Health workforce planning in the Netherlands

How a projection model informs policy regarding the general practitioner and oral health care workforces

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Contents

Background

The importance of a sufficient health workforce

Ensuring proper access to health care is an important policy objective of governments in many countries. Crucial for reaching this objective is having the right number of the right health care providers to respond to health care demand of the population (1). The health workforce is an essential component for the functioning and performance of health care systems (2). Healthcare is highly labour intensive and is one of the largest sectors in the EU (3). Almost 10% of all jobs in the EU region contribute to the health care sector (3,4) and the largest part of health care budgets is allocated to the health workforce (5,6).

Health care systems and health workforces across Europe are faced with significant challenges. The needs for health services are evolving due to demographic (ageing population) and epidemiologic (multiple chronic diseases) changes in the population. Other factors, such as changing patients' expectations, technical innovations organizational innovations and cross-border mobility also influence the need for health services (3,7). To respond adequately to these challenges, the availability of health workers with relevant skills is crucial. The ultimate goal is, therefore, to achieve a sufficient number and appropriate distribution of health workers (2). Some parts of the health care sector (such as health care for the elderly or health care focusing on chronic diseases) require a change in skill-mix to meet the changing demand for health care. Determining what will be the "right" number and mix of different categories of health professionals to meet the demand for care is a very complicated task (8,9). Both health care supply and demand are subject to hard-to-predict changes and developments (1) and there are multiple views on what type of healthcare supply is optimal to serve what type of healthcare demand. Planning health workforces is not only a matter of determining the right numbers, but also requires a vision on the right qualitative match between professional skills and patients' needs.

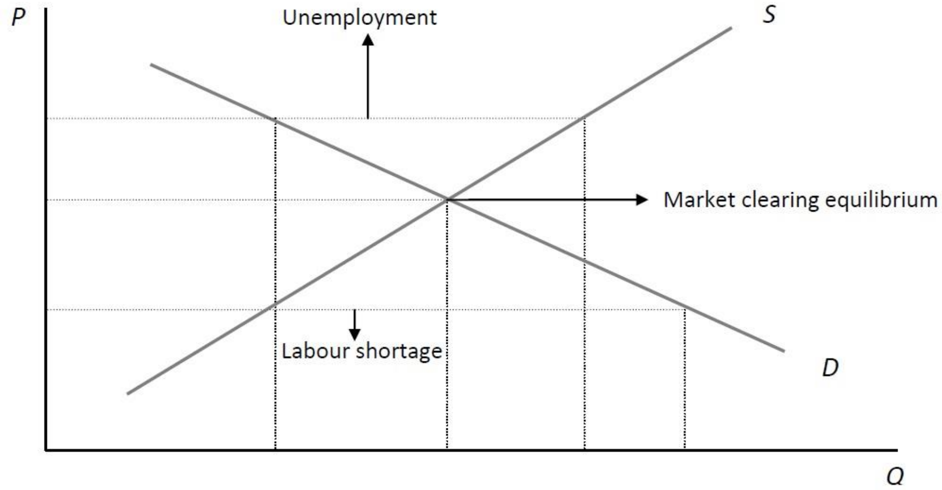
From an economic perspective, it is important to note that balance on the health labour market does not emerge 'spontaneously'. Selection, allocation and employment mechanisms in the field of healthcare do not comply to what can be assumed as 'perfect' labour market conditions. This topic is further discussed in the next section. As of now, we see that countries increasingly develop policies to make sure that the health workforce is sufficient in size, skills, composition and distribution to provide the health services that are needed (2) and to achieve the desired balance between health care supply and demand.

In this thesis, we study the topic of matching and planning health workforces by focusing on the current Dutch system of health workforce planning for physicians. As this system, which exists since 2000, consists of both a model-based and policy-driven approach, and is well monitored and documented, it provides an interesting case to explore and evaluate. The background, working and aim of the Dutch system of health workforce planning for physicians are described. First, the reasons for health workforce planning in the Netherlands are discussed. Second, we will briefly discuss the methods on which health workforce planning for physicians is based; and third, the importance of evaluating health workforce planning and in particular evaluating its policy effect is explained from a health systems perspective.

Imbalances in the physician workforce and other health workforces

According to the standard economic theory of a ‘perfect’ labour market, the supply and demand of labour tends towards an equilibrium, because wages (the prices of labour) adjust supply and demand (10-12). When labour markets fail to reach a balance between supply and demand, they exhibit either labour surplus or unemployment or labour shortage. When there is a labour shortage, wages are high, attracting more workers to the particular labour market. When there is a labour surplus, wages are low. This mechanism is illustrated in Figure 1 (13-15).

Fig. 1 Possible labour market scenarios (13)



Note: The supply curve (S) ascents because higher levels of P (price or wage rate) result in a higher quantity (Q) of supply. This means that there is a higher number of professionals or that professionals are willing to work more hours. The demand (D) curve descents because the demand for services decreases at higher levels of price (P) (13).

This standard theory of a 'perfect' labour market is not applicable to health services labour markets, such as the physician labour market. In health services labour markets of many countries (1,3,6), there are strong limitations to the working of market mechanisms and the supply of health professionals is influenced by many different factors: economic, social, technological, legal, demographic and political factors (16,17). Market failure of the health labour market occurs due to and several reasons. Imbalances occur due to, among other reasons, restricted entry to the workforce through licensing, limited training intake, the time lag between the beginning of training and entering the labour market and negotiated wages (13,14).

Furthermore, price mechanisms (i.e. wage adjustments) are generally not explicitly used to create an equilibrium between supply and demand in the (Dutch) health care sector. Up to 2006 prices of health services were nationally set by the Board for Health Care Tariffs. The 2006 Health Care Reform aimed at introducing market elements in health care among which 'free price' negotiations between healthcare providers and insurers. These free price negotiations were introduced stepwise and partially (18). The prices for general practice care, for instance, are in 2016 for 80% nationally set by the Dutch Health Care authority. Free price setting is further limited by the system of macro-budget allocation, meaning that the Minister of Health intervenes when costs in a part of the health care sector exceeds the planned yearly macro budget. At the demand or consumption side of the market, the role of patients in setting prices for health services is almost absent. Their choice behavior is restricted as many health services are almost universally contracted and covered by health care insurers, in practice, patients hardly select or switch between health care providers, hence price mechanisms dot not determine their consumption and choices (19).

Because of market imperfection and actual imbalances between supply and demand, caused by the above-mentioned reasons, the Netherlands and many other countries developed different types of health workforce planning. Matching supply and demand of health services to stabilize the health labour markets in general and for physician labour markets in particular, is a complex challenge, but unavoidable as both over and undersupply cause high financial and societal costs (1,6,14).

Health workforce planning and policy to correct the health workforce pork cycle
Given that health labour markets deal with far from ‘perfect’ conditions, many countries are forced to act on an alternation of shortages and oversupply. In economics, the cyclical pattern of over- and undersupply as a result of delayed responses (for example in student intake) to changes in the market is known as the ‘pork cycle’ (20-22). For policy makers, avoiding these cyclic variations and keeping a balance in the health workforce is a major challenge (1).
A wide range of interventions can be used to regulate imbalances. Examples are restricting entry to the labour market or education, or creating coercive measures to direct health professionals to specific areas (13).
Many countries use health workforce planning and policy to reach a balance between supply and demand in the short and long run, particularly in the medical workforce (1,6,14). Besides access problems for populations groups as a consequence of shortages, countries also use workforce planning to avoid oversupply, which could lead to a waste of human capital (1). Choosing the appropriate intervention for a specific country (or: health care system) requires evidence-based understanding of the dynamics of health labour markets and its dimensions (13).
In 2012, the European Commission initiated a program of projects and activities to support health workforce policies across Europe in general and to promote planning systems a to balance the health workforce. Approved as the Joint Action program on Health Workforce Planning and Forecasting, the proposed actions were: 1) forecasting workforce needs and improving workforce planning methodologies, 2) planning future required skills of health professions and, 3) share knowledge on recruitment and retention strategies to make the health workforce sufficient (3). The need for a European approach was already advocated by several policy briefs and reports before the Joint Action program, but the need for more coordination and exchange was

growing fast since 2010. According to the EU, one of the omissions was the lack of overview of the variety of policy instruments across Europe, applied to control the supply of health professionals including training policies, migration policies and policies affecting retention and retirement (23-25). More specifically, these policy instruments include licensing professional occupations, accrediting universities and institutions, subsidizing medical education and restricting entry to the market (13,26).
Probably the best known example of a policy measure that is used by a majority of OECD countries is a numerus clausus, mostly applied for basic physician training (1,6,27). Countries with such a numerus clausus policy include Canada, Japan, New Zealand, the United Kingdom and the Netherlands (1,27).

Workforce planning can be used as an instrument to estimate the 'right' level for the numerus clausus. It is acknowledged by several international studies that health workforce planning can be valuable to control fluctuations within the health workforce (28-30) and at the European level it remains one of the top priority policy topics (e.g. European Commission Action Plan 2012 (3)). The Handbook on Health Workforce Planning Methodologies across EU countries (31) demonstrates how health workforce planning is used in several EU countries and shows that planning the health workforce is feasible and adds value in to the labour market policy of countries.

Reasons for health workforce planning
Estimating whether the size and composition of the health workforce will be sufficient to meet the health needs of the population is the primary purpose of health workforce planning. However, there are other reasons to plan human resources for health (32). The first reason is that planning the health workforce is done to prevent under-employment of highly skilled professionals. Second, it is to prevent over-employment of under-skilled employees for complex health care tasks. Third, planning is used to prevent over-treatment of patients if too many medical specialists have been trained. Fourth, it can be used to prevent imbalances in geographical distributions of the workforce between rural and urban regions, although this is not an explicit goal of health workforce planning in all countries. The fifth reason is to prevent hiring more workers than can be afforded, reduced productivity, and high personnel turn-over (particularly in countries where the government is hiring health personnel) (32). The base of all reasons are financial considerations; health workforce planning is also an instrument to control health care costs. As such, it is part of general health policy to contain costs. An oversupply of doctors may lead to 'supply induced demand'. Because of the information asymmetry between physicians and patients, patients usually follow the proposed treatment of healthcare professionals, who have strong incentives to monitor and treat patients disregarding the costs, leading to rising health care costs.

Health workforce planning is not only a way to control cyclical variations in the total health workforce, but also to control the fluctuations in student intake in health professional training. These fluctuations can be an ad-hoc reaction to signs of under- and oversupply in the health workforce and can create adjustment problems for medical schools (1).

The art of workforce planning is therefore to anticipate on current and future developments in both the supply and the demand side of the health care system and doing this in the most accurate and flexible way, by also taking into account the interests of multiple health care stakeholders. Anticipating on developments that could influence demand or supply is a challenge in the health care sector, because the size, complexity and composition of the health workforce are influenced by many different societal, political and technological developments. Hence, workforce planning is not an isolated technical exercise; it is important to understand which developments influence health care supply and demand and how future trends will develop in a broader perspective. Health workforce planning should be sensitive to the different developments that influence health care supply and demand, and their match or interaction. In the next section, examples of such developments are discussed. In the discussion section of this thesis is discussed which additional developments and factors are potentially affecting supply and demand in health care.

Taking recent developments into account

In recent years, health care systems and the health workforce are challenged by multiple developments in the health care system. These developments, as well as tight budget constraints caused by the financial crisis that started in 2008, made appropriate and efficient health workforce planning more important than ever (1,3,6). Below, we elaborate on new developments that will make planning the health workforce complicated from both the supply side and the demand side perspective of workforce planning. This implies that the system of health workforce planning needs regular adaptation to new developments and changing structures.

The supply side of the health care system is getting more complicated to measure and to model, due to several developments in, among others, substitution and task distribution and specialization. Within most primary care and medical specialties, new professions have emerged. Furthermore, organizational developments and changes in working hours, roles, contracts and retirement patterns led to fundamental changes in the structure of the health workforce (1,3,7,33-36).

In addition, the health workforce will age. Between 1995 and 2000, the number of physicians in Europe under the age of 45 dropped by 20%. At the same time, the number aged over 45 increased by over 50%. On average across OECD countries, almost one-third of physicians is above age 55 and thus likely to retire in the coming ten years (1). It is important that there will be a sufficient number of newly trained physicians to replace the retiring staff (37). Knowledge about the retirement age of physicians and other health professionals is essential for workforce planning.

Furthermore, in recent years, there is a tendency towards task reallocation between different health professionals in many countries. This can be a strategy for improving the efficiency of health care provision or a reaction to workforce shortages (23,38-40). The World Health Report 2000 (38), as well as more recent publications, noted that determining and achieving the 'right' mix of health personnel are significant challenges for most health care systems (6,42,43).
Across the EU interest is growing in integrated health workforce planning, in which different health professionals and the skill mix of health workers are taken into account to inform policy interventions in health workforce planning and to better match supply and demand of health professionals (3,25). Matching the integrated workforce goes beyond the aim to achieve a numerical equilibrium on the labour market, taking into account the 'right' skill-mix of health professionals to provide the required care.

