussed its work on future demand, although an assessment of future supply had been done previously by the Ministry of Health, Labour and Welfare (MHLW, see Annex 1.17 and 1.18).

Objective

Provide a future vision of the service delivery for health care, long-term care and other welfare services and estimate the size of the financial and human resources to do so.

Projection Method

Projection Period: 2007- 2025

Coverage: Physicians, nurses, long-term care workers, other health and LTC workers (in both the private and public sectors)

Experts involved in the sub-committee of the NCSS began by developing a future vision of health care and LTC services. They proposed that service provision might change to: 1) concentrate more resources in acute care to promote quick recovery and early discharge, 2) achieve gains in efficiency by matching better specialised services to patients needs, 3) improved services in community-setting or home care, 4) shift outpatient services from hospitals to private practice physicians' offices, and 5) strengthen GP services at community level.

Once this framework for future orientations of service provision was established, the future demand of health services and allocation of patients in different settings of care were determined. The new configuration of distribution of health services allows the estimation of future resource needs, including health workforce. The need is calculated based on the staffing level per beds in hospitals, the number of outpatient visits, and care needs in community or home care.

Main Results

In addition to a baseline scenario (which assumed that the demand for health services would be solely driven by changes in the population structure), the sub-committee developed 3 scenarios that differ by the "aggressiveness" of the reform. The direction of the service delivery reform is the same under all three scenarios, but the speed and intensity of the reform are different (with the third one being the most "aggressive"). For instance, the reconfiguration of services under the first alternative scenario would require a 58% increase of health workers in acute care (scenario B1), while such increase would be 100% under the second scenario (scenario B2) and 116% under the third scenario (scenario B3). Table 34 presents the results of these alternative scenarios compared with the baseline scenario (A1).

The main purpose of the projection exercise was to assess the consequences of these reforms on government expenditure and the need to raise additional revenues (tax reform). The expenditure/tax impact assessment of the four scenarios was conducted based on four different sets of economic assumptions.

A secondary purpose of the projection exercise was to assess the workforce demand related to different reforms in health care and LTC service provision. Under the baseline scenario (where the demand for health services and health workers would only be affected by changes in the size and age structure of the population), there would be a substantial increase in the demand for all categories of health and LTC workers driven by population ageing. If the reform proposed under the B1 scenario was adopted, the need for physicians would be slightly lower (4%) than under the baseline scenario, but this would be compensated by a much bigger increase in the demand for other health professions (15%). If the most “aggressive” reform package were to be adopted, the demand for physicians would be almost equivalent than under the baseline scenario, but the demand for all other categories of health and LTC workers would be even greater (23%) so the cost of implementing these reforms would be higher because of greater service provision.

Table 34: Health workforce projections according to different assumptions in service delivery reform, Japan, 2007-2025

	Current (2007)	2025			
		A1 (status quo)	B1	B2	B3
Physicians	275 000	329-343 000	317-331 000	321-335 000	327-341 000
Nurses	1,322 000	1 696-1 767 000	1 791-1 872 000	1 947-2 029 000	1 980-2 064 000
Care workers	1,172 000	2 117 000	2 501 000	2 552 000	2 552 000
Other health workers[1]	781 000	834-876 000	945-991 000	1 081-1 135 000	1 096-1 151 000
Other LTC workers[2]	300 000	535 000	718 000	736 000	736 000
Total	3 850 000	5 511-5 638 000	6 278-6 413 000	6 637-6 787 000	6 691-6 844 000

[1] Includes pharmacists, occupational and physical therapists, nurse assistants and other administrative staffs

[2] Includes care managers, occupational and physical therapists in LTC care

Source: National Commission on Social Security (2008) (slide 29).

Reference

National Commission on Social Security (2008), *Final report from subcommittee on Health, Long-term Care and Social Services*, Cabinet Office, Government of Japan, Tokyo http://www.kantei.go.jp/jp/singi/syakaihosyoukokuminkaigi/iryou/siryou_1.pdf.

Annex 17 Japan: Physicians Demand/Supply Model

Background

The Ministry of Health, Labour and Welfare has established several committees to assess the future demand and supply of physicians since the 1970s, although these assessments have not been done at regular intervals. The latest assessment was conducted in 2006, led by Professor Toshihiko Hasegawa.

Objective

- Assess the future supply and demand of physicians under different scenarios

Projection Method

Projection Period: 2005-2040

Coverage: Physicians

Disaggregation: Hospital-based services and services provided by private practice physicians

Two separate projection models for both supply and demand were produced: one for hospital-based services and another for services provided by (mostly) private practice physicians. This reflects the ways health services are organised in Japan as well as career transitions for many physicians. The majority of physicians enter the labour market by gaining experience first in hospitals. In mid-career, a substantial proportion of physicians moves to private practice. The patterns of transition from hospitals to private practice are important determinants of the distribution of services, and these have been taken into account in the supply projection.

The supply model is a standard stock-flow model, which takes advantage of Japan's relatively rich set of data sources on physicians (Table 35). Using results from various surveys as well as information contained in the registry of licensed physicians, the model calculated age/sex specific participation rates between 1998-2004. It took into account inflow from the education system (assuming that all students entering medical schools will enter the labour market six years later). Immigration was not considered as a meaningful inflow, since the number of foreign-educated physicians passing the Japanese physicians' licensure exam is almost zero. While a conversion from headcounts to FTE was not used in the baseline scenario (given the fact that most physicians in Japan work very long hours), the model used data on the number of working hours to determine the effect of limiting working hours to 48 hours per week in one of the scenarios.

The demand model used utilisation rates by age and sex for both inpatient services and outpatient services (Table 36). Past trends in utilisation rates by age and sex were used to assess future demand based on three different assumptions: 1) constant at 2002 level, 2) a linear projection of past trends between 1984-2002, and 3) a linear projection of past trends, but limiting the changes to no more than a 30% increase over the projection period. In addition to the number of hospital discharges and physician visits, the model also considered the "severity" of cases (and intensity of services) for discharges and visits. Assuming that health care cost reflects the severity of cases and intensity of services provided, age-specific indicators of service intensity were estimated.

Main Data Sources: Survey of Physicians, Dentists and Pharmacists, Hospital Report and Survey of Medical Institutions, School Basic Survey (MEXT)

Supply

Table 35. Supply variables and assumptions for projections

	Variables	Measurement Approach	Baseline scenario assumptions
Inflow	Education	Entry to medical schools	Assuming 100% graduates and entrance in labour market six years later Constant at 7700 (2006 level). Percentage of female entry in the baseline scenario: fixed at current proportion
Stocks	Number of Health Workers	Head counts of all registered physicians	
	Working Time	Average working hours of physicians by age, sex, and location of practice (hospital vs. private practice)	Constant
Outflow	Exit rates	Survey/registration data for 1998-2004.	Constant, based on data for 1998-2004 by age/sex
Mobility	Transition from hospital to private practice	Rate of transition from hospital to private clinics using datasets combining physicians registration data and survey data	Constant

Source: Hasegawa (2006)

Demand

Table 36. Demand variables and assumptions for projections

Variables	Measurement Approach	Assumptions (Baseline Scenario)
Population	Population by age and sex	Population Projection, National Institute of Population and Social Security Research
Utilisation	Hospital-based: Measured by the number of discharges. Age-specific rates from 1984-2002, projected forward until 2040. Out-patient: Measured by number of consultation with physicians.	Used three distinct projection approaches for utilisation rates by age: • Status quo at 2002 level • Based on trend from 1984-2002, • Based on trend from 1984-2002, but limited to no more than 30% increase
Severity of service demand	Severity of service demand was estimated by using average cost per discharge/visit for each age group	Constant

Source: Hasegawa (2006)

Main Results

Three main types of scenarios were explored in this model:

- **Number of student intake**: current level, 5%, 10% increase over the projection period
- **Working hours**: current working hours on average over 50 hours vs. 48 hours/week limit
- **Proportion of female students in medical school**: current proportion of approximately 33% (2006) vs. increase to 50% by 2050

Table 37 shows that a 5% increase in the number of medical students would increase the physicians-to-population ratio from 28.2 per 10 000 in 2010 to 35.0 in 2040. A 10% increase would increase it further obviously.