The demand side of the health care sector is also getting more complex to measure and model. The main reasons for this are the ageing population with increasing multi-morbidity and at the same time a pro-active population with changing expectations. The demand side of the health care sector is also influenced by technological developments and organizational innovation aiming to improve the performance of health care systems (6,7,44).

With an ageing population, it is crucial that people grow older in good health (37). Still, when life expectancy increases, the number of older people in need of long-term care will probably increase because multiple chronic conditions are more prevalent in old age (45,46). These developments have implications for the provision of care, not only in terms of workforce quantity, but also in terms of quality as the requirements for workforce competences and the mix of health services skills may change. A challenge for health workforce planning is therefore to respond to demographic changes that increase the need for new (i.e. more generalist and integrated) orientations on health workforce policies and practices.

Health workforce projection models supporting health workforce planning
It can be expected that an increasing number of countries will apply health workforce planning to cope with their health system challenges, as were stated above, taking into account the attention there is for health workforce planning in the European Union. Health workforce planning is often supported by one of several types of health workforce projection models. The models are mostly used to provide guidance for policy decisions on entry into health professional training, but also to assess the impact of possible re-organizations in the health workforce to better respond to changing health care needs, according to several international studies (1,6, 31).

Recently, Matrix Insight (6) conducted a study that was aimed at identifying EU level actions that could support the Member States in assessing, forecasting and planning their health workforce needs. It also provided an overview of health workforce planning in the European Union. From this study it was concluded that thirteen out of 34 European countries engage in model-based workforce planning, all of which use some form of supply-side projections to plan the health workforce, and some countries extended their models with demand projections. Another study, by Ono et al. (1) reviewed the primary characteristics and projection results from 26 health workforce projection models in 18 OECD countries. This review has identified interesting developments in those health workforce projection models, although many models continue to be based on a fairly traditional approach by focusing mainly on demographic developments. In many countries, the scope of health workforce planning models could be broadened by taken into account several other factors that may affect the future supply and demand of the health workforce, such as retirement patterns or unmet demand for care. In the Handbook on Health Workforce Planning Methodologies across EU countries (31) is demonstrated how health workforce planning is used in several EU countries and it shows that planning the health workforce is feasible and adds value in those countries. The Handbook is intended to inform people from different backgrounds: policy makers, public officials and researchers about best practices regarding health workforce planning in de EU. Physician workforce planning in the Netherlands is included in the Handbook as one of the best practices in Europe.

It has been noted earlier that among the fundamental requirements for health workforce planning based on workforce projections, is accurate and comprehensive information on the actual number of health care professionals (47). Data on a variety of topics is necessary for accurate workforce planning and projecting the workforce of health professionals. This was confirmed by the Matrix Insight study (6). Many countries share concerns about data availability on the health workforce and have argued that the lack of data represents one of the main obstacles to effective health workforce planning. Data availability is crucial to model the health workforce using full-time equivalent (or whole-time-equivalent) data and data on the outflow of health professionals. Countries differ in their data infrastructure and administration systems for health professionals, and it is not always clear how much (historical) data is required and available to construct adequate projections based on trends.

Evaluating health workforce projections and their policy effect

While there are diverse types of health workforce planning and models, little is known so far about the success of health workforce planning and the position of health workforce projections and planning in general health services policy. This lack of information about the performance of health workforce planning and policy implies that existing shortcomings and room for improvement are difficult to identify (6). So for the further development of workforce projections and workforce planning in rapidly changing health care systems, it is important to evaluate workforce projections and their techniques (48), as well as investigating the policy value of the projections.

These subjects are discussed in this thesis from a health systems perspective, rather than from an economic labour market perspective. A main reason is the highly regulated nature of the Dutch health care system in general and health workforce planning in particular. Focus is directed to the Dutch health workforce planning system and the model used for physicians and its position in the Dutch system of health workforce planning which has informed training policy for physicians since 2000. New policy applications of this model are explored.

During the last decade, several studies were conducted by Dutch organizations in which the methods of labour market forecasting models have been investigated, including a number of studies specifically investigating the Dutch model for physician workforce planning (49-51). These studies focused on the methodological plausibility of the model in a macro-economic context. In the discussion section of this thesis, the recommendations of these studies are reconsidered. The recommendations focus on improving the demand-side of the model and taken macro-economic developments into account. We will elaborate on one specific point of the discussion that concerns the monodisciplinary level of health workforce planning. There is a growing need for multidisciplinary health workforce planning that is based on skill mixes, and includes substitution between different professions, between secondary and primary care or between different specialists.

In this thesis we focus on the white spot in evaluating the policy value of health workforce planning in the Netherlands from a health system perspective. So it is essentially applied research, ultimately meant to improve the Dutch health care planning model. It is not a theoretical, econometric analysis. For this, we are referring to the above-mentioned publications. The uncertainty inherent to projection exercises makes it important to monitor the accuracy of the projections and their techniques, because this uncertainty affects policy informed by these projections. Studying this accuracy is one of the key goals of this research, including the methodology and data sources that need continuous updating to make the workforce projections as accurate as possible (1). Besides ensuring the accuracy of the workforce projections, it is also important to evaluate the impact of health policies on health labour market structures (13). Another key goal of this thesis is thus to understand the impact of health workforce policies, by analyzing different policy-relevant scenarios about health care supply and demand that can be tested using health workforce projection models, and thus explore new policy applications.

These aims and subjects will be further addressed in the next section.

Thesis subject and research questions

The health physician workforce planning model and system in the Netherlands
The Netherlands is one of the thirteen countries in the EU that engages in model based health workforce planning (6). The Dutch health workforce planning model has been used since 2000 to advise the government on the intake in physician training and the Netherlands has planned medical school intake since 1972. Also, intake for specialist medical training has been regulated for years.

The Dutch health workforce planning model calculates the required number of physicians in training to advise the government on the adjustment of the annual student intake. Student intake is adjusted to balance the supply and demand of health professionals in the future (52-55). This health workforce projection model projects both supply and demand developments.
At the supply side, trends are modeled for different cohorts of medical specialist applicants, including their return on specialist training and work retention as a medical specialist. Furthermore, trends in working hours of medical professionals are modeled, including their timing of retirement and the entrance of medical professionals from

other countries. Many sub-studies are performed to collect specific data for modeling those trends.
At the demand side of the model , trends in the demand for specific health care services are defined and the required capacity related to these trends is projected. Demand trends include demographic, epidemiologic and socio-economic developments. Furthermore, trends in the care process are included in the model, such as technical developments and developments regarding efficiency and substitution between professionals. These trends are based on, for instance, health care utilization studies, health insurance statistics and national studies about the trends in the health situation of the Dutch population by the National Institute for Public Health and the Environment (RIVM), the Netherlands Bureau for Economic Policy Analysis (CPB) and the Netherlands Institute for Social Research (SCP).
While, in practice, this model is used to advise on student intake for medical doctors, in theory, it is suitable to project supply and demand of any other health professionals.

As sketched before, the Dutch model is challenged by increasing complexity and dynamics of the health workforce. Around 2000, shortages of GPs and many medical specialists were reported and widely experienced. The reform of the Dutch health care system in 2006 and the financial crisis from 2008 onwards, caused health care demand to increase less steeply (45,46). Still, it is expected that for some medical specialties in the Netherlands shortages will occur, in particular for physicians for the mentally disabled, specialists in elderly care and social medicine specialists (53). A specific case is dentistry, as without policy intervention a rapidly growing number of foreign trained dentists started working in the Netherlands for the last 5 years, challenging the future planning of the Dutch dental workforce (57,58).

Throughout the years, the planning of the health workforce in the Netherlands remained an important strategy of the Dutch government. As stated above, much is unknown about the performance of health workforce planning models. Studying the Dutch health workforce planning model and system for physicians will provide good opportunities to actually fill this gap in research and investigate the policy value of this model in the Netherlands.

In this thesis, we study the Dutch health workforce planning model and its history from a health systems and policy perspective. The focus lies on projecting and planning the primary health care workforce in the Netherlands. A main reason is that professionals like general practitioners and dentists are gatekeepers of the Dutch health care system.

This thesis addresses four main subjects and seven research questions to investigate the application of the Dutch health workforce projection model and Dutch health workforce planning policy.

I. The Dutch health workforce planning model and system and its background
The first subject is the Dutch health workforce planning model and system and the historical development of Dutch health workforce planning for physicians. The first and second research question are of descriptive nature:

1. *How does the Dutch health workforce planning model work and how does it support the health workforce planning system for physicians in the Netherlands?*
2. *How did Dutch health workforce planning for physicians historically develop?*

The first research question is answered by doing a case study of the Dutch model for workforce planning, including the subsequent process of policy discussion with stakeholders. Data on Dutch GPs (from the NIVEL GP database) is used to illustrate the calculations.

To answer the second question, the history of health workforce planning for Dutch general practitioners is described, based on policy documents and white papers.

II. The accuracy and impact of Dutch health workforce planning and projections
As was mentioned in the background section of this chapter, health workforce projections, such as those used in Dutch health workforce planning, require accurate and comprehensive information on stocks and flows of human resources for health (6). Furthermore, the impact of health workforce planning on decision making/policy making and the impact on the health workforce and health care system are not always evident.

According to Ono et al. (1), several criteria can be used to assess the quality and impact of health workforce planning models. The criteria that are mostly used are, first, reviewing the actual use and impact of the health workforce model in policy decision-making, and, second, testing the accuracy of the models in helping to achieve their primary objective; ensuring a proper balance between supply and demand of different health professionals.
Ono et al. (1) identify at least three criteria or subjects for evaluating health workforce projection models. Firstly, the content, underlying concept of the model and variables that are included in the model are important evaluation criteria. Secondly, the performance and accuracy of the model should be evaluated according to Ono et al.

(1). The third criterion which is considered important is the actual impact of the model. Is the projection model supporting policy-making, or at least accepted by various stakeholders? (1,58).

Inspired by these, we pose two research questions that focus on the second and third criterion that Ono identified, i.e. the *evaluation* of (parts of) the Dutch projection model itself, and an analysis of training policy before the introduction of this model:

3. *What was the impact of Dutch general practitioner workforce planning policy on the general practitioner workforce in the Netherlands, before and after the introduction of the health workforce planning model?*
4. *What is the projecting accuracy of the Dutch general practitioner workforce projections?*

The accuracy of the current model for Dutch GP workforce projections will be back tested. Backtesting (or hindcasting) is an analysis to evaluate a strategy, theory, or model by applying it to historical data. The current version of the Dutch health workforce projection model is used to project the GP workforce. The projections are based on historical GP workforce data retrieved from the NIVEL GP database. Secondly, ex-post counterfactual analysis will be performed, to investigate the impact of health workforce policy. Counterfactual analysis is “a comparison between what happened and an estimate of what would have happened in the absence of the intervention” (59). This analysis will be done based on historical data of the GP workforce and information from policy papers.
Thirdly, the acceptance of health workforce planning by various stakeholders will be investigated by comparing different policy positions through time.

III. New developments in the Dutch health workforce

The Dutch health workforce model is challenged by increasing complexity and dynamics of the health workforce. This implies that the system of workforce planning needs regular monitoring and adaptation to new developments and changing structures, such as changing retirement patterns and changing roles of health professionals. These two subjects are increasingly important in policy discussions regarding the Dutch health workforce. Below, these two trends are addressed in general, and then specifically in relation to the Dutch system of health workforce modeling.

Changing retirement age of physicians

Demographic changes in Europe, especially the ageing of the population, increase demands for health services. Population ageing also affects the health workforce: the pool of health professionals available to offer health care is shrinking (47,60).
There is also another trend visible in the past years: the moment of retirement is changing. Dutch general practitioners, for example, are leaving their profession at a relatively early age (61,62). GPs' early retirement reflects a wider societal trend towards early retirement seen in the past. However, it seems that this societal trend is changing as more people are willing to work until statutory retirement age in the Netherlands (63).
Changes in the retirement age of physicians and the changing age structure of the health workforce are likely to affect the outflow of physicians and thus the future supply of physicians. A greater understanding of the link between the factors affecting the decision to retire and the moment of actual turnover would benefit policies designed to influence the moment of retirement.
Knowledge about the retirement age of physicians and other health professionals provides valuable information for health workforce planning. The projections of the future outflow of health professionals are based on the retirement age of health professionals in the past.

Developments in the health workforce staff-mix

The need to account for substitution processes within the health care system is, as previously noted, one of the challenges on the current model of physician health workforce planning. In the Netherlands, there is a tendency towards task substitution between different health professionals. Changes in the workforce staff-mix are often used to address shortage problems of single professions, or as a strategy for improving the effectiveness and efficiency of health care (23,28). An important health workforce in the Netherlands of which the 'optimal' staff-mix has been a debate for years is the oral health workforce (39,57,64-69). In the 1990s, an increasing shortage of dentists had already led to an informal transfer of tasks from dentists to dental hygienists (39,66). Also in general practice, task reallocation between general practitioners and practice nurses has developed over the years (34).