Table 38 shows that if the working hours of all physicians were to be capped at 48 hours per week, it is estimated that the demand for physicians would increase by 3.5%. For instance, the model estimated that the demand for physicians in 2010 would be 275 000 under the current working hours, but if the working hours were capped at 48 hours, the demand would increase to 284 000 physicians.

The results also indicated that, based on past trends in utilisation, the demand for hospital services might increase while the demand for services in private clinics might decline. This would further increase the shortage of physicians in hospitals, while there may be an over-supply of physicians in private practices.

Table 37. Main results of scenarios based on different assumptions of medical student intake, Japan, 2010-2040 (supply of professionally active physicians per 10,000 population)

Scenarios	2010	2015	2020	2025	2030	2035	2040
Medical school intake, constant	28.2	29.9	31.4	32.6	33.4	33.9	34.0
Medical school intake 5% increase	28.2	30.0	31.7	33.0	34.0	34.7	35.0
Medical school intake 10% increase	28.2	30.1	31.9	33.5	34.6	35.5	35.9

Source: Hasegawa (2006)

Table 38. Main results of scenarios based on different assumptions of demand, Japan, 2010-2040 (practicing physicians per 10,000 population)

Scenarios	2010	2015	2020	2025	2030	2035	2040
Limiting the changes in the utilisation rate within 30%, taking into account severity of cases	27.5	28.6	29.3	29.8	30.0	29.9	30.2
Limiting the changes in the utilisation rate within 30%, taking into account severity of cases, and limiting working hours to 48 hours per week	28.4	29.5	30.2	30.6	30.8	30.7	31.1

Source: Hasegawa (2006)

Reference

Hasegawa, T. (2006), *Projections of Supply and Demand for Physicians*, Ministry of Health, Labour and Welfare, Tokyo, http://www.mhlw.go.jp/shingi/2006/07/dl/s0728-9c.pdf.

Annex 18 Japan: Nursing Supply and Demand

Background

Projections of the supply and demand for nursing professions (including midwives) have been conducted regularly by a committee formed at the prefectures level. The Ministry of Health, Labour and Welfare (MHLW) takes responsibility for bringing together regional estimates. Such analysis has been conducted since the 1970s, with the latest report released in 2010 report. The supply projection covers only a short period of 5 years.

Objectives

- To estimate the future supply and demand for nursing professions over the next 5 years

Projection Method

Projection Period: 2011-2015

Coverage: Nurses and midwives

Disaggregation: By type of provision: hospitals, private practices, LTC services

The supply projection is based on a stock-flow model. Using a national standard questionnaire, the assessment is conducted in each prefecture taking into account their specific conditions. The prefectures were asked by the MHLW to include in their model at least four key variables: new entry to labour market, the flow of nurses returning to the labour market, the current stocks of nurses, and the number of nurses leaving their occupation. The results of the supply projection over 5 years are determined by the number of entrants and re-entrants and the effectiveness of policy initiatives in each jurisdiction to retain nurses (Table 39).

The demand for nurses is based on a questionnaire sent out to medical institutions seeking their views on the future requirement of nursing staff, given the expected changes in nursing care and in their working conditions. Both the demand and supply assessment is done on a FTE basis.

Supply

Table 39. Supply variables and measurement approach

	Variables	Measurement Approach
Inflow	Education	Number of new graduates entering to labour force at the beginning of the year
	Return	Number of nurses who return to the workforce
Stocks	Number of health workers	Head count of nursing staff at the beginning of the year
	Working Time	FTE
Outflow	Exit	Number of leavers including retirement

Source: Expert Panel on Projection of Supply and Demand for Nurses (2010), Ministry of Health, Labour and Welfare.

Main Results

The main results from the projections indicate that the demand for nurses may grow by about 7% between 2011 and 2015, while the supply is expected to grow by about 10% (Table 40). This would narrow the gap between supply and demand, from 4% in 2011 to 1% in 2015.

Table 40: Expected supply and demand of nursing staffs, FTE

	2011	2012	2013	2014	2015
Demand	1 404 300	1 430 900	1 454 800	1 477 700	1 500 900
Supply	1 348 300	1 379 400	1 412 400	1 448 300	1 486 000
Stock	1 320 500	1 348 300	1 379 400	1 412 400	1 448 300
New Entry	49 400	50 500	51 300	52 400	52 700
Return	123 000	126 400	129 600	133 400	137 100
Exit	144 600	145 900	147 900	149 900	152 100
Gap	-56 000	-51 500	-42 400	-29 500	-14 900

Source: Expert Panel on Projection of Supply and Demand for Nurses (2010), Ministry of Health, Labour and Welfare.

Reference

Expert Panel on Projection of Supply and Demand for Nurses (2010), *7th Projections of Supply and Demand for Nurses,* Ministry of Health, Labour and Welfare, Tokyo http://www.mhlw.go.jp/stf/houdou/2r9852000000z68f-img/2r9852000000z6df.pdf.

Annex 19 Korea: Future Prospects of Demand and Supply of Health Workforce

Background

The Korean Institute for Health & Social Affairs (KIHASA) has carried out projections of the future supply and demand for 15 health occupations over the period 2010 to 2025. KIHASA has a mandate to provide empirical and analytical support for short- and long-term policymaking in health and welfare and facilitate public understanding of policy issues. The health workforce projections were designed to improve national-level health workforce planning and training arrangements, specifically to adjust entrance quota in colleges.

Objectives

- To make supply and demand projections for 15 health workforce occupations
- To identify imbalances between supply and demand
- To develop possible options to reduce imbalances between supply and demand

Projection Method

Projection Period: 2010-2025

Coverage: 15 health occupations (physicians, oriental medical doctors, dentists, nurses, pharmacists, and other occupations)

The projection model has used a stock-flow model on the supply side, and a utilisation-based model on the demand side. The main supply-side variables include the annual numbers of college enrolees in each health occupation, graduates, and applicants/pass/fail examinees in the state examination, registered licensees and practicing health personnel (Table 41). On the demand side, the main variables are utilisation rate by age, gender, type of health insurance and type of health care institutions from the Health Insurance Review and Assessment Service, and future population estimates from the National Statistical Office (Table 42). The model also includes some measure of productivity (e.g. the number of patients per physician).

Main Data Sources: Registered licenses database from the National Health Personnel Licensing Examination Board and active and practicing health personnel database from each occupational group.

Supply

Table 41: Supply variables and assumptions for projections

	Variables	Measurement Approach	Assumptions
Inflow	Education	Number of entrants in domestic medical schools Graduation rates	Medical graduates: estimates based on current enrollment rates up to 2015 and held constant thereafter. Other health workforces: growth until 2012 and held constant onwards.
	Entry to Labour Market	Application rate to state exam	Average of last 3 years, constant
		Pass rate of state exam	Average of last 3 years, constant
	Immigration	International graduates	Application and pass rates of foreign-educated health workers are calculated separately from domestically trained health workers
Stocks	Number of Health Workers	Head count (the number of part time health workers is minimal in Korea, so FTE for each health workforce was not measured)	
Outflow	Mortality	Calculated separately for each health occupation	Mortality rates derived from National Statistics Office's data on mortality rates by age group
	Retirement Emigration		Excluding all workers over 70 years of age Constant, emigrants are taken as the average emigration rate of last 5 years

Source: Oh (2011)

Demand

Table 42: Demand variables and assumptions for projections

Variables	Measurement Approach	Assumptions (Baseline Scenario)
Population	Population by age and sex	Population projection by Korea Bureau of Statistics
Utilisation	For physicians, oriental medicine doctors, dentists, nurses: Outpatient visits and length of stay by age, type of insurance, type of facilities and type of care	Based on utilisation growth trend over the period 2003-2007, assuming steady growth rate (ARIMA model) and gradual slowdown in growth rate (logit model).

Source: Oh (2011)

Main Results

The supply and demand of different categories of health workers were assumed to be in "balance" in the reference year (2007). The model explored several scenarios. A range of scenarios around productivity growth test different arbitrary assumptions (120%, 110%, 100%, 90%, 80% of productivity in 2025 compared with 2007). The model also assesses the impact of two different scenarios concerning working days (255 and 265 days worked). It also considers two scenarios on utilisation rate (steady growth based on 2003-2007 trends and a slower growth rate). All demand projections take into account changes in utilisation due to changes in population structure (i.e. ageing).

Table 43: Demand and supply projection for physicians and registered nurses, 2025

		Physicians				Registered nurses			
		Demand scenario 1 (growth slowdown)		Demand scenario 2 (steady growth)		Demand scenario 1 (growth slowdown)		Demand scenario 2 (steady growth)	
		255 days	265 days	255 days	265 days	255 days	265 days	255 days	265 days
Supply									
	Licenses registered	153 092	153 092	153 092	153 092	488 665	488 665	488 665	488 665
	Available	122 947	122 947	122 947	122 947	391 479	391 479	391 479	391 479
	Active (A)	113 714	113 714	113 714	113 714	250 655	250 655	250 655	250 655
Demand (B)									
Productivity	1: 120% of 2007 level	100 253	96 470	125 213	120 488	233 336	224 531	262 896	252 975
	2: 110% of 2007 level	109 367	105 240	136 596	131 442	254 549	244 943	286 795	275 973
	3: 100% of 2007 level	120 303	115 763	150 256	144 586	280 004	269 437	315 475	303 570
	4: 90% of 2007 level	133 670	128 626	166 951	160 651	311 115	299 375	350 528	337 300
	5: 80% of 2007 level	150 379	144 704	187 820	180 733	350 004	336 797	394 344	379 463
Difference (A-B)									
Productivity	1: 120% of 2007 level	13 461	17 244	-11 500	-6 775	17 319	26 124	-12 241	-2 320
	2: 110% of 2007 level	4 347	8 474	-22 883	-17 728	-3 894	5 712	-36 141	-25 318
	3: 100% of 2007 level	-6 590	-2 050	-36 542	-30 872	-29 349	-18 783	-64 820	-52 915
	4: 90% of 2007 level	-19 957	-14 912	-53 238	-46 938	-60 460	-48 720	-99 873	-86 645
	5: 80% of 2007 level	-36 665	-30 991	-74 107	-67 019	-99 350	-86 142	-143 689	-128 808

Source: Oh (2011)

Reference

Oh, Y. (2011), *The Future Prospects of Demand and Supply of Health Workforce in Korea*, Korea Institute for Health and Social Affairs, Seoul.

Annex 20 Netherlands: Medical Manpower Planning Model

Background

The Advisory Committee on Medical Manpower Planning (ACMMP, or Capaciteitsorgaan meaning Capacity Body) was established in 1999 to be an independent advisory body which focuses on determining the medical training capacity required in the Netherlands to meet the demand for care. The board of the ACMMP consists of three major stakeholders: health insurance companies, medical professions and universities/teaching institutes. The planning model used by the Advisory Committee builds on a model developed by NIVEL (the Netherlands Institute for Health Services Research; Van Greuningen et al., 2012). It is designed to assess any current gap between the supply and demand of different categories of doctors and the projected balance for the next 10 to 20 years, based on different scenarios.

Objectives

- Assess any current gap between the supply and demand of different categories of doctors
- Estimate the required yearly inflow in medical education and training programmes, based on the expected gap between supply and demand for the next 10 to 20 years

Projection Method

***Projection Period*: **2010-2028 (between 10 to 20 years)

***Coverage*:** Physicians, dentists, dental hygienists, clinical pharmacologists, clinical chemists and clinical physics

Disaggregation: 35 different medical specialists, 8 recognised semi-specialist occupations in the medical field, dentists, dental hygienists, and 3 technical professions in hospital (clinical pharmacologists, clinical chemists and clinical physics).

The model uses a macro approach. Based on empirical data and expert opinions, the planning model used by the ACMMP assesses how each factor influences the supply and demand for medical care now and in the future. The approach allows a relatively easy combination of various factors and possible assumptions for each variable.

On the supply side, the model includes a careful assessment of the inflow in various medical specialties based on past trends in graduation rates from medical education programmes and entry into the labour market and the projected outflow based on evidence about the length of physicians' career and retirement patterns (Table 44). On the demand side, the model includes several factors to estimate any current unmet demand/need and future changes over the projection period: demography, epidemiology, socio-cultural factors and current unmet needs. The Advisory Committee determines the potential impact that each factor might have on the demand for services for different medical specialties based on empirical data and expert opinions (Table 45).

Main Data Sources: Registration databases, surveys of health professionals, population projections (from the Central Bureau of Statistics)

Supply

Table 44. Supply variables and assumptions for projections

	Variables	Measurement Approach	Assumptions (Baseline Scenario)
Inflow	Education	Number of students entering medical education	"Adjustment variable" (number required to fill projected gap)
		Graduation rates: proportion of people who commence training and successfully complete in respective field of study	Based on past trends
	Labour market entry	Number of new GP registrations Number of specialists completing the training	Based on past trends
	Immigration	Number of physicians entering from other countries	Based on past trends and expert estimations for the future
Stocks	Number of Health Workers	Head counts	Calculated based on inflows minus outflows
	Working Time	FTE calculation	Based on past trends
Outflow	Exit	Percentage of specialists/GPs who will leave their profession in the next 5, 10, 15 and 20 years	Based on past trends (by age/sex) Example of projected exit rates for GPs: Next 5 years: 18.9% (M) 8.4% (F) Next 10 years: 38.2% and 19.2% Next 15 years: 54.6% and 31.3% Next 20 years: 67.9% and 44.3%

Source: ACMMP (2010)

Demand

Table 45: Demand variables and approach

Drivers	Approach
Demography	Population projections, including changes in population structure (based on the Central Office for Statistics projections)
Epidemiology	Expert estimations and empirical data (if available for instance from the National Institute for Public Health and Environment) on changes in disease incidence/prevalence and risk factors
Socio-cultural factor	Expert estimations and empirical data (if available) of under-use or unmet care needs for certain population groups (low socio-economic status or different racial/ethnic groups)
Unmet demand/need	Expert estimations and empirical data (if available) on self-reported unmet medical care needs, hard-to-fill vacancies, under-supply of physicians in rural areas
Horizontal or vertical substitution	Expert estimations and empirical data (if available)

Source: ACMMP (2010)

Main Results

The model is able to test several scenarios based on different assumptions related to the different factors mentioned above that might affect the supply and demand for different categories of doctors. The baseline scenario (basic variant) for the projection model of GPs considers only demographic factors for demand and the feminization of the workforce for supply. The main result of this baseline scenario is that there would to have an intake of about 500 medical students in General Practice per year between 2012 and 2025 to achieve balance in the number of GPs in the next 10 to 20 years. All the alternative scenarios (e.g. assuming an expansion of morbidity and greater service provision for certain socio-cultural groups to meet any unmet care needs) result in greater demand for GPs and therefore a need to train more new doctors to maintain balance in the future. The variants that are including some form of vertical substitutions (task shifting from GPs to physician assistants and nurse specialists) would reduce to a certain extent the demand for GPs and therefore the need to train more of them.

The model used by ACMMP also uses two approaches to calculate the needed inflow to medical schools and specialists training (Table 46). The first approach (called "segmented inflow") separates the projection period in two for the purpose of determining the number of medical intakes required to achieve balance in about 10 years and in 20 years: 2012-2019 and 2020-2025. The second approach (called "continuous inflow") assumes a constant intake of medical students through the projection period. The first approach results in recommendations to train a higher number of new doctors (GPs) in the earlier years (2012-2019) to achieve balance earlier, but it involves some projected reduction in training places in the following years (2020-2025) to avoid over-supply. The second approach involves, by definition, a more stable approach in setting the "numerus clausus".