Health workforce planning in OECD countries is mostly focused on planning one health professional group at a time, without considering possible overlap in tasks between different health professionals. (1). Also, the Dutch health workforce planning model does not have an automated link to connect health workforce planning of different health professionals. The model is designed to execute projections for each medical profession separately. This implies, e.g. that the required number of general

practitioners in projections is generated without “automatically” recognizing the developments within other professions, such as internists.
The lack of taking task re-allocation between multiple professions into account in workforce planning models is a common critique (70). An increasing number of publications underlines the importance of taking into account the potential re-allocation of activities and collaboration between health professionals in workforce planning models (1,24,25). The re-allocation of activities implies a shift from planning for separate occupations to planning teams of health professionals and integrating workforce planning for several health professionals (24).

The fifth and sixth research question of this thesis addresses these recent developments and dynamics in the health workforce and their influence on workforce projections:

5. *How can the Dutch health workforce planning model take changing retirement patterns into account?*
6. *How can the Dutch health workforce planning model be adapted to developments regarding task reallocation in the health care sector?*

These research questions will be answered by investigating the ability of the Dutch health workforce planning model to incorporate new dynamics in the health workforce. In doing this, the focus lies on the development in the retirement age and the impact of policies regarding this topic, and on the changing staff-mix in Dutch oral health care.
Information about the trends in retirement age of Dutch GPs will be extracted from survey data from two different time periods, to investigate retirement age and factors influencing retirement decisions.
The changing staff-mix in Dutch oral health care will be investigated by studying the consequences of policy recommendations regarding the staff-mix. Also, the possibility to integrate health workforce projections of multiple health professionals in the Dutch health workforce planning model is investigated.

IV. Evaluating health workforce policy measures
The primary goal of the Dutch health workforce planning model is to support policy decision-making on balancing supply and demand in the health workforce by calculating the annual required entry into health professional training to reach a future balance. The model estimates the results of several developments in supply and demand, as policy-neutral as possible. It does not explicitly test health policy plans.

However, it is plausible that implemented health policy measures will influences the developments of supply and demand. It is thus an interesting exercise to take health policy measures explicitly into account in modeling the health workforce developments. It seems useful to investigate the consequences of health policies, both before and after the implementation of policy measures, to assess their impact on the health workforce.

In this thesis, the capability of the Dutch health workforce planning model to evaluate policy measures (ex-ante and ex-post) will be tested. If the model can be used to conduct such evaluations, the feasibility of policy measures or particular norms that exist can be tested by doing evaluations like this.

The seventh question of this thesis therefore addresses the policy evaluating role of the projection model:

7. *How can health workforce policy measures be evaluated by using the Dutch projection model?*

To answer this last research question two different evaluations will be executed, using the Dutch health workforce planning model. One of the evaluations will be an ex-post counterfactual analysis to study the impact of health workforce policy on GP density. The other evaluation will be an ex-ante evaluation using the Dutch health workforce planning model to test the future consequences of oral health workforce policy that has been implemented quite recently.

Outline of this thesis

The results of the thesis are presented in chapter 2 through chapter 6. The chapters are separate articles and can be read independently of each other. As a consequence, the content of the chapters shows some overlap. In table 1, the chapters are schematically presented.

Table 1 Research questions and methods applied in the chapters of this thesis

Research question	Chapter	Method
1. How does the Dutch health workforce planning model work and how does it support the health workforce planning system for physicians in the Netherlands?	2	Case study illustrated with Dutch GP data
2. How did Dutch health workforce planning for physicians historically develop?	3	Narrative literature review based on policy documents and white papers
3. What was the impact of Dutch general practitioner workforce planning policy on the general practitioner workforce in the Netherlands, before and after the introduction of the health workforce planning model?	2 & 3	Comparing historical data, using six criteria for evaluating policy models; ex-post counterfactual analysis
4. What is the projecting accuracy of the Dutch general practitioner workforce projections? With the following hypotheses: 1. The longer the projections, the lower the accuracy of the Dutch GP workforce projection model is. 2. The shorter the base period, the lower the accuracy of the Dutch GP workforce projection model is because short base periods could be influenced by fluctuating data. 3. The accuracy of the Dutch GP workforce projection model will be highest when the lengths of the base period and the projection horizon are similar. Hypothesis 3 is not dependent on hypotheses 1 and 2.	4	Backtesting the model
5. How can the Dutch health workforce planning model take changing retirement patterns into account?	5	Retrospective survey, comparing means in two time periods

6. How can the Dutch health workforce planning model be adapted to developments regarding task reallocation in the health care sector?	6	Development of a software tool
7. How can health workforce policy measures be evaluated by using the Dutch projection model?	3 & 6	Ex-post counterfactual analysis; ex-ante evaluation

The first research question, about the working of the Dutch health workforce planning model and system for physicians, is answered in chapter 2 of the thesis. Chapter 2 explains the operation of the Dutch workforce planning model, as well as the subsequent stakeholder decision-making process. The Dutch general practitioner workforce is used as an example to explain the Dutch health workforce planning system.
Research question two, about the historical development of health workforce planning in the Netherlands is discussed in chapter 3, in which the historical evolution of GP training policy from the 1970s onwards is discussed.

In chapter 2 and 3, the third research question, regarding the impact of GP workforce policy on the GP workforce, is answered. In chapter 2, a tentative evaluation of ten years of Dutch health workforce planning for physicians is done, by using several indicators for labour market balance in the health workforce, and by using six criteria to evaluate models that are designed for policy objectives (Don & Verbruggen, 2006). Chapter 3 concerns an ex-post evaluation of 40 years of GP training policy and its influence on GP density, both before and after the introduction of the Dutch health workforce planning model.
It elaborates on the development and history of GP training policy and the Dutch health workforce planning model and the relation with Dutch GP density.
Chapter 4 deals with the fourth research question: regarding the accuracy of general practitioner workforce projections. The projection accuracy is back tested in this chapter by comparing a posteriori GP workforce projections and observed GP workforce number in several years. The accuracy is tested for different base period lengths and projection horizon lengths.

Chapter 5 and 6 focus on two strategies to improve the current health planning model for physicians. Chapter 5 answers the ability of the Dutch health workforce planning model to take changing retirement patterns into account (research question five).

Chapter 6 tests how the Dutch health workforce planning model can be adapted to task reallocation (research question six). In-depth studies regarding these elements of the planning model are done to keep assumptions about the models' elements up-to-date. In chapter 5, retirement patterns and motives for retirement of self-employed GPs were compared between two periods to inform health workforce planning for Dutch GPs. Chapter 6 conducts an ex-ante evaluation of policy measures regarding the Dutch primary oral health workforce staff-mix. The Dutch health workforce planning model was used to conduct this analysis. The model was extended by a task reallocation software tool to link the projections of multiple health professionals. Chapter 5 and 6 are a response to common criticisms of traditional methods of workforce planning.

The seventh research question is answered in chapters 3 and 6, where the studies (also described above) demonstrate whether the Dutch health workforce planning model can be used to evaluate health workforce policy measures, ex-post and ex-ante. Finally, an overall discussion will be presented in chapter 7, where the main results are discussed, as well as a discussion of the scientific and practical implications of the findings and the implications for policy. Furthermore, suggestions for future research are formulated.

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Abstract

Introduction In many countries, health-care labour markets are constantly being challenged by an alternation of shortage and oversupply. Avoiding these cyclic variations is a major challenge. In the Netherlands, a workforce planning model has been used in health care for ten years.

Case description Since 1970, the Dutch government has explored different approaches to determine the inflow in medical schools. In 2000, a simulation model for health manpower planning was developed to estimate the required and available capacity of health professionals in the Netherlands. In this paper, this model is explained, using the Dutch general practitioners as an example. After the different steps in the model are clarified, it is shown how elements can be added to arrive at different versions of the model, or: 'scenarios'. A comparison is made of the results of different scenarios for different years. In addition, the subsequent stakeholder decision-making process is considered.

Discussion and evaluation Discussion of this paper shows that workforce planning in the Netherlands is a complex modelling task, which is sensitive to different developments influencing the balance between supply and demand. It seems plausible that workforce planning has resulted in a balance between supply and demand of general practitioners. Still, it remains important that the modelling process is accepted by the different stakeholders. Besides calculating the balance between supply and demand, there needs to be an agreement between the stakeholders to implement the advised training inflow.
The Dutch simulation model was evaluated using six criteria to be met by models suitable for policy objectives. This model meets these criteria, as it is a comprehensive and parsimonious model that can include all relevant factors.

Conclusion Over the last decade, health workforce planning in the Netherlands has become an accepted instrument for calculating the required supply of health professionals on a regular basis. One of the strengths of the Dutch model is that it can be used for different types of medical and allied health professionals. A weakness is that the model is not yet fully capable of including substitutions between different medical professions to plan from a skill- mix perspective. Several improvements remain possible.

Introduction

Health-care systems are essentially labour-intensive, and so the workforce is an important component for their functioning and performance. Shortages in health-care personnel are a major concern to health policy makers, professional bodies and patient organizations (1-3). For a long time, the two major challenges in health care worldwide have been to make it less expensive and more capable of meeting the demands of a more accessible, more equitable and more effective health-care delivery system. It is commonly acknowledged that workforce planning is an important instrument for controlling shortage as well as oversupply within the health-care labour market, in particular by determining the inflow in medical training (4-7).

Health-care labour markets in many countries are constantly being confronted with an alternation of shortage and oversupply. This has all the characteristics of what is known in economics as the pork cycle: a cyclical pattern of surplus and shortage as a result of delayed responses to changes in the market. It is a major challenge for policy makers to avoid these cyclic variations between shortage and surplus of health-care personnel. In most countries, such alternations in shortage and oversupply are adjusted by incidental and ad hoc actions that are not able to prevent these variations. Nowadays, these countries are increasingly monitoring the fluctuations with the intention to abolish the pork cycle.

This case study details a simulation model that has been developed since 2000 to support health-care workforce planning in the Netherlands, by calculating the future required inflow in medical specialized training. The goal of this study is to explain the model’s principles, strengths and weaknesses, and to evaluate the extent to which the planning exercise has been accepted by the different stakeholders. Taking the workforce planning of general practitioners (GPs) as an example, the advised and realized inflow over the last 10 years is described, as well as the extent to which the planning process has been successful in reaching a balance between supply and demand.

The case of Dutch GP planning is used to illustrate the working of the model for several reasons. First, GPs play a highly important role within the Dutch health-care system (8), and second, GPs represent one of the largest occupational groups within the physician workforce. GPs administer primary health care 24 hours a day, 7 days a week. In general, patients cannot consult a medical specialist without the mandatory referral by their GP. Most GPs in the Netherlands work in private practices and are self-employed, although a growing number of GPs are being contracted by community health centres.

GPs can also be contracted by another (self-employed) GP, or can work as locum GPs. In the Netherlands, there are 60 GPs for every 100 000 inhabitants, which is quite moderate by international comparison (9).

In the Netherlands, GP specialization training lasts three years (full-time) including an internship. The first and third year of training take place at a GP practice, whereas the second year of training consists of six months' training at a general hospital, three months' training at a psychiatric hospital and three months' training at a nursing home. During these three years, GP residents follow one day of training per week at medical school while working in practice the other days (10).

In the next section, the Dutch model for workforce planning will be explained. The Dutch GPs will be used to illustrate the calculations, and the results of the workforce model simulations will be presented for four different years during the last decade. Subsequently, the model will be discussed and evaluated, using six criteria to evaluate simulation models that are developed for policy objectives. At the end of this paper, the conclusions will be presented.

Case description

A short history of workforce planning for Dutch health professionals

In the Netherlands, labour market tensions are often on the policy agenda. Shortages in the Dutch health-care workforce become public issues if, for example, people have difficulty finding a GP who registers new patients, or if there are long waiting lists for consulting a medical specialist. Political debates emerge if labour market tensions find expression in a high workload among health professionals, but also in unemployment or underemployment (11-13).

In the Netherlands, workforce planning is considered an important instrument for controlling shortage and oversupply. Before 1972, there was no central planning for health professionals. In those days, this was not seen as a task for the government or the medical professions. Medical schools were autonomous in their decisions on the inflow of students. This situation changed when the numerus clausus was introduced in Dutch medical schools in 1972 to limit the oversupply of students and to curb the high costs involved in training physicians. The Ministry of Health, Welfare and Sport advised on this limit and the Ministry of Education, Culture and Science set the limit for the number of students to be enrolled in Dutch medical schools per year. In the 1970s and 1980s, several advisory committees were established to specifically advise the government on the numerus clausus threshold for medical schools, mainly to prevent future oversupply of health professionals. In the late 1980s and early 1990s, the government chose to make its own planning models rather than use advisory committees. The planning policy had one aim: maintaining the status quo in the GP workforce and medical specialist workforce density. In this period, cost containment was the main focus of workforce planning. Reaching an adequate supply of physicians to meet the foreseeable demand for care seemed a goal of lesser importance. Such planning was executed at a governmental level until 1992. In this year, the government withdrew from health workforce planning, leaving health workforce planning to the professions. Between 1992 and 1999, professional organizations subsequently conducted their own planning studies. Many professions decided to increase their training capacity, but the government, although still monitoring the health workforce, did not increase the numerus clausus.