Table 46: Estimated total number of GPs required per variant (scenarios) in 2022 and 2028, Netherlands

	Variant	**2010** (base year)		**2022**		**2028**	
		Number	**FTE**	**Number**	**FTE**	**Number**	**FTE**
1	**Basic variant** • Demography/feminization	10 371	7 353	12 008	7 937	12 557	8 133
2	**Low Variant Combination** • Socio-cultural/epidemiology added						
a	Trend stops in 2020			14 031	9 207	14 626	9 435
b	Trend continues until 2028			14 435	9 461	16 281	10 476
3	Low variant combination with vertical substitution						
a	Trend stops in 2020			13 151	8 655	13 726	8 868
b	Trend continues until 2028			13 350	8 780	14 483	9 344
4	High variant combination with vertical substitution						
a	Trend stops in 2020			14 051	9 229	14 647	9 448
b	Trend continues until 2028			14 343	9 403	15 604	10 049

Source: ACMMP (2010) (p.49, Table 14, P62 Annex 2)

Table 47. Required annual intake of medical students in General Practice between 2012-2022 to reach balance of GPs by 2028, Netherlands

	Variant	Segmented inflow			Continuous inflow
		2010	2012-2019	2020-2025	2012-2025
1	**Basic variant**	596	501	493	497
2	**Low variant combination**				
a	Trend stops in 2020		833	512	685
b	Trend continues until 2028		899	759	834
3	Low variant combination with vertical substitution				
a	Trend stops in 2020		689	503	603
b	Trend continues until 2028		721	614	672
4	High variant combination with vertical Substitution				
a	Trend stops in 2020		836	512	686
b	Trend continues until 2028		884	643	773

ACMMP (2010). Capaciteitsplan 2010. Deelrapport 2: Huisartsgeneeskunde [Capacity Plan 2010. Report Part 2: General Practice], Capaciteitsorgaan, Utrecht, (p.51, Table 15)

References

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ACMMP (2010), *Capaciteitsplan 2010. Deelrapport 2: Huisartsgeneeskunde [Capacity Plan 2010. Report Part 2: General Practice]*, Capaciteitsorgaan, Utrecht, http://www.capaciteitsorgaan.nl/Portals/0/capaciteitsorgaan/publicaties/capaciteitsplan2010/Deelrap2_Huisartsgeneeskunde.pdf.

Van Greuningen, M., R.S. Batenburg, L.F.J. Van der Velden (2012), "Ten years of health workforce planning in the Netherlands: a tentative evaluation of GP planning as an example", *Human Resources for Health*, **10**(1):21, BioMed Central, London, http://www.human-resources-health.com/content/10/1/21

Annex 21 Norway: HELSEMOD (Health Care and Social Services Model)

Background

Statistics Norway carries out every three years projections of future requirements of health care personnel on behalf of the Norwegian Directorate of Health, as part of their broader labour force projection work.

Objectives

HELSEMOD is a model that projects the future supply and demand of health care personnel. It is mainly used to plan future health and educational policies. In Norway, such projections have been produced since the mid-1990s. The 2012 report presented projections up to 2035.

The model projects the supply and demand for 20 different groups of health care personnel. It is based on several simplifying assumptions. In particular, the model assumes that a projected long-term imbalance for one specific group does not affect the number of applicants, wage growth or substitution effects. The model also generally assumes that the composition of personnel in each sector remains unchanged compared to the baseline year (2010). The results must therefore be interpreted with caution.

Projection Method

Projection Period: 2010-2035

Coverage: Health care personnel in health and social services.

Disaggregation: HELSEMOD produces separate supply projections for 20 different education groups. Demand for health workers were estimated separately for 12 different activity areas (e.g. acute care services, mental health services, nursing services, social services).

HELSEMOD projection model uses a stock-flow approach on the supply side and a utilisation-based approach on the demand side. The supply side considers labour force participation, average working hours, students' admissions to relevant education programmes, completion rates of studies, and exit for various reasons (Table 48). On the demand side, the baseline scenario considers population structure, utilisation patterns of health services, and the impact of economic development on utilisation rates. It assumes that economic growth will lead to higher expectations and ability to expand health and social services. For the baseline scenario, it is assumed that economic growth contributes a 0.4 percent annual increase in demand per user of services, in addition to demographic development (Table 49).

Supply

Table 48: Supply variables and assumptions for baseline/comparison scenario

	Variables	Measurement Approach	Assumptions (Baseline Scenario)
Inflow	Education	Education capacity/Student admission	Constant at 2010 level
		Completion rates	Constant at 2010 level
		Norwegian citizens who study abroad	Average of the last 5 years
Stocks	Number of Health Workers	Head counts: initial year is restricted to Norway residents aged 17-74 years.	
	Working Time	FTE calculation, based on contractual working hours.	Constant rate by age and sex at 2010 level
Outflow	Exit patterns	Labour force participation, for aged 16-67 years.	Constant rate by age and sex at 2010 level
	Death	Mortality rates by age and sex of general population	
	Retirement		Assume everybody retire at age 67

Source: Roksvaag and Texmon (2012)

Demand

Table 49: Demand variables and assumptions for baseline scenario

	Measurement Approach	Assumption (Baseline Scenario)
Population	Population by age and sex	Population projection (Statistic Norway, 2011)
Utilisation	Differential utilisation patterns by age, sex and type of services.	Constant utilisation rate by age/sex
Economic development		0.4 % annual increase in demand per user of services

Source: Roksvaag and Texmon (2012)

Main Results

The HELSEMOD projection model explores three scenarios on the supply side and four on the demand side. On the supply side, in addition to the reference scenario, two additional scenarios were tested: 1) higher education capacity (20% increase) and 2) improved completion rates. Table 50 shows the expected growth in the supply for nurses and physicians between 2010 and 2035 under the three different scenarios (the original report provides these results for all 20 occupation groups). Similarly, the report present results for four different scenarios on the demand side: 1) demographic changes only, 2) reference scenario (0.4% annual increase due to economic growth in addition to demographic changes), 3) a more optimistic economic growth scenario (0.9% annual increase in addition to demographic changes), and 4) a "coordinated reform" scenario (taking into account the cumulative effects of planned policy reform in Norway, including a 10% increase in the care sector, a 20% increase in preventive health care and physicians' services, a reduction in specialist health services and a reduction in frequency of utilisation for specialist services for all age group (Table 51).

In addition to these scenarios, the Directorate for Health asked to assess the impact of the following alternative scenarios: 1) changes in admission rates for students (1% annual growth during the projection period), 2) reduced sick leave or higher proportion of full-time job holders (10% increase in working time), and 3) increased labour force participation, particularly among people over age 60 (1% increase in labour force participation). These calculations were done only for selected health care occupations.

Table 50. Supply for health workers (full-time equivalent), projected growth, 2010-2035

Occupation	2010	2035 (% increase from 2010)		
		Reference	Higher education capacity	Improved completion rate
Nurses	75,254	27.8	43.2	32.3
Physicians	22,612	44.9	58.7	49.7

Source: Roksvaag and Texmon (2012) (p.32, Table 6.1)

Table 51. Demand for health workers (full-time equivalent), projected growth, 2010-2035

Occupation	2010	2035 (% increase from 2010)			
		Demographic changes only	Reference scenario	Higher Growth scenario	Coordinated reform
Nurses	75 273	49.2	65.3	87.1	62.8
Physicians	22 660	36.0	50.7	70.7	47.2

Source: Roksvaag and Texmon (2012) (p.34, Table 6.3)

The estimated gap between the supply and demand for nurses and physicians are presented in Table 52. It depicts the gap between four different demand scenarios and two different scenarios for supply.

Table 52. Gap between supply and demand for health workers (in 1,000, full-time equivalent) in 2035

Demand scenario	Scenario1 Demographic	Scenario2 Reference	Scenario3 Growth	Scenario4 Reference	Scenario5 Reform
Supply scenario	Reference	Reference	Reference	Higher education	Reference
Nurses	-16.1	-28.2	-44.7	-16.7	-26.4
Physicians	1.9	-1.4	-5.9	1.7	-0.6

Source: Roksvaag and Texmon (2012) (p.35, Table 6.5).

The baseline scenario shows a deficit for nurses, but this is to some degree avoidable by increasing the educational capacity or the average working hours. For physicians, projections show a minor deficit. These results vary a lot with the different scenarios and assuming a reduction in the working hours for physicians or increased public funding of dental services, the projections show a major deficit.

Reference

Roksvaag, K. and I. Texmon (2012), *Arbeidsmarkedet for helse- og sosialpersonell fram mot år 2035* [Helsemod- the labor market for healthcare personel towards 2035], Report 14/2012, Statistics Norway, Oslo, http://www.ssb.no/emner/06/01/rapp_helse/rapp_201214/rapp_201214.pdf.

Annex 22 Switzerland: Supply and Demand of Ambulatory Care Physicians – Projections to 2030

Background

In Switzerland, the federal government does not have any specific mandate for health workforce planning. However, several federal institutions address various questions related to the health workforce, including the Swiss Health Observatory (OBSAN). The Swiss Conference of Cantonal Directors of Health (CDS), in collaboration with the national umbrella organisation interested in initial and continuous training in the health sector in Switzerland (OdASanté) commissioned OBSAN a few years ago to assess the possible evolution of the supply and demand of health personnel. OBSAN produced two separate reports in 2008 and 2009: the first report analysed the projected supply and demand for physicians in the ambulatory care sector; the second report covered a wide range of health care providers working in hospitals, nursing homes or providing home-based care (see next section). While the general analytical framework was similar for the two reports, the first report described here provides more analysis of supply-side factors, including not only assumptions about future student intakes, but also about retirement rates.

Objective

- Assess the balance between the future supply and demand of ambulatory medical care up to 2030

Projection Method

***Projection Period*:** 2005-2030

***Coverage*:** Physicians in ambulatory care (those who receive reimbursement from the compulsory health insurance)

Disaggregation: 6 categories: 1) General medicine, 2) Paediatrics, 3) Gynaecology and Obstetrics, 4) Specialised medicine with surgical activity, 5) Specialised medicine without surgical activity, and 6) Psychiatry.

The supply side of the model is based on a 'stock-flow' model, with the main inflow coming from the domestic education system. The main outflow comes from retirement (the proportion of physicians who stop their activity before the age of 55 being negligible in Switzerland, the exit rate after the age of 55 is estimated based on evidence of losses at each age until physicians reach the age of 70 using registry data) (Table 53).

The demand side of the model includes population projections and the average number of physician consultations by the demographic characteristics of patients (age, sex and residence) and physicians' specialization (Table 54).

Main Data Sources: Physician registry, billing data to the compulsory health insurance (AOS) to measure the number of consultations per physician.

Table 53. Supply variables and assumptions for scenarios

	Variables	Measurement Approach	Assumptions (Baseline Scenario)
Inflow	Education	Number of medical school graduates, by sex and specialization	Constant from 2015 (based on the projected average for 2011-15)
		Number of new federally-recognised specialist titles, by sex, age, specialization (these include foreign-trained physicians obtaining a recognition of their foreign diploma)	
	Immigration	Number of physicians who settle in outpatient private practice (included under new federally-recognised specialists]	
Stocks	Number of Health Workers	Head count	
	Productivity	Average number of consultations per physician per year, by age, sex, specialization	Constant
Outflow	Exit	Retirement only (exit rate at each age after 55 up to 70)	Constant

Source: Seematter-Bagnoud et al. (2008)

Table 54. Demand variables and assumptions for projections

Variables	Measurement approach	Assumptions (baseline scenario)
Population	Population by age, sex and Canton	Middle scenario of demographic projections, 2006
Utilisation	Average number of physician consultations by sex, age, specialization and Canton	Average rate between 2001-2006, constant

Source: Seematter-Bagnoud et al. (2008)

Scenarios and Main Results

The projections are testing a variety of assumptions that might have an impact on the demand for ambulatory care physician services, including: changes in the health status of the population (Scenario B1 and B2), changes in health service delivery (Scenario C1 and C1i), and some combinations of these scenarios (Scenario D1 and D2).

On the supply side, the projections only test one alternative scenario to the baseline scenario (which assumes a constant number of inflow from the education system and no change in retirement patterns). The alternative scenario is a reduction in physician productivity of 10% (measured as a reduction of 10% in the number of consultations per year) for all the new physicians entering ambulatory care practice after 2005, based on the assumption that new physicians will work fewer hours per year and spend more time on administrative tasks.

Table 55. Description of the baseline (reference) and alternative scenarios regarding the future supply and demand of ambulatory care physicians in Switzerland, 2010-2030

	Scenarios	Description
Demand	Reference (A)	Only influenced by changes in demography
	B1	Improved health status of the population (assumes that the consultation rate of people 66-75 years old in 2030 would be equivalent to the consultation rate of the 41-65 years old in 2005, that the consultation rate of the 76-85 years old in 2030 would be equivalent to the consultation rate of the 66-75 years old in 2005, etc.)
	B2	Deterioration of health status of the population (assumes that the consultation rate of the 66-75 years old in 2030 would be equivalent to the consultation rate of the 76-85 years old in 2005, etc.)
	C1	Introduction of gate keeping
	C1i	Substitution of physicians by other health care providers for certain consultations (5% to 10% fewer physician consultations)
	D1	Mixed scenarios reducing the demand for primary care physicians (B1, C1i)
	D2	Mixed scenarios increasing the demand for primary care physicians (B2, C1)
Supply	Reference	No change in student intakes/graduates, retirement patterns or productivity
	Reduced Productivity	Declining productivity (10% less consultation per physician per year for all physicians entering ambulatory care practice after 2005 compared to those who entered before, due to a reduction in working hours)

Source: Seematter-Bagnoud et al. (2008)

Table 56: Estimated gap between demand and supply of physician consultations in ambulatory care in 2030 (in million consultations and % of total consultations), based on different scenarios, Switzerland

	Reference Scenario	B1	B2	C1	C1i	D1	D2
General Medicine	-9.3	-5.5	-12.5	-10.4	-6.9	-3.5	-13.8
	-39%	-28%	-47%	-42%	-33%	-20%	-49%
Gynecology	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	3%	3%	3%	3%	3%	3%	3%
Pediatrics	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	14%	14%	14%	14%	14%	14%	14%
Specialists without Surgical activity	-1.2	-0.3	-1.5	-1.1	-1.2	-0.3	-1.4
	-23%	-7%	-27%	-22%	-23%	-7%	-26%
Specialists with Surgical activity	-0.7	-0.1	-0.8	-0.6	-0.7	-0.1	-0.7
	-15%	-3%	-17%	-13%	-15%	-3%	-15%
Psychiatry	-0.7	-0.7	-0.7	-0.6	-0.7	-0.7	-0.6
	-26%	-26%	-26%	-25%	-26%	-26%	-25%
Total	**-11.6**	**-6.3**	**-15.2**	**-12.5**	**-9.2**	**-4.3**	**-16.2**
	-29%	**-18%**	**-35%**	**-30%**	**-24%**	**-13%**	**-36%**

Source: Seematter-Bagnoud et al. (2008) (p.80, Table 8)

Reference

Seematter-Bagnoud, L. et al. (2008), *Offre et recours aux soins médicaux ambulatoires en Suisse*, Document de travail 33. Observatoire suisse de la santé (OBSAN), Neuchatel, http://www.obsan.admin.ch/bfs/obsan/fr/index/05/02.Document.110590.pdf.

Annex 23 Switzerland: Healthcare Personnel – Current Status and Prospective until 2020

Background

In Switzerland, the federal government does not have any specific mandate for health workforce planning. However, several federal institutions address various questions related to the health workforce, including the Swiss Health Observatory (OBSAN). The Swiss Conference of Cantonal Directors of Health (CDS), in collaboration with the national umbrella organisation interested in initial and continuous training in the health sector (OdASanté) commissioned OBSAN a few years ago to assess the possible evolution of the supply and demand of health personnel. OBSAN produced two separate reports in 2008 and 2009: the first report analysed the projected supply and demand for physicians in the ambulatory care sector (see the previous section); the second report covered a wide range of health care providers working in hospitals, nursing homes or home-based care. The following summarises the objectives, method and main results of this second report.

Objectives

- Assess the current situation of health personnel in hospitals, nursing homes and home-based care
- Estimate the possible evolution of health personnel needs in different settings

Projection Method

***Projection Period*:** 2006-2020

Coverage: Health personnel, including physicians, nurses and “therapeutic technicians/assistants”.

Disaggregation: By settings: hospitals, nursing homes, and home-based care.

The projections of health workforce needs in different settings focussed on the ***demand*** side. By contrast with the other projection model on ambulatory care physicians, this analysis did not include any supply projection due to the difficulties of obtaining reliable data on the inflow/outflow of many categories of health care providers in different settings. The demand projections over the 2006-2020 period were made for hospitals, nursing homes (établissement medico-social), and home-based care, excluding ambulatory care (which was covered in the other model), psychiatry, rehabilitation and long-term care for people under 65.