In the late 1990s, signals of a forthcoming shortage in GPs and medical specialists led to the decision to recentralize the planning of medical specialists. In 1999, three groups of stakeholders (the medical professions, the medical training institutes, and the health insurers) decided to found the Advisory Committee on Medical Manpower Planning (Capaciteitsorgaan). This Advisory Committee is an independent advisory committee which focuses on determining the medical training capacity in the Netherlands required to meet the demand for care. One of its main achievements has been the development of a simulation model. The goal of this model is to measure the current gap between the required and available number of health professionals and the expected balance for the next 10 to 20 years. This should take place through planning the yearly inflow of health professionals in training. Because of the time between the start of initial medical training and entering the labour market for physicians (9 years for GPs, 12 years for medical specialists), the planning model requires projections of developments in the labour market for a period of between 10 and 20 years. The output of the planning model is a calculation of the required yearly inflow in medical training within the next 5–15 years. After these calculations, the results of the model are discussed within specialized platforms of the Advisory Committee on Medical Manpower Planning, which consists of representatives of professionals, health insurers and the medical training institutions (14). In the following sections, the Dutch simulation model for health professionals will be discussed more extensively (15,16).

The Dutch simulation model for health professionals

In the year 2000, the first version of a simulation model was developed to estimate the yearly number of health professionals in training required to meet the future demand for care. This first version of the simulation model was technically developed by the Netherlands institute for health services research (NIVEL: Nederlands instituut voor onderzoek van de gezondheidszorg), which manages this model and executes the calculations. Several sources of information are applied to determine the values for the elements of the model. These sources are based on information about health professionals (e.g. surveys among health professionals, registration databases), about the demand for care (e.g. population projections, expert estimations) and about the training of health professionals (e.g. the number of female students, drop-out rate). A more extensive description of the sources used to estimate each of the elements of the model is shown in Table 1.

Table 1 Elements included in the workforce planning model with corresponding data source

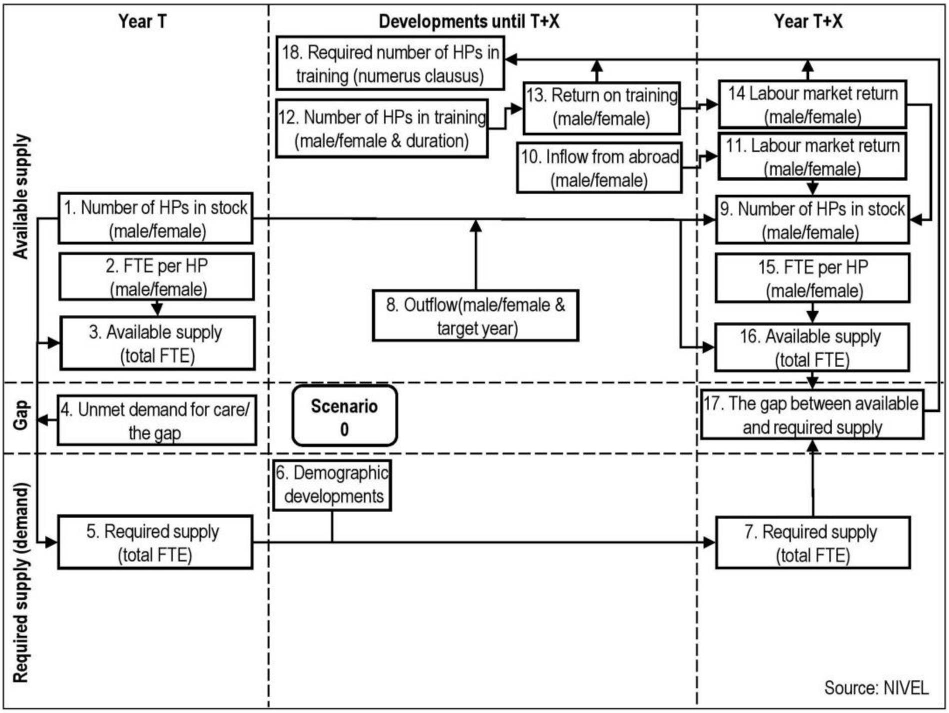
Element	Data source
1 HPs available in baseline year	Registration of HPs
2 Amount of FTE per HP in baseline year	Surveys
3 Available supply (total FTE) in baseline year	Calculation using 1 & 2
4 Unmet demand for care in baseline year	Expert estimations
5 Required supply (total FTE) in baseline year	Calculation using 3 & 4
6 Demographic developments	Population projections and patient registration
7 Required supply (total FTE) in target year	Calculation using 5 & 6 and 19–25 when applicable
8 Outflow	Medical registration, information work status, surveys + unexpected outflow
9 HPs available in target year	Calculation using 1, 8, 10, 11, 12, 13 & 14
10 International migration	Medical registration migration past and expert estimations future migration
11 Labour market return of migration	Information training, medical registration and information work status
12 Number in HP training	Information from HP training
13 Return on training	Information training, medical registration and information work status
14 Labour market return of training	Medical registration and information work status
15 Amount of FTE per HP in target year	Surveys
16 Available supply (total FTE) in target year	Calculation using 9 & 15

Element	Data source
17 Difference between available and required supply	Calculation using 7 & 16
18 Required number of HPs in training	Calculation using 17
20 Sociocultural developments	Expert estimations, and empirical data if available
21 Change of working hours per FTE	Expert estimations, and empirical data if available
22 Technical developments regarding the profession	Expert estimations, and empirical data if available
23 Developments regarding efficiency	Expert estimations, and empirical data if available
24 Developments regarding horizontal substitution	Expert estimations, and empirical data if available
25 Developments regarding vertical substitution	Expert estimations, and empirical data if available

FTE: full-time equivalent: HP: health professional.

The basic version of the Dutch health workforce planning model is depicted in Figure 1. The 18 elements of this basic version will be explained in the following paragraph. This workforce planning model can be characterized by several classification frameworks of different workforce planning models (17-19). According to these classification frameworks, the model used in the Netherlands can best be classified as a demand-based model, as the planning of the workforce is not only derived from the inflows and outflows of health professionals, but also by projecting the future demand for a certain occupational group (for example, GPs).

Figure 1 The Dutch simulation model for workforce planning, basic version



The model and its elements can be divided into three different stages, presented as columns in Figure 1. The elements on the left-hand side of the model refer to the current situation (baseline year, year T). The elements on the right-hand side deal with the target year (year T + X), the projection or target year in the future. The goal of the model is to reach a balance between health-care supply and demand in the target year. Between the baseline year and the target year, in the central part of the figure, the expected developments are represented (between years T and T + X). Calculations of the available and required health care with regard to a specific health profession are compared to estimate the difference between supply and demand in the present and in the future (i.e. the size of a surplus or shortage of health professionals). In Figure 1, the supply side of the model is presented in the upper part of the figure and the demand elements in the lower part. The difference between supply and demand is translated into advice about the required number of health professionals in the first year of training. Below, we present the subsequent steps of the simulation model, referring to the numbers of the elements used in Figures 1 and 2 between brackets.

Description of the baseline model

Step 1: Calculating the current situation (left-hand side of the model)

First, the total available full-time equivalent (FTE) supply (indicated as element 3 in Figure 1) is calculated by computing the product of the total number of health professionals available (element 1) and the amount of FTE (one FTE working on a 100% full-time basis) per health professional (element 2). Both elements are specified by gender (male/female). The gap between supply and demand in the baseline year ('unmet demand'; element 4) is estimated by experts (see next section) and is used to calculate the required FTE supply of health professionals in the baseline year (element 5). In Table 2, the calculations of this step are illustrated by using Dutch GPs as an example.

Table 2 Example of step 1 of the baseline model (scenario 0): General Practitioners in the Netherlands

Part of model	Calculation
Current available supply	For 2009, the total number of available GPs was 10,215; of these, 6,129 were male and 4,086 were female. On average, male GPs worked 0.822 FTE and female GPs 0.551 FTE. With these numbers, the total available supply in FTE for 2009 can be calculated as 7,290 FTE.
Current required supply	Experts estimated that in 2009 the gap between health-care demand and available supply was 1%. Based on the total available supply in 2009 of 7,292 FTE and the gap of 1%, the required health-care supply can be calculated for 2009; this is estimated at 7,363 FTE.

There are several challenges in finding the information that is needed to calculate the value of each element. One such challenge concerns element 1, which requires information about the number of active health professionals. All medical specialists and GPs who want to practice in the Netherlands are registered by the Medical Registration Committee. However, not all registered specialists are active and this information is sometimes difficult to recover. For Dutch GPs, this information is available as NIVEL has managed its own GP registration since 1975. For other professions, surveys are needed to obtain this information. Another challenge is to obtain information about the average percentage of FTE that health professionals work (element 2). This is mostly obtained from surveys among a representative sample of health professionals. This information is necessary to calculate the value of element 2. The unmet health-care demand in year T (element 4) is estimated by experts, which is a challenge for its high uncertainty ranges. This estimation is partly based on information on waiting lists and job vacancies, but predominantly by the experience of the experts, which makes it vulnerable to subjective interpretation and expectations.

Step 2: Developments between baseline year and target year (mid column of the model)

The second step is to estimate the supply and demand for the target year. To estimate the values of the supply and demand for the target year, the values of the elements in the period between the baseline and target year need to be determined. Several elements with regard to changes in supply and demand are considered in this mid column (see Figure 1). See also Table 1 for an overview of the data sources that are used in the Netherlands to determine the values of the elements.

Demographic developments (element 6)

A key element on the demand side of the model (lower part of Figure 1) is in regards to demographic developments in the period between the baseline year and the target year. These developments represent changes in the age and gender structure of the population. For most health professions, the changes in age structure are the most influential demographic developments in the nearby future on the demand side: the relative size of older groups is increasing while the younger groups are becoming smaller. Older people tend to have a higher demand for care, and therefore this change may lead to an increase in the total demand for health care and the required supply of health professionals. This element is based on population projections from Statistics Netherlands (Centraal Bureau voor de Statistiek) combined with information about the number of contacts with health professionals for different age groups. Based on age and gender, demographic extrapolations have been made using the current health-care consumption per inhabitant and the predicted number of inhabitants for a specific target year. In the extended model, discussed below, a number of other developments are described that also contribute to the total required supply of health professionals.

Outflow (element 8)

On the supply side of the model (the upper part of Figure 1), the outflow of health professionals in the period between the baseline year and the target year is an important predictor of the future number of health professionals available in year T + X. Reasons for leaving the profession are mostly (early) retirement or choosing another profession. The pattern of retirement is therefore largely determined by the age structure of active health professionals (20). Furthermore, it is known that most female health professionals tend to leave the profession at an earlier age than males (21).

Health professionals trained abroad (element 10)
Another contributing factor in the future number of health professionals is the inflow from other countries. However, although the free movement of employees within Europe has been officially regulated since 1985 (22), the inflow from abroad is relatively small for most medical professions. Moreover, some health professionals that have been trained abroad and that come to the Netherlands to work are actually Dutch doctors, who finished medical school in the Netherlands but specialized in another country. The majority of such health professionals followed specialized training in Belgium (23) and return to the Netherlands to occupy a position (8,21,24). This implies that the inflow of non-Dutch health professionals is low compared with other countries, such as the UK (22).

Training (elements 12 and 13)
The number of health professionals available in the target year is predicted using different data, including the expected inflow into the specialized training in different years. Attention is paid to the number of women in training in this element, so that feminization of the future workforce can be estimated.

The duration of and return on training are important elements in the model, as they determine the number of graduates and when these graduates enter the labour market (21).

In Table 3, the calculations regarding these developments are illustrated with Dutch GPs. From 10 years of experience, the challenges regarding the measurements for Step 2 of the model can be summarized as follows. First, to calculate the percentage of health professionals that will have left practice before the target year, i.e. Element 8 of the model, information is required about the age, career ambition and work status (active or not) of health professionals. Surveys are used to acquire this information, but the retirement expectations of professionals might not always be reliable, in particular if they are at the beginning of their career. For Dutch GPs, the advantage is that this information can be obtained from survey data and the NIVEL GP registration system.

Table 3 Example of step 2 of the baseline model (scenario 0): General Practitioners in the Netherlands

Part of model	Calculation
There are different developments regarding the available supply of GPs in the Netherlands between 2009 and 2019 that will influence the available supply in 2019:	
Outflow	It is estimated that 38.2% (2,341) of male GPs and 19.2% (785) of female GPs working in 2009 will stop work before 2019. This estimation is mostly based on the GPs' age structure.
Inflow from abroad	It is assumed that between 2009 and 2019, 109 GPs will come from abroad to work in the Netherlands, 46 of whom will be female. It is estimated that 93 of these GPs will still be active in the Netherlands in 2019.
Inflow from training	In the baseline year (2009), there were 1,507 GPs in training, of which 71% were female. The return on training is 98% and therefore 1,477 students from this year will complete their training before 2019. In 2019, 1,320 of them will still be working as GPs. In 2009 and 2010, 1,228 students will start GP training, of which 1,153 will complete their training before 2019. In 2019, 1,054 of these will still be working as GPs. To obtain a complete picture of the size of the inflow from training until 2019, five more years of students, from 2011 to 2016, will have to be taken into account. This means an additional number of 3,070 students will start GP training, of whom 2,883 will graduate before 2019. In 2019, 2,690 will still be working.
There are also developments regarding the required supply of GPs in the Netherlands between 2009 and 2019 that will eventually influence the required supply in 2019:	
Demand developments	It is estimated that the required supply (or health-care demand) will increase by 6.0% as a result of demographic developments in this period.

A second challenge is to achieve a reliable estimation by expert groups on the future number of foreign trained health professionals. Although some information can be used about past international migration, available from the Medical Registration Committee, this still remains a difficult element to estimate as it strongly fluctuates with the labour market conditions in other countries. Finally, collecting reliable information from training institutions on their return on training, i.e. Element 13, can be complicated. This element is calculated as a percentage based on two kinds of information: the number of students starting training and the number of students successfully finishing training. However, training institutions differ in defining these inflow and outflow numbers, due to differences in starting dates and switching behaviour of students within and between training institutions.

Step 3: Calculating the future situation (right-hand side of the model)

The right-hand side column in the model (Figure 1) represents the situation in the target year (T + X). First, the expected total available supply of FTE in the future (element 16) is calculated by multiplying the predicted number of health professionals available (element 9) with the predicted percentage of FTE per health professional (element 15). The number of health professionals available is calculated using several data, including the number of health professionals in the baseline year (element 1) and the outflow of health professionals in the intervening years (element 8). In addition, the future number of available health professionals is influenced by the return on training (element 13), the labour market return of the training (element 14), and the inflow from abroad (element 11).

The required supply of health professionals in the target year, measured as the total number of required FTE (element 7), calculated using the number of FTE required in the baseline year (element 5), is influenced by demographic developments (element 6).

Labour market return and future capacity (elements 11, 14 and 15)

Element 14, in year T + X in the right column of the model, represents the so-called labour market return of health professionals. This element covers the fact that not all health professionals who complete their specialized training start to work in the intended area of specialization. For some professionals this is a career choice, others cannot find the position they want. For example, from 1974 onwards (the start of specialized GP training), 25% of GPs who finished their training did not start to work in their area of specialization. Most of them started working as physicians in other health-care areas. Since the duration of GP training was changed from two to three years in 1987 and the admission procedure has been altered (application instead of admission by lot), the participation rate has risen (14).

The value of element 11 represents the labour market return on migration. This value is a percentage that is based on past international migration and an estimation of the number of health professionals still active after a certain period of time (based on past information). Element 14 represents the labour market return on training. The value of this element is a percentage that is based on the number of students that successfully finish their training and an estimation of the number of health professionals that are still active after a certain period of time (based on past information).

Finally, element 15 represents the future number of health professional FTEs. Information on the average percentage of FTE that health professionals work and on the FTE percentage they wish to work can be obtained from surveys among a representative sample of health professionals.

In Table 4, the calculations of this third step are illustrated using statistics about Dutch GPs. Many of the measurement challenges that have been described for the previous two steps also apply here. Labour market return on training and immigration can be derived from statistics from the Medical Registration Committee. Still, supplementary surveys are needed, in particular to monitor the average FTEs health professional wish to work in the future. These career estimations are queried by questionnaires, and also change within generations, and are therefore associated with certain levels of uncertainty.

Table 4 Example of step 3 of the baseline model (scenario 0): General Practitioners in the Netherlands

Part of model	Calculation
Future available supply	For 2019, it has been predicted that the total number of GPs available will be 12,246; of these, 5,301 will be male and 6,945 will be female. It is estimated that male GPs will work 0.822 FTE and female GPs will work 0.551 FTE on average. Using these numbers, the total available supply in FTE in 2019 can be predicted as 8,187 FTE.
Developments between 2009 and 2019	This number has been derived from the earlier presented estimations: the number of GPs available in 2009 and 2019, the outflow and inflow of GPs between 2009 and 2019, the return on training, labour market return of training, and the inflow from abroad (see Table 3).
Future required supply	For 2019, it has been predicted that the total required supply is 7,807, based on the required supply in 2009 (7,365 FTE, including unmet demand), the estimated gap between supply and demand, and demographic developments until 2019 (which will increase demand by 6.0%).

Step 4: Calculating the gap

Step 4 is the final step of the model simulations. The difference between the required supply and the available supply in the target year constitutes the expected gap between supply and demand (element 17). The target of the simulation model is to reach equilibrium by adjusting the future number of health professionals in training (element 18). See Table 5 for the illustration using Dutch GPs.

Table 5 Example of step 4 of the baseline model (scenario 0): General Practitioners in the Netherlands

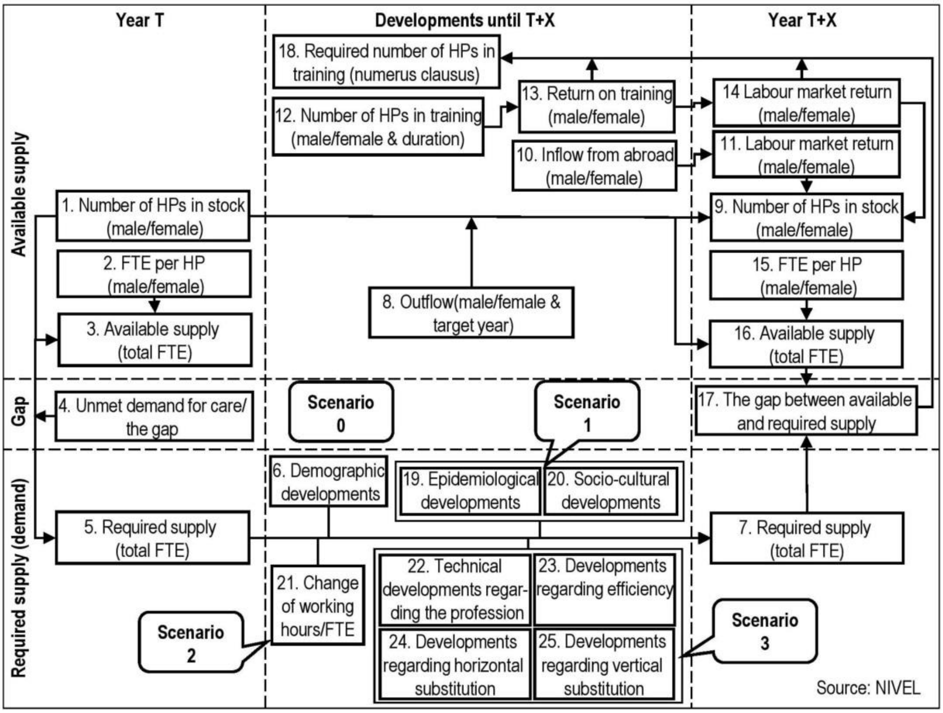
Part of model	Calculation
Difference between supply and demand	As seen earlier, the total required supply in 2019 is 7,807 FTE, while the total available supply in 2019 is 8,187 FTE. This means that if the baseline model is applied, there will be an oversupply in 2019 of 380 FTE.
Future inflow in training	To correct this oversupply, the model calculates that the future number of GPs in training per year should be decreased from 614 to 476.

Description of the extended model: adding elements to create different scenarios
The previous four steps showed how the baseline model (scenario 0) for workforce planning is built. In 2001 and 2004, other elements were added to the baseline model to compose several extended versions of the model. The basic model predicts the future gap between supply and demand of health professionals by including only demographic factors to predict the future demand. New scenarios have been developed to extend the modelling of the future demand for health professionals to improve the model's fit with reality.

Figure 2 depicts what elements have been added to the basic version of the model (scenario 0) on the demand side (lower part), to create the three different scenarios 1, 2 and 3. In practice, these elements are estimations (in terms of a percentage of change between the baseline year and the target year) made by expert groups consisting of representatives of three stakeholder groups: professionals, health insurers and training institutions. The experts base their estimations on information from several sources and on their own experiences. Expert discussions regarding the estimation of the scenario elements are organized in several rounds and on several occasions, not via a predetermined route.

The outputs of the basic and the extended model are calculated in the same way; it is the additional elements that result in the different scenarios explained below.

Figure 2 The Dutch simulation model for workforce planning, version including scenarios



Scenario 1

Scenario 1 adds the influence of epidemiological and sociocultural developments to the model, as well as developments regarding the profession: technical developments, developments in efficiency, and developments regarding horizontal substitution. See Table 6 for the illustration.

Table 6 Example of the extended model (scenario 1): General Practitioners in the Netherlands

Part of model	Calculation
Supply and demand developments	It is assumed that demographic developments will increase the demand for GPs until 2019 by 6.0%, epidemiological developments by 3.0%, sociocultural developments by 5.0%, and technical developments by 1.0%; that developments regarding efficiency will decrease the demand by 2.0%; and that developments regarding horizontal substitution will increase the demand by 5.0%. This leads to the estimation that the required supply in 2019 will be equal to 9,056 FTE.
Difference between supply and demand	As seen earlier, the total available supply in 2019 will be 8,187 FTE; hence, there will be a shortage of 869 FTE GPs if Scenario 1 is applied.
Future inflow in training	To bridge this gap, the future number of GPs in training per year should increase from 614 to 929.

Epidemiological developments (element 19)
This element represents the changes that take place in the prevalence and incidence of diseases, not related to age and gender, which will continue to increase in the case of some diseases and decrease in others. Lifestyle factors, for instance, influence the incidence of certain diseases. For example, if the percentage of smokers continues to decrease, the number of patients with lung cancer, coronary heart disease, stroke, chronic bronchitis and emphysema is expected to decline. On the other hand, the increasing number of obese people will lead to a rise in the incidence of breast cancer, diabetes mellitus and arthritis (14). Health statistics published yearly by Statistics Netherlands and the National Institute for Public Health and the Environment are used as a source for this element. The actual value of this element is defined as a yearly change rate in the demand for a health profession, due to these epidemiological developments, between the baseline year and the target year. This percentage is estimated by experts based on the sources mentioned above, including their own expectations.

Sociocultural developments (element 20)
Element 20 represents sociocultural developments, such as increasing patient empowerment and differences between ethnic groups with respect to their health-

care demands. These developments may lead to an increase in the actual demand for health care and, as a result, an expansion of the required supply for health care (14). The value of this element is defined as the yearly growth rate in demand for health professionals due to these sociocultural developments, which are also determined by expert estimations (Table 1).

Technical developments and developments in efficiency (elements 22 and 23)
These two model elements represent technical developments regarding the profession and changes in relation to efficiency. Technical developments as a part of the labour process depend strongly on the type of medical speciality and the research and development regarding this medical speciality. The proportional influence of this factor on the future demand for a health profession is estimated by experts, preferable from the specific medical domain or specialty. Medical technical developments can be of great influence on the productivity of health-care services and providers. Many innovations occur in prevention, diagnostics and therapy. Apart from actual developments, there is an increase in the expectations regarding these innovations. As a result of the changing and complicating clinical pictures (multimorbidity) caused by the ageing population, more future technical developments are expected regarding these specific cases. The computerization of the health-care system, which mainly involves supporting processes, is also an area with many innovations.

Developments regarding horizontal substitution (element 24)
Horizontal substitution refers to the shift of tasks between different professions of the same occupational level, e.g. shifts between physiotherapists and occupational therapists. Horizontal substitution can occur within larger health-care organizations such as hospitals, but also in primary care.

Professional associations are mostly asked to estimate the value of this element. In addition, information about referrals can be used to determine if activities are (or will be) shifted to other professions and which activities are involved (14,25), causing changes in the future demand for certain health professionals.

During the last 10 years that scenario 1 has been applied in Dutch workforce planning, several challenges have been met. Clearly, elements 19, 20, 22, 23 and 24 are fully dependent on the estimation by expert groups and their ability to forecast and project. To avoid dominance of one interest group, the expert groups consist of representatives of professional associations, training institutions and health insurers. The experts are instructed to base their estimations partly on their own experiences, but also use information from research on specific topics. The decision-making process of these expert groups does not take place via a predetermined route, but has been guided and supported intensively by the Advisory Committee on Medical Manpower Planning during the last years. For the future, a more structured approach to expert consultation will be sought.

Scenario 2

After scenario 1 was developed, scenario 2 was introduced in Dutch workforce planning. This scenario adds the change in working hours per FTE (element 21) to the projection of the future demand. This element accounts for the tendency of health professionals to work fewer hours (26). This scenario element is not based on the labour market behaviour of health professionals but on the system in which they are active. During the last few decades, in many sectors of the Dutch labour market there has been a growing tendency towards reducing the formal working time (working hours-to-FTE ratio), to decrease the strain on the labour market, to increase job quality, and to improve the relationship between work and leisure time. Element 21 is mainly introduced in the simulation model to incorporate this trend and incorporates an estimation of developments that lead to a reduction in working hours, based on the desire of the future generation of health professionals entering the labour market, in particular the female health professionals (Table 7). Expert groups estimate this element as the annual (expected) change in the demand for health professionals, due to a structural reduction in working hours. As addressed above, improving the reliability of this prediction by experts is a key challenge.