The demand side of the model was driven by population projections and health service utilisation rates (Table 57). The population projections used the “median” scenario of the Federal Statistical Office. Based on previous studies by OBSAN on utilisation rates, health services needs were projected to 2020 and converted in health workforce requirements. The projection was based on utilisation rates by age and sex in 2006, and included two scenarios (a baseline and one alternative scenario). Contrary to the approach used in most other health workforce planning models, the baseline scenario did not assume *constant* utilisation rates of hospital, nursing home and home-based services (by age and sex), but rather was based on a more optimistic assumption of a reduction in utilisation rates due to the introduction of DRG payment systems in hospitals (which it was assumed would reduce the average length of stay) and expected improvement in population health status (delaying the need to receive home-based care or to move to nursing homes). The alternative scenario assumes constant utilisation rate.

Main Data Sources: Hospital Administrative Statistics, Data from the medical and social institutions, Spitex Statistics, Labour Force Survey, Federal Population Census.

Table 57: Demand variables and assumptions for projections

Settings	Main variables	Assumptions: Baseline Scenario	Assumptions: Alternative Scenario
Hospitals	Length of stay	Decreases due to implementation of DRGs	Unchanged from 2006
	Admission rate	Unchanged from 2006	Unchanged from 2006
Nursing homes	Length of stay	Unchanged from 2006	Unchanged from 2006
	Admission rate	Rate by age and sex reduced due to improvement in population health status (postponement in age of entry equal to gain in life expectancy)	Unchanged from 2006
Home-based care	Utilisation rate	Rate by age and sex reduced due to improvement in population health status (postponement in age of receipt of services equal to gains in life expectancy)	Unchanged from 2006

Source: Ruedin et al. (2009)

Main Results

Under the baseline scenario, hospital-based care needs (measured by hospital days) would increase by 2.4% between 2006 and 2020, while the needs for nursing home services would increase by 31% and home-based care needs by 20%. Assuming that productivity and working hours would remain unchanged, meeting these additional needs would require an additional 25 000 workers in hospitals, nursing homes or providing home-based care in 2020 compared with 2006 (a 13% increase over this period). This would be in addition to of the 60 000 workers in these settings who are expected to retire between 2006 and 2020.

Under the alternative scenario, the demand would be greater, with the needs for hospital-based care rising by 16% between 2006 and 2020, the needs for nursing home services growing by 42% and home-based care increasing by 22%. This would translate in a requirement for 48 000 additional staff in these settings in 2020 compared with 2006 (a 25% increase).

Table 58: Possible evolution of care needs and health personnel in hospitals, nursing homes and home care in Switzerland, 2006-2020

	2006	2020	
		Baseline scenario	Alternative scenario
Hospital days	13 325 000	13 647 000	15 522 000
Number of patients in nursing homes	82 000	107 500	116 500
Number of people receiving home care and assistance	268 000	321 000	327 000
Number of positions (FTE)	138 600	155 100	171 400
Number of employees (headcount)	195 000	220 000	243 000

Source: Ruedin et al. (2009)

Reference

Ruedin, H.J. et al. (2009), *Personnel de santé en Suisse – Etat des lieux et perspectives jusqu'en 2020,* Document de travail 35, Observatoire suisse de la santé (OBSAN), Neuchâtel, http://www.obsan.admin.ch/bfs/obsan/fr/index/05/publikationsdatenbank.Document.118254.pdf.

Annex 24 United Kingdom: A Strategic Review of the Future Healthcare Workforce

Background

The Centre for Workforce Intelligence (CfWI) updated in 2012 its analysis of the future demand and supply of the medical workforce in England, in support of the Health and Education National Strategic Exchange (HENSE) Review Group. The HENSE Review Group is responsible for making recommendations on medical and dental student intakes to the Department of Health and the Higher Education Funding Council for England. The analysis was conducted for both physicians and dentists, but only the results for physicians are presented here.

Objective

- Establish whether there will be an adequate supply of physicians in England
- Prepare data and analysis to inform HENSE's recommendations on medical student intake

Projection Method

***Projection Period*:** 2011-2040

***Coverage*:** Physicians in NHS England

Disaggregation: General practitioners (GPs) and trained hospital doctors

The supply side of the model is based on a standard stock-flow model, including an assessment of the post-graduate training process (length of training and attrition/dropout rates). Table 59 provides selected indicators and their assumptions for the baseline scenario.

On the demand side, the CfWI focussed its analysis on four key factors that are likely to affect the future demand for physicians: 1) population (the size of the population, by age and sex), 2) level of need (the needs of this population given the distribution of health and illness, and future risk factors), 3) level of service (the service planned to be provided according to the population's level of need). and 4) productivity (the ability of the workforce to deliver the necessary services, taking into account factors such as skill mix and technology). The CfWI asked experts to develop scenarios around these key factors. In addition, the CfWI also assessed the impact of alternative scenarios on future public expenditure on health on the demand for physicians, based on various assumptions.

Table 59. Supply variables and assumptions for projections

	Variables	Measurement approach	Assumptions (Baseline Scenario)
Inflow	Education	Medical school intake	Constant, 5884 "home fee" students and 493 foreign students per year from 2011
		Dropout rate	Constant, at 5%
		Time spent in medical school	Constant, 13.4% take 4 years, 40.1% take 5 years and 46.5% takes 6 years
	Post-graduate training	Various indicators (e.g. intake, length of training, drop out) for different types of training module (separately for GPs and trained hospital doctors)	
Stocks	Number of Health Workers	Stock of health workers	
	Working time	FTE conversion, by age and gender	Constant, Average for male physicians: 96.4% Average for female physicians: 90.5%
Outflow	Exit	Attrition rate, by age and gender	GPs Early leavers: TBD Trained hospital doctors Early leavers: 2% per year below the age of 54 , based on turnover data Retirements: age-specific retirement rates based on historical data

Source: CfWI (2012) [Appendix J]

Scenarios and Main Results

Supply and Demand

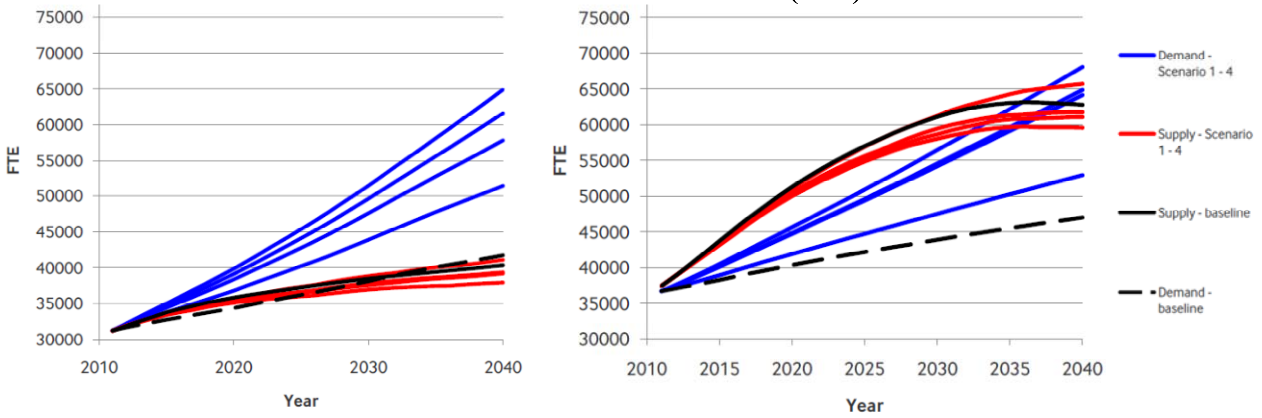
Following expert consultations, four different scenarios were presented in the report on the demand side:

Scenario 1: Compression of morbidity in a "higher resource environment"
Scenario 2: Compression of morbidity in a "lower resource environment"
Scenario 3: Expansion of morbidity in a "higher resource environment"
Scenario 4: Expansion of morbidity in a "lower resource environment"

For the supply, four sets of different average age of retirement for GPs and trained-hospital doctors were assumed to create scenarios. Figure 11 shows the results of the four demand scenarios and the four supply scenarios for GPs and trained hospital doctors. For GPs, with the exception of the baseline scenario, the projections suggest that there will be a growing shortage over time. On the other hand, the growth in the number of trained hospital doctors is expected to be much greater than the growth in demand, and England may face a substantial excess of hospital doctors at least for the next 20 years.