Table 7 Example of the extended model (scenario 2): General Practitioners in the Netherlands

Part of model	Calculation
Supply and demand developments	In Scenario 2, the developments of Scenario 1 are repeated and in addition experts assume that the developments of working hours per FTE will neither decrease nor increase the demand for GPs for this period. This means that the estimated required supply in 2019 will be equal to 9,056 FTE (same as in Scenario 1). In contrast, as is depicted in Figure 3, for other years (2000, 2003, 2006) a certain amount of change in working hours per FTE was estimated (Scenario 2).
Difference between supply and demand	As we saw earlier, the total available supply in 2019 will be 8,187 FTE, which means that there will be a shortage of 869 FTE GPs if Scenario 2 is applied (same as in Scenario 1).
Future inflow in training	To bridge this gap, the future number of GPs in training per year should increase from 614 to 929 (same as in Scenario 1).

Scenario 3

The third and last scenario 3 is based on developments regarding vertical substitution (element 25). This element was added to the simulation model in 2006 (27). Vertical substitution is the shift of activities between health professionals of different professional/educational levels, e.g. shifts between GPs and nurse practitioners. Similar to horizontal substitution, information about referrals and task delegation are used to measure vertical substitution. Experts are informed by this information to estimate the degree to which activities are shifted from one profession to another in different domains of health care (Box 6) (25). Expert groups estimate this element in terms of the percentage of (expected) annual change in the demand for care for health professions, due to vertical substitution.

The calculations regarding this scenario are illustrated in Table 8 using Dutch GPs.

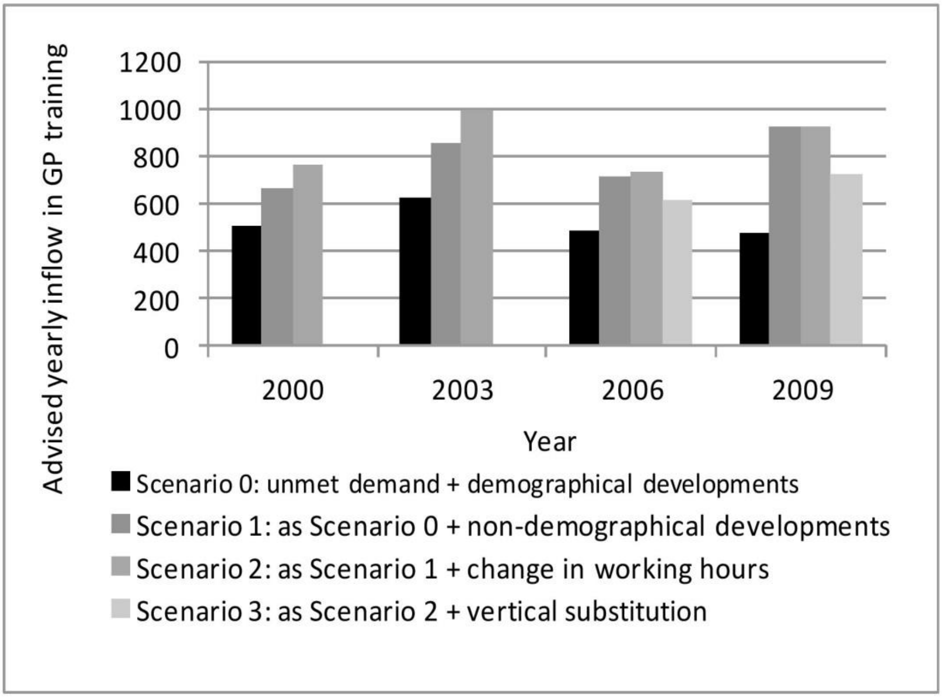
Table 8 Example of the extended model (scenario 3): General Practitioners in the Netherlands

Part of model	Calculation
Supply and demand developments	In Scenario 3, the developments of Scenario 1 and 2 are repeated and in addition experts assume that the developments regarding vertical substitution will decrease the demand for GPs by 6.0%. It is estimated that the required supply in 2019 will be 8,512 FTE.
Difference between supply and demand	As we saw earlier, the total available supply in 2019 will be 8,187 FTE, which means that there will be an undersupply of 325 FTE if Scenarios 3 is applied for this period.
Future inflow in training	To bridge this gap, the future number of GPs in training per year should increase from 614 to 732.

Advice based on the simulation model for inflow in GP training, 2000–2009

The inflow in the first year of specialized training (the numerus clausus) has been adjusted to respond to the developments in the labour market for GPs. Taking the Dutch GP workforce as an example, during the last decade the required inflow in specialized training strongly varied by the different scenarios that were applied. Figure 3 shows the results of the Dutch simulation model as applied at four years during the period 2000–2009. Scenario 0 generates the highest inflow advice in the year 2003, but results in lower inflow numbers advised in the years following. The other scenarios 1, 2 and 3, including expert estimations regarding additional demand developments, have a strong effect on the training inflow advice. For example, between 2000 and 2009, the inflow numbers advised according to scenario 1 were the lowest for 2000 and 2006, but the highest for 2009. In the same period, the inflow advised as generated by scenario 2 were lowest for 2000 and 2006 but the highest for 2003. This is due to the fact that in 2006 and 2009 little or no effect of the change in working hours was expected. In 2006 and 2009, the inflow advice generated by scenario 3 was the lowest, due to inclusion of the (then) expected substitution effect on the demand for GPs (27).

Figure 3 The advised yearly inflow of GPs in training according to different scenarios



Source: NIVEL

In brief, the figure shows that the results of the scenarios (the advised number of GPs to be trained) mostly increased when adding more developments to the scenarios. An exception is the addition of vertical substitution to scenario 3, which leads to a decrease in the advised number of GPs to be trained.

The policy decision-making process versus the advice

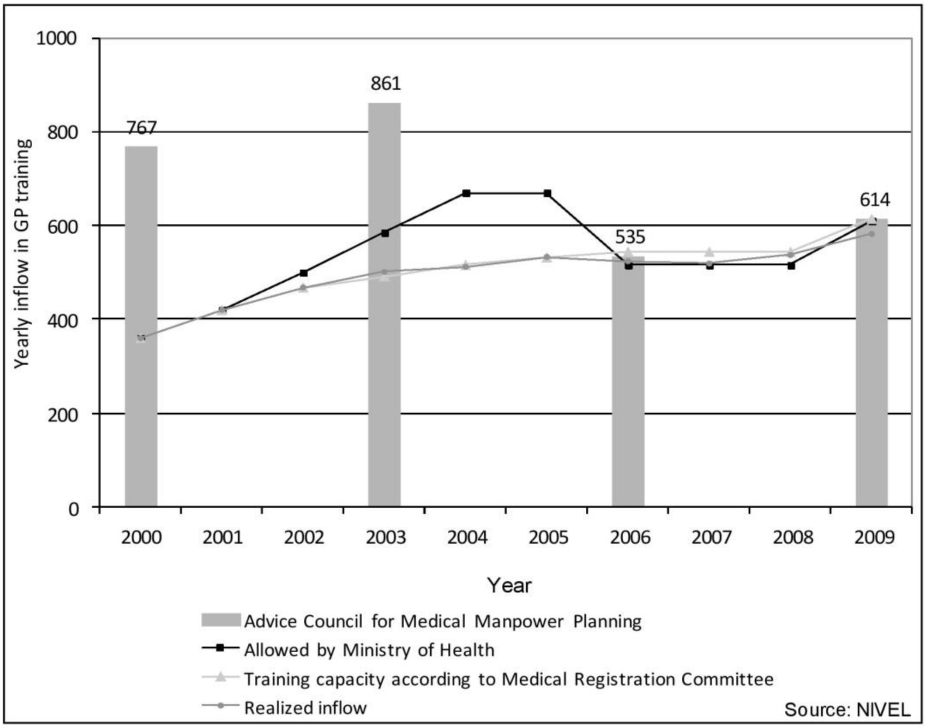
Since the foundation of the Advisory Committee on Medical Manpower Planning in 2000, the outcomes of the simulation model have become the start of a complex process of decision-making. Within the Dutch workforce planning system for health professionals, the political process of decision-making is an important part (28). The inflow numbers advised as a result of the scenarios of the simulation model indicate a direction in policy rather than determining the exact number of GPs to be trained, because the different outcomes of the scenarios result in differences in the inflow advised.

When the model simulations, including the different scenarios, have been carried out, the draft inflow recommendations are discussed by the plenary platform of the Advisory Committee. This platform determines the advice to give to the Ministry regarding the yearly inflow in training for health professionals. This advice is subsequently discussed with the Ministry of Health, Welfare and Sport. After the Ministry and national government have decided on the total budget for the training of all (academic) health professionals, this budget steers the numbers that are used to advice medical faculties, schools and universities on their annual student enrolment number.

The decision-making process is complex because different stakeholders with different interests are involved. For example, health insurers are interested in high numbers of medical specialists, as a certain level of oversupply can result in competition and thus may decrease prices. Educators strive to have stable student numbers because teaching capacity is difficult to adjust. Professional organizations often prefer a lower number of medical specialists than insurers because they are averse to too much competition; however, they do want enough young GPs and specialists to take over practices (29).

The policy positions about entry numbers in GP training remain a potential point of discussion between stakeholders. Figure 4 depicts what the actual inflow in GP training was in 2000, 2004, 2006 and 2009, compared with the advice based on the model scenarios. The grey bars represent the advice of the simulation model (taken over by the Advisory Committee on Medical Manpower Planning); the different grey-scale lines represent the inflow allowed by the Ministry, the potential inflow according to medical schools and the Medical Registration Committee, and the realized inflow. As is depicted in the figure, the yearly inflow numbers in training preferred by the various stakeholders are different from the advice generated by the simulation model and theAdvisory Committee. This is particularly the case between 2000 and 2006. Since 2006, when scenario 3 was implemented in the simulation model, the differences in the preferred level of GP training inflow between stakeholders have become smaller. In 2006 and 2009, there seems to be a greater tendency for stakeholders (Ministry, Registration Committee, training institutions) to agree with the advice generated by the simulation model scenarios and the advice of the Advisory Committee.

Figure 4 Preferred yearly inflow numbers of different stakeholders into GP training and the realized yearly inflow



Discussion and evaluation

This paper has presented the evolution and structure of the simulation model for health workforce planning in the Netherlands. Data and information about the Dutch GP occupation has been used as an example, to describe the different steps of the simulation model, and to explain the policy process with regard to the preferred yearly inflow in GP training. It has been shown that the Dutch model for health workforce planning is directed at reaching an equilibrium between the supply of and demand for different health professionals. Different scenarios have been developed to improve the fit of the simulation model with reality, and to create a 'decision space' for policy makers and stakeholders.

The basic proposition is that health workforce planning controls unintended cyclic labour market fluctuations, and helps to avoid societal waste and loss of quality, both in the consumption and production of health care. Can we conclude from the Dutch experience that this is the case? In the previous sections, we have described that the Dutch model for workforce planning for physicians is accepted by stakeholders and has supported the numerus clausus and specialization inflow policy of the Ministry for 10 years. In this respect, the Dutch model is a success. The model is not without complications and challenges, however. Most of these challenges have been described, like the reliability of surveys as data sources, and the need to use mix methods to validate experts' estimations. Secondly, the relevant question is whether the system of health workforce planning has been successful in ensuring a balance between health supply and demand in the Dutch labour market in the last 10 years. To answer this question for the example of Dutch GPs, we can investigate four indicators to measure labour market balance.

1. The first indicator is that in 2000, the Advisory Committee on Medical Manpower Planning estimated that the unmet demand for GP care was 5%. In 2010, the Advisory Committee stated in its report that this unmet demand is close to 0%. Within 10 years, the labour market for GPs has become stable, as there is no national shortage or oversupply of GPs (30).

2. A second indicator is that the number of vacancies is low. According to the weekly magazine of The Royal Dutch Medical Association (Medisch Contact), the number of vacancies over the last years has been stable and relatively low. In 2010 there were 1.7 vacancies per 100 GPs on average (31).

3. The third indicator is that most GPs who complete the specialized GP training find an appropriate place to work. In 2000, 7.2% of active GPs were searching for their desired type of practice. In 2010, this proportion had fallen to 6.5%. According to a survey among practice seekers and locum GPs, these GPs generally found their preferred kind of practice quite quickly in both 2000 and 2010 (32).

4. The fourth and final indicator is the stability of GP density. In 2000, there were 2483 Dutch inhabitants per 1 FTE GP. In 2009, this figure was 2350 inhabitants per FTE (30,33). Hence, the inhabitant-to-GP ratio is stable and actually increased slightly, which may also reflect that the unmet demand for care has been compensated in the last decade.

Based on these four indicators, it appears that workforce planning of GPs has been successful in sustaining a balance between supply and demand.

Our analysis of the Dutch system also showed that the advice by the Advisory Committee, based on the simulation model, has not always been implemented on a one-on-one basis. Figure 4 shows that, in 2000, the advised inflow in GP training was higher than the inflow that has been realized in that year. Figure 4 also shows, however, that in the following years, the inflow in specialized training for GPs was increasing, and that the gap between the advised and realized number was decreasing. This demonstrates that it takes time for the workforce planning system to adapt to practice, and vice versa. A specific condition in 2000 was that the high advised inflow in GP training in 2000 was used to 'signal' to the field an potential upcoming shortage of physicians. To take unexpected developments into account, the workforce planning exercise is carried out approximately every three years for all medical professions. By repeating and adjusting the simulation model and its element values regularly, the planning model can be increasingly in line with actual developments.

In this section of evaluation and conclusion, we finally reflect on the 'policy value' of the model. To do so, we apply six criteria that Don and Verbruggen (34) formulated to evaluate models that are designed for policy objectives.

The first criterion they formulated is "qualitative plausibility". All model elements have to be comprehensible and interpretable in qualitative terms, with the relevant economic theory as the guiding principle. The economic theory applied in the Dutch model of workforce planning is the principle of finding an equilibrium between supply and demand in the labour market in the current time and in the future. This assumption is supported by the theories of Abbot (35) and Thurow (36). Also, the principle of markets being controllable by policy actions is used in this model.

The next three conditions are all supported by the fact that repeated measures registration data provides information regarding several elements in the simulation model. The second criterion (the first of these three conditions) is "quantitative plausibility". According to this criterion, the elements of the model should have realistic numerical values in the light of stylized facts, input–output ratios and institutional knowledge. Most elements of which the Dutch model is composed are based on information from these types of repeated measures registration data, which are updated regularly. Some elements are an exception to this: these scenario elements are determined by expert estimations.

The third criterion reflects the required “broad correspondence of the model with results of empirical studies”. Estimation results can only be interpreted according to the hypothesis that we know the real model. To acquire information for the elements of the Dutch model, results of repeated and validated studies and surveys are used as illustrated earlier in this paper. The use of this kind of data implies that the results of the model simulations have a close connection with reality.

The fourth criterion represents the need for a “good match with recent data”. The main applications of a model tend to relate to the future, and therefore it is important to use up-to-date information and that the model can describe the recent economic situation, i.e. the starting point of the analysis. For this reason, to keep the data for the Dutch model up to date, results of repeated studies and annual registration data are used, for example from the Medical Registration Committee and the NIVEL GP registration.

The fifth criterion demands “good simulation characteristics” of the model as a whole: plausibility of the equations and their interrelationships, including the analyses of policy scenarios and uncertainty ranges. The equations used in the Dutch simulation model are simple, and most relationships are straightforward and designed close to reality, which is also concluded by Smits et al. (29). They are, to a large extent, based on demographic information. The extension with scenario elements is numerically simple, because a percentage of change is used to calculate the scenario results. The scenarios are included to show uncertainty. The equations and scenarios have been explained more extensively earlier in this paper.

The sixth condition is the “suitability of the model for the analysis in question”. All the relevant relationships which play a role from the theoretical economic perspective should be incorporated into the model and correctly quantified.

From the six evaluation points, it can be additionally concluded that the Dutch model is a comprehensive model that probably include all relevant factors, while it is also a parsimonious model. It is considered important to find a trade-off between a small and simple model and a large and complex model. A large model would reflect reality in the most complete way, but it may lead to a very complex, and as a result, unstable model. For this reason, the Dutch simulation model actually has to be parsimonious to remain stable. As concluded earlier, the model has been accepted by the different groups of stakeholders, who inspect the model and interpret its outcomes every time new calculations are executed, to advise the Ministry.

Conclusion

We can conclude that the health workforce planning model that has been in use in the Netherlands for the last ten years, has significant policy value and has been successful in stabilizing the labour market for physicians. In the previous sections, the workforce planning system and the simulation model is broadly described and evaluated. Obviously, there are also other performance measurements for workforce planning and labour market stability. For example, one can opt to do workforce planning based on a normative framework of the skills or competencies that are demanded in health-care services, projecting the ideal skill-mix of health professionals at the organizational level (37,38). Or one could depart from the notion that misfits as underemployment (11-13) or overeducation (39-41) are to be minimized at the health-labour market, and base workforce planning on this type of goals.

It should be recognized that the current health workforce planning system in the Netherlands aims to achieve a numerical equilibrium in the labour market, taking into account the qualitative fit between supply and demand. In this respect, the planning system and the model are accepted by policymakers and stakeholders. In principle, the model can be used for all types of medical and allied health professionals, as the model is designed as “one size fits all”. Another strength of the model is its flexibility. The elements for non-demographic changes can encompass several types of developments that are modelled as expected percentages of yearly change (delta). This makes it numerically easy for experts to estimate trends in terms of relative changes, not absolute numbers. Thus it is easily expandable with different scenarios by using the different elements that represent demographic and non-demographic developments. Still, several weaknesses of the model have also become clear. The simulation model as such is complex, because it contains many elements, heuristics, submodels and data sources. In addition, the model is not capable of fully simulating the demand and supply of different medical professions in conjunction, i.e. to model systems of profession and training. This is an important weakness of the model, as interactions between health-care professionals are becoming more and more important in view of horizontal and vertical substitution, skill-mix perspectives and the mutual interaction between professional and educational systems in health-care (42). The fact that workforce planning in the Netherlands occurs at a national level can also be considered a limitation as well. It might become problematic to control regional labour market tensions, such as GPs having difficulty finding successors for their practices. Other countries that are starting or re-evaluating workforce planning in health care can learn from the strengths and weaknesses of the Dutch model and the experiences as presented in this paper. However, health-care systems and health-labour markets in other countries will certainly deviate from the Netherlands at some or many points. Future international comparative research needs to be conducted into the possibility to adapt the simulation model to these aspects (43).

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Abstract

Several countries have implemented policies to control physician training intake and physician density to ensure a balance between supply and demand. Little is known about the effect of these policies. In this paper, Dutch training intake policy for General Practitioners (GPs) is studied, which has changed several times between 1970 and 2010. The relationship between policy and density was evaluated, by an ex-post comparison of the factual and counterfactual GP density, i.e. the density if the policy would not have been implemented. The Dutch workforce projection model was used to perform these analyses.

A historical overview shows that GP training policies evolved from ad hoc supply-driven decisions to decisions based on long-term workforce planning. The counterfactual analysis demonstrated that restrictions in student intake slowed down the growth rate of Dutch GP numbers and kept GP density relatively low. Despite the difficulty of retrospectively assessing the 'net' impact of policies, this study shows that in using counterfactual analyses the relationship between GP training intake policies and GP density can successfully be investigated ex-post. It also demonstrates that new GP training intake policies take at least 10 years to affect GP density. Long-term workforce projections are useful in obtaining insight in long-term policy consequences and avoiding ad-hoc decisions and fluctuations in student intake.

Introduction

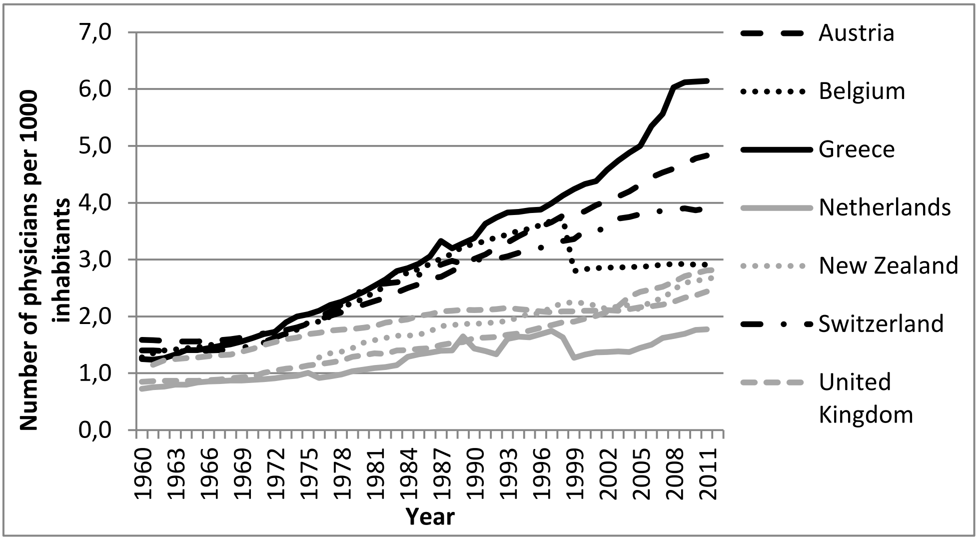
Several OECD countries (1) have policies to influence in- and outflow of physicians and to control physician density. What is considered an adequate density is based on proposed thresholds for workforce-population ratios, or on demand-based considerations of the match between supply and demand. In both cases, a particular physician density is not likely to emerge spontaneously. Employment in the field of health is not a classic labour market due to restricted entry to the workforce through licensing, limited training intake and negotiated wages (2).

Physician density is often used as an indicator of labour market balance, i.e. the balance between health care supply and demand. In density, demand is usually indicated by general population numbers. Supply is indicated by developments in the number of physicians and depends on the inflow into the workforce through training and immigration and possible settlement policies and the outflow through emigration, retirement, death and career changes.

Policy interventions to influence the in- and outflow of healthcare professionals (and thus physician density) are aimed at one or more of the following.
Intervening in basic medical training and/or vocational training intake is the first example. Intervening in basic medical training intake is observed as an effective measure to limit the size of the total physician workforce (1). Imbalances between supply of and demand for specific specialties can, however, occur if vocational training intake is not regulated as well. A combination of these measures is frequently deemed most efficient.
Alternatively, interventions can focus on regulating the inflow into the workforce more directly, for example, by work permits. However, these measures can cause unemployment among newly trained physicians. An additional measure is that workforce inflow can be supplemented with physicians from abroad. This inflow is difficult to influence.
The outflow from the physician workforce through emigration, retirement and career changes can be subject to policy measures. Policies stimulating the early or late retirement of physicians are the most common measure to influence the workforce size.

A majority of OECD countries have some sort of numerus clausus for basic physician training (1, 3, 4). Countries without a numerus clausus tend to leave medical school entry to market forces (or at least to decentralized mechanisms). These different approaches partly explain why countries differ in physician density. Figure 1 suggests that the increase in physician density has been much higher in countries that have not centrally planned (or only recently started planning) medical school intake (based on(1)). Those countries include Austria, Belgium (which introduced the numerus clausus policy in 1997), Greece and Switzerland. Countries with a numerus clausus policy include Canada, Japan, New Zealand, the United Kingdom and the Netherlands (1, 4). To investigate the relevance of this relationship over time, an in-depth study focusing on one specific medical profession in one single country is conducted.

Figure 1 Influence of planning and market regimes on physician density in selected OECD countries, 1960-2000 (Source: OECD Health data 2013; Online database Statistics Netherlands)



Notes: Data for Austria, Belgium and Japan refers to practicing physicians that provide services directly to patients. Data for Greece, New Zealand, Switzerland, UK and Canada refers to professionally active physicians including practicing physicians and other physicians for whom their medical education is a prerequisite for the execution of the job.
Break in time series for Belgium: Data from 1999: Number of physicians with a minimal volume of patient contacts; Data up to 1998: Number of physicians who carried out at least one reimbursed medical act during the year.
Data for the Netherlands is extracted from the online database of Statistics Netherlands. Break in time series for the Netherlands: Data from 1999: Number of practicing physicians in health care, based on registered physicians. Without double counts; Data up to 1999: Data from several sources, partly including inactive physicians and with double counts.

The Netherlands is one of the countries that has planned medical school intake for a number of years. Student intake in vocational training for general practitioners has also been regulated for a long time. Furthermore, when looking at macro numbers, Dutch physician density has been increasing slowly (Figure 1). Also, compared with other OECD countries GP density has been relatively low in the Netherlands (5).

Due to this low density, the patient list size of Dutch GPs has been relatively large in the period from 1970 to 2010 (approximately 2,400 standard list size per FTE GP) compared with other countries. GPs' workload in the Netherlands has been a topic of discussion for several decades. GPs presumably improved their efficiency to cope with the increased workload (6). Increasing GP training intake was, however, not one of the measures implemented to reduce workload.

Detailed longitudinal data are available about the size and composition of the Dutch GP workforce. These data make it possible to analyze Dutch GP density in relation to policies concerning GP training implemented in the Netherlands, over time. Four periods can be distinguished in which there were changes in training policies – each policy with a distinct reason for its introduction – between 1970 and 2010. The goal of this study is to analyze the relation between GP training policies and GP density in the Netherlands and to answer the following question:
How did GP training policy evolve between 1970 and 2010, and what was its relation to Dutch GP density during that same period?