Figure 11: Demand and supply forecasts for GPs and trained hospital doctors

GP supply and demand (FTE) **Trained hospital doctors supply and demand (FTE)**



Source: CfWI (2012) [Figure 14 and 15]

Funding Scenarios

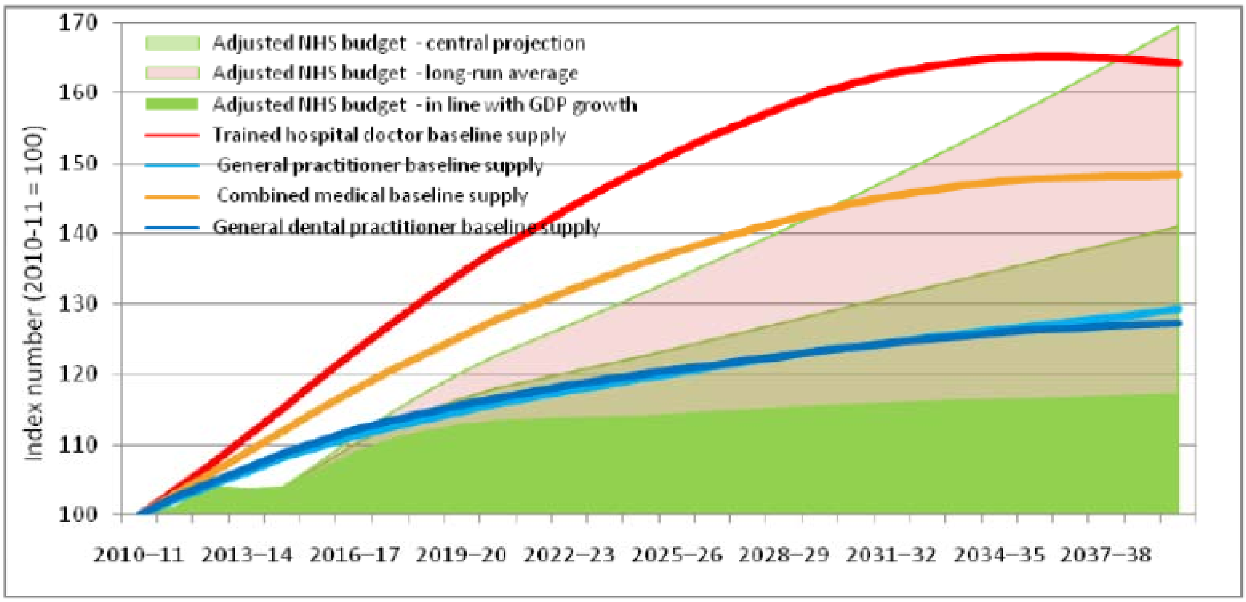
In addition, the CfWI also conducted an assessment of different scenarios concerning future growth in public spending on health, to assess the affordability of the physician workforce. A report by the Institute for Fiscal Studies (IFS, 2012) for English NHS spending provided the starting point for three spending scenarios between 2015-16 and 2012-2022. The CfWI then extended these scenarios to 2040 using the most recent Office for Budget responsibility long-term economic growth projections (OBR, 2012). One of the scenarios, a spending freeze in real terms over the entire projection period, was deemed to be unrealistic (as this would imply that the share of public spending on health would halve from around 7% of GDP to only around 3.5% of GDP in 2040). As a result, the CfWI used the two other IFS scenarios and added scenario third one (which became its central projection) taking a mid-point between the two IFS scenarios. Specific funding scenarios are described as following.

1) **Public spending on health grows in line with GDP growth** (share of public spending on health remains constant at around 7% of GDP by 2040)
2) **Public spending on health exceeds GDP growth but by a smaller margin than in the past** (share of public spending on health increase to 8% of GDP by 2040)
3) **Public spending on health grows in line with the long-run average of around 4% per year** (share of public spending on health increase to above 9% of GDP by 2040)

Assuming that non-wage costs would rise in line with the overall price trends in the economy and that pay increase for staff would be equal to the Office for Budget Responsibility's most recent central projections for public sector average earning growth, the CfWI estimated that projected health expenditure growth (under scenario 2, the central projection) could accommodate an increase in NHS staff of around 41% over the projected period. While the expected growth in the supply of GPs is 29%, the growth in the supply of trained hospital doctors is 64%, exceeding by a wide margin the expected NHS recruitment ability.

These analyses led the HENSE Review Group to recommend in December 2012 a reduction of medical school intakes by 2% in 2013 in order to signal the expected oversupply of trained hospital doctors in the NHS in the coming years (HENSE, 2012).

Figure 12 : Medical baseline supply projections and adjusted NHS real budget scenario, 2010-11 to 2039-40



Source: CfWI (2012) [Figure 27]

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Annex 25 United States: Clinician Projection Models

Background

The National Center for Health Workforce Analysis (NCHWA) was established in the Federal Department of Health and Human Services after the passage of the Affordable Care Act in 2010 to provide data and information on health workforce trends and needs, in order to assist both private and public sector decision-making. The NCHWA is currently developing a health workforce planning and forecasting model, relating to medical care provided by physicians and non-physician clinicians (NPCs, including physician assistants, nurse practitioners, nurse anaesthetists and nurse midwives). As these models are still under development, the following information is incomplete and provisional.

Objectives

- Provide data to evaluate the adequacy of the existing and future health workforce
- Project future health workforce imbalances (shortages/surpluses)

Projection Method

Projection Period: 2010-2030

Coverage: Physicians and non-physician clinicians (NPCs), including physician assistants (PAs), nurse practitioners (NPs), certified registered nurse anesthetists (CRNAs) and certified nurse midwives (CNMs)

Disaggregation: 42 specialties

The supply side of the model is based on a stock-flow approach, which tracks the supply of active clinicians by age and sex and specialty. For physicians, the model also tracks the country of medical education and major professional activity (patient care, teaching, research, administration or other. The past trends of educational inflow were analyzed and the model makes conservative assumption (lower than the currently observed growth rates of inflow in each occupation) (Table 60). It produces two measures of clinician supply: head counts and FTE. The demand side of the model is driven by population demographics, insurance coverage and patterns of care delivery.

This model projects supply and demand for each type of clinician separately, but the results are integrated in the following manner;

- Changes in non-physician clinicians'(NPC) specialty distribution is projected based on changes in the physician specialty distribution, implicitly assuming that new job creation for NPCs will be driven by changes in the specialty mix of physicians
- NPCs have a visit volume of approximately 75% that of physicians, based on the best available evidence
- NPCs are assumed to be more flexible with regard to specialty choices, allowing NPC specialty distribution to change in response to specialty-specific shortages and surpluses.

Supply

Table 60. Supply variables and measurement approach

	Variables	Measurement Approach	Assumptions (Baseline scenario)
Inflow	Education	Physicians: number of graduate medical education (GME) training positions (post-medical school training positions)	Annual 1% growth, assuming the vast majority of U.S. graduates will obtain GME training positions and the number of positions filled by international medical graduates (IMGs) will decline from 6 800 to 3 900 per year.
		Physician assistants: number of newly licensed PAs	Annual 2.5% growth for 2012-2017 and constant (0% growth rate) afterwards
		Nurse practitioners: number of NP graduates	Annual 5% growth for 2012-2017 and constant (0% growth rate) afterwards
		Certified registered nurse anesthetists: number of newly certified CRNAs	Annual 3% growth for 2012-2017 and constant (0% growth rate) afterwards
		Certified nurse midwives: number of newly certified CNMs	Annual 3% growth for 2012-2017 and constant (0% growth rate) afterwards
Stocks	Working time	FTE	
Outflow	Exit	Attrition due to retirement and death	Constant retirement rates by age and sex, computed from American Community Survey data

Demand

Table 61. Demand variables and measurement approach

Variables	Measurement approach
Population	Population projection by age and sex
Utilisation/need	Projected insurance distributions by insurance type, age and sex
	Clinician-to-population ratios for each specialty and population segment defined by age, sex and insurance type

Scenarios under development

In addition to the baseline scenario, the model is expected to explore different groups of alternative scenarios as following on the supply side and demand side

Supply forecasts

- Different assumptions for education inflow for each type of clinician
- Change in effective retirement age (plus or minus two years)

Demand forecasts

- Assess the effects of the 2010 Patients Protection and Affordable Care Act (ACA)
- Assumes that demand growth will be correlated with GDP growth
- Assess potential impact of changes in health care delivery and payment system

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Annex 26 United States: Open-Source Model for Projecting Physician Supply and Demand

Background

The Cecil G. Sheps Center for Health Services Research at the University of North Carolina is developing an open-source, web-based model to project physician supply and utilisation of their services, based on various scenarios. This model will provide estimation of possible physician shortages at multiple geographic levels and allow examination of the impact of various policy options to address any projected imbalances in the United States.

Objective

- Develop an open-source projection model that can be used by policy makers, physicians, health system executives and others, to forecast supply, utilisation and shortages of physicians in the United States

Projection Method

Coverage: *Physicians (35 specialties)*

The model is designed to build on the strengths of existing projection models, while improving some concepts and methodological aspects. One of the main innovative features of the model is that it is moving away from a silo-based approach to modelling the future supply and demand for each medical specialty. It recognises that different specialties have overlapping scope of practices: that "generalist" providers often provide a significant amount of specialist care and that specialists provide generalist care. It incorporates the concept of "plasticity", to reflect that there are multiple potential configurations of providers able to provide for a community's utilisation of health care services.

Supply

The supply side of the model uses an "agent-based" modelling approach rather than only a typical stock-and-flow approach. This "agent-based" modelling approach is designed to better reflect "real world" decisions of physicians about where and how much to practice, and in what clinical areas. Using this agent-based modelling approach, the model will be design to project physician supply, simulating the location, workforce participation rates and service decisions of each individual physician from training to retirement. The model includes the main inflows into the medical workforce (new medical graduates and immigration) and outflows (attrition, retirement and emigration) that are included in most stock-flow models, but taking into account as much as possible the interactions between physician practice decisions and the environment in which they practice. The model will produce a forecast of the supply of physicians by headcounts and full-time equivalents (FTE) for 35 specialty groups.

Utilisation

The demand side of the model is based on utilisation of physicians services. The initial step is to forecast the future number of physician visits for a population in a defined geographic area in four medical settings (physician offices, hospital inpatient settings, hospital outpatient settings and emergency departments) and for 18 different clinical service areas (CSA). Distribution of visits by CSA in Wayne County of North Carolina is shown in Table 62. Combining the 18 CSA with the 4 medical settings produces 72 different physician visit use rates that will be calculated by the model. The number of physician visits is estimated based on current utilisation rate of different population groups taking into account their socio demographic characteristics (age, gender, race/ethnicity, income, rurality), health insurance status, and risk factors (e.g.

smoking and obesity). Individual-based data are aggregated at the county level, using county-level data from sources such as the U.S. Census Bureau and the Behavioral Risk Factor Surveillance System to create area-level utilisation forecasts.

Table 62. Distribution of Visits by Clinical Service Areas, Wayne County, North Carolina

Clinical Service Areas	Visits in Wayne County
Blood	1 461
Circulatory	48 585
Congenital anomalies	1 269
Digestive	14 852
Endocrine/immunity	24 067
Genitourinary	22 761
Infectious	7 632
Injury	28 785
Mental	34 492
Musculoskeletal	66 777
Neoplasms	21 958
Nervous system	34 457
Perinatal	163
Pregnancy/childbirth	12 613
Residual codes	3 923
Respiratory	43 021
Skin	11 872
Symptoms & signs	11 179
Total visits	**389 867**

Source: The Cecil G. Sheps Center for Health Services Research (2012) (p.6, Figure 4)

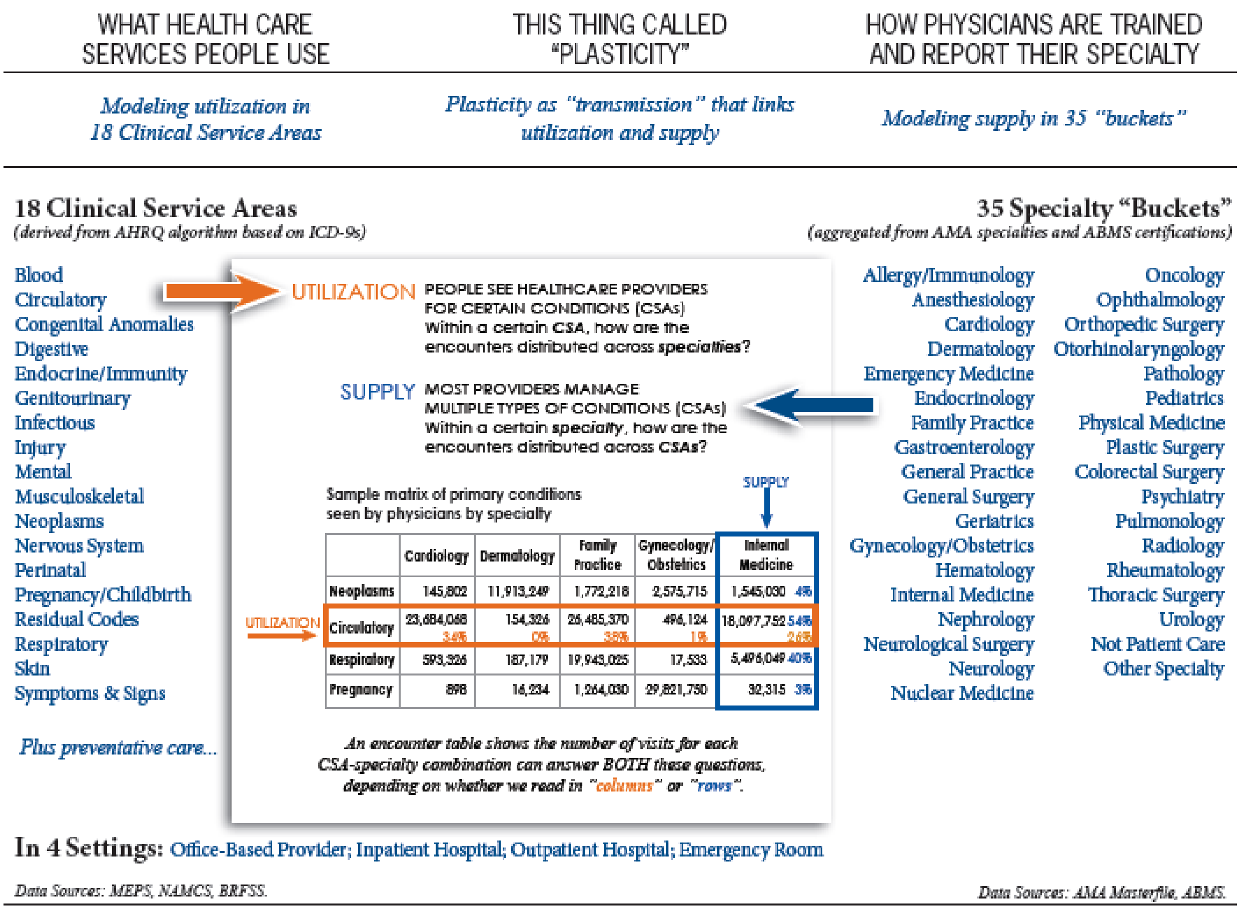
"Plasticity"

The concept of "plasticity" is introduced as a "transmission" mechanism to link the current and projected utilisation of physician services with physician supply. The model allows for the possibility that physicians may adjust the service they provide based on local utilisation patterns and other service providers behaviours in the area. This approach introduces flexibility in the projection model and allows interactions between service provisions of different specialty groups (Figure 13).

Estimation of the gap between supply and utilisation

The gap will be estimated by comparing capacity for visits for a particular clinical service area to the predicted utilisation of that health services. The model assumes that physicians may adjust the composition of their services based on local conditions. The model is set up to converge to a distribution of services among physicians, which minimises excess capacity in their geographic regions and consistent with generally accepted service distributions.

Figure 13. Explaining "Plasticity"



Source: The Cecil G. Sheps Center for Health Services Research (2012) (p.5, Figure 3)

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