Materials and methods

To answer the research question the relationship between GP training policies and GP density in the Netherlands is investigated. An ex-post counterfactual analysis is performed, using the Dutch workforce projection model. Counterfactual analysis is a comparison between what actually happened and an estimate of what would have happened in the absence of the intervention (7). In this study, the so-called supply side of the Dutch health workforce projection model is used to conduct the counterfactual analyses.

The Dutch health workforce projection model has been developed for health workforce planning in the Netherlands. It is designed to calculate the required annual student intake, per physician speciality, to achieve a (future) balance between health supply and demand. These calculations take all relevant developments and expectations with regard to supply and demand of specific physician specialities into account. Based on this model, the Advisory Committee on Medical Manpower Planning (ACMMP) advises the Ministry of Health on the required student intake, once every three years (8-11). In this paper, we focus on the interaction between GP training intake policies and GP density in the Netherlands and therefore only use the so-called supply side of the projection model to calculate the counterfactual GP density. This part of the model consists of several elements that project the future supply of health professionals: the number of practising health professionals, the amount of the full-time equivalent (FTE) they work, the estimated inflow of new GPs from training and return on GP training and labour market return, the estimated outflow and the estimated inflow from abroad and its labour market return (11). In most cases, these elements project the required workforce size in the next 10 to 15 years. In the case of this paper, it estimates the counterfactual GP workforce for a number of periods in the past.

Comparing factual and counterfactual GP density

The factual and counterfactual GP densities in the Netherlands, which are further explained below, are compared across four historical periods in which GP training policies have changed. This is performed to investigate the relationship between these policies and GP density. The following measures have been implemented or changed at four specific moments in time:

- The introduction of numerus clausus for medical schools (1972) and the introduction of one-year vocational GP training (1973) with an, in principle, unrestricted student intake.
- The extension of GP training from one to two years (1988) with a decreased intake.
- The extension of GP training from two to three years (1994) with gradually expanding intake.
- The foundation of the Advisory Committee on Medical Manpower Planning (ACMMP) (1999) and its first advice on GP training intake (2000). The intake was gradually increased after this advice was taken into consideration.

The four periods above are delineated by the introduction of each policy measure and each period ends before the next policy measure was implemented, i.e., 1970-1985, 1985-1995, 1990-2005 and 2000-2010. This division of periods was used to minimise the interference of effects of preceding or subsequent policies and thus to approximate the 'net' influence of a specific policy change. Below, we explain the methods for calculating the factual and counterfactual GP densities. In the following section, we describe the policy developments and the circumstances during these periods under scrutiny using a narrative literature review and consulting several policy documents.

Factual GP densities

The factual GP densities are calculated by dividing the total factual FTE of practising GPs from 1970 to 2010 by the number of inhabitants in the corresponding years. GP data were retrieved from the NIVEL GP database, which provides longitudinal data about the careers of all Dutch GPs (10, 12-14). The number of inhabitants was retrieved from the online database of Statistics Netherlands (15).

Counterfactual GP densities

As indicated earlier, the counterfactual GP densities in the Netherlands during the period 1970-2010 are calculated using the Dutch projection model. For this calculation, the first step is to replicate the factual developments for all elements of the model to base the counterfactual density on.

To replicate all elements of the factual GP workforce, the number of active GPs in 1970, 1980, 1990 and 2000 was retrieved from the NIVEL GP database, as well as the factual outflow after 5, 10 and 15 years, the factual inflow from abroad and its labour market return after 5, 10 and 15 years, the factual student intake, and the return on training and labour market return (of physicians from Dutch training) after 5, 10 and 15 years.

Then, to estimate the counterfactual GP densities in four historical periods it is assumed that the policy changes regarding GP training length and student intake (as described above) would not have been implemented. Therefore, the factual GP training intake is replaced by the counterfactual intake (because this is the crucial element that is changed by the implemented policies). The values of all other elements of the model are maintained as factual or ‘observed’. Hence, the other elements in the model influencing GP density (such as return on training) are assumed as being constant to focus on reconstructing the net influence of GP training policy.

Below, for each of the four periods studied, the estimation of the counterfactual student intake in GP training is discussed in detail.

1970 – 1985: The counterfactual number of GPs in 1975, 1980 and 1985 is estimated as if one-year vocational GP training was not introduced, and there was no numerus clausus for medical schools. The estimated annual inflow into the GP workforce (from medical school) is used to project the counterfactual GP workforce size in the prognosis years. This inflow is based on the increasing number of medical graduates, which is derived from the growing number of university graduates in general from 1970 onwards. This corresponds with the trend of increasing participation in higher education in the Netherlands and other OECD countries (16). For further explanation of the performed calculations, see appendix I.

1985 – 1995: The counterfactual number of GPs in 1990 and 1995 is estimated as if GP training was not extended from one to two years and if student intake was not decreased. The annual student intake of 1985 (500) – the annual student intake before the policy changed – is used to project the counterfactual GP number in the prognosis years.

1990 – 2005: The counterfactual number of GPs in 1995, 2000 and 2005 is estimated as if GP training was not extended from two to three years and if student intake was not expanded gradually from 1994 onwards. The annual student intake of 1990 (280) is used to project the counterfactual GP number.

2000 – 2010: The counterfactual number of GPs in 2005 and 2010 is estimated as if the Advisory Committee on Medical Manpower Planning was not founded and if it would not have recommended the government to increase student intake. The annual student intake of 2000 (360) is used to project the counterfactual GP number.

Results

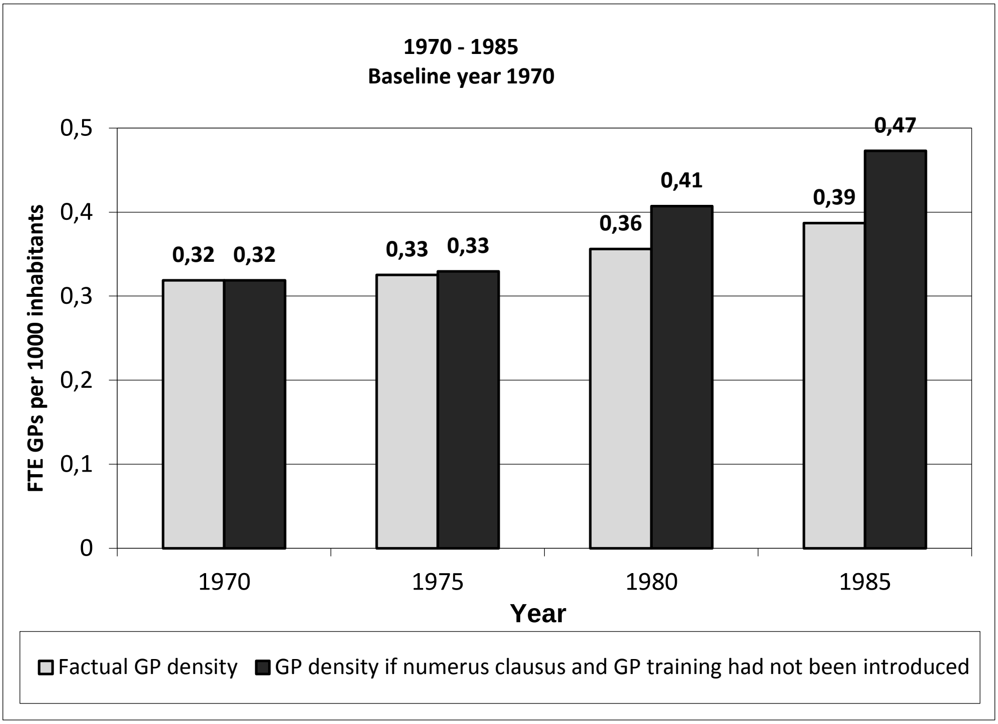
In the figures below, the factual and counterfactual GP densities are depicted and compared for the four key periods between 1970 and 2010, as described in the previous sections. The results of the comparison between factual and counterfactual GP densities are discussed drawing on the policy measures that were introduced or changed during the investigated periods and by reflecting on the circumstances that influenced these policies.

Difference between factual and counterfactual GP densities in 1970-1985

Before 1972, universities autonomously decided on medical training intake, but medical school capacity was not sufficient to cope with the growing number of medical students. To expand capacity, the government opened two new medical schools in 1966 and 1974 (17, 18). Capacity problems were, however, not solved as student numbers continued to increase. In 1972, a numerus clausus for medical schools was introduced and in 1973, one-year vocational training for GPs. Medical school graduates could previously become GPs without additional training.

Figure 2 shows that factual GP density increased between 1970 and 1985. If numerus clausus for medical schools and vocational GP training (with a high student intake) had not been introduced, counterfactual GP density would have increased 20% more during this period. There would have been 2,114 inhabitants per FTE GP on average instead of 2,585 in 1985.

Figure 2 Effect on GP density of introduction numerus clausus/ one-year GP training (observed) compared with no numerus clausus/no GP training (counterfactual)



Circumstances of the implemented policies in 1970-1985

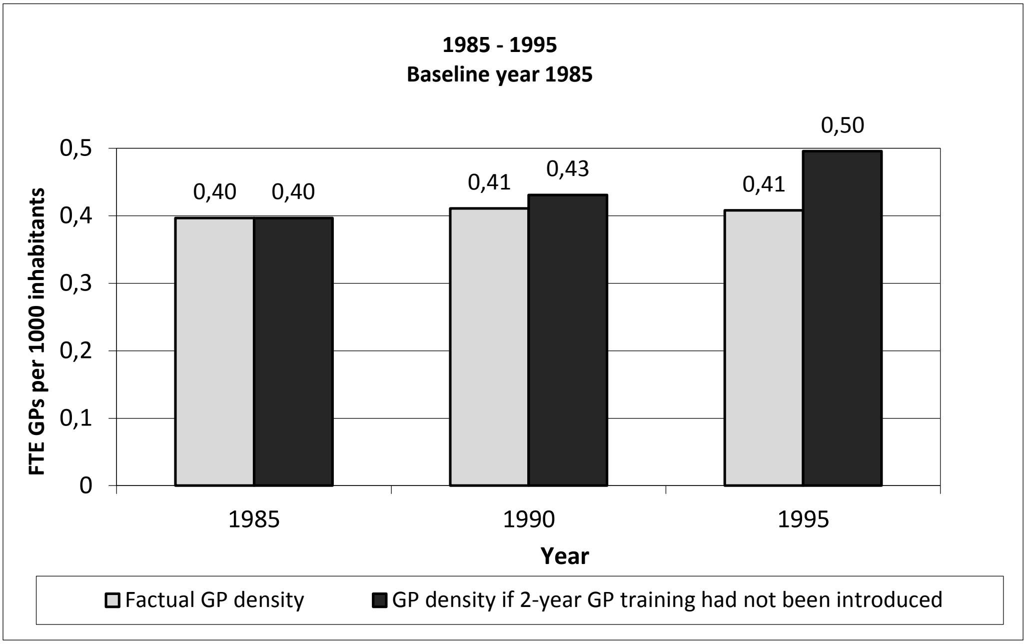
From the early 1960s, which was the beginning of a period of continuing economic growth, the government loosened regulations for the developing health care sector, which resulted in steadily growing health care expenditures (19). From 1972 onwards, the economy started to decline, and the government expressed concern about the sharply increasing health care costs (20). Governmental influence on the health care system was increased to reduce the costs of the public expenditures. Furthermore, hospital care was targeted to be substituted by a strengthened primary care sector. By enforcing the gatekeeping role of general practitioners, the government hoped to control expenditures (21). In combination with the development of general practice into an independent medical specialty, the GPs' central role in the Dutch health care system was reinforced (22).

Difference between factual and counterfactual GP densities in 1985-1995

The extension of vocational GP training from one to two years in 1988 influenced (factual) GP density. Student intake for one-year training was high (500 per year). After the length of vocational training was extended to two years, student intake was restricted because the extension was not allowed to influence the budget (23).

Figure 3 shows that the factual GP density increased minimally between 1985 and 1990 and remained at the same level in 1995. If vocational GP training had not been extended with one year in 1988 and annual student intake had not been restricted, GP density would have increased 22% more during this period. There would be 2,018 inhabitants per FTE GP in 1995 instead of 2,452.

Figure 3 Effect on GP density of two-year GP training and a restricted inflow (observed) compared with one-year GP training and high inflow (counterfactual)



Circumstances of the implemented policy measure in 1985-1995

Professional organizations and several advisory committees believed one year of training would not provide GPs with enough experience to fulfil their central role in a strengthened primary care sector. They advised the government several times to extend the length of GP training and decrease student intake (22, 24-28). The advice to decrease student intake was motivated by financial reasons (extension of training had to be budget neutral) and by a perceived oversupply of GPs (29). In 1985, the government extended GP training and reduced student intake by half (22, 30). Additionally, European guidelines regarding the minimal duration of GP training (two years) were introduced (22).

Between 1985 and 1991, the government published white papers regarding workforce planning for the health care sector and social services (31-34). These white papers argued for the maintenance of the contemporary physician-to-population ratio and cost containment seemed to be their focus.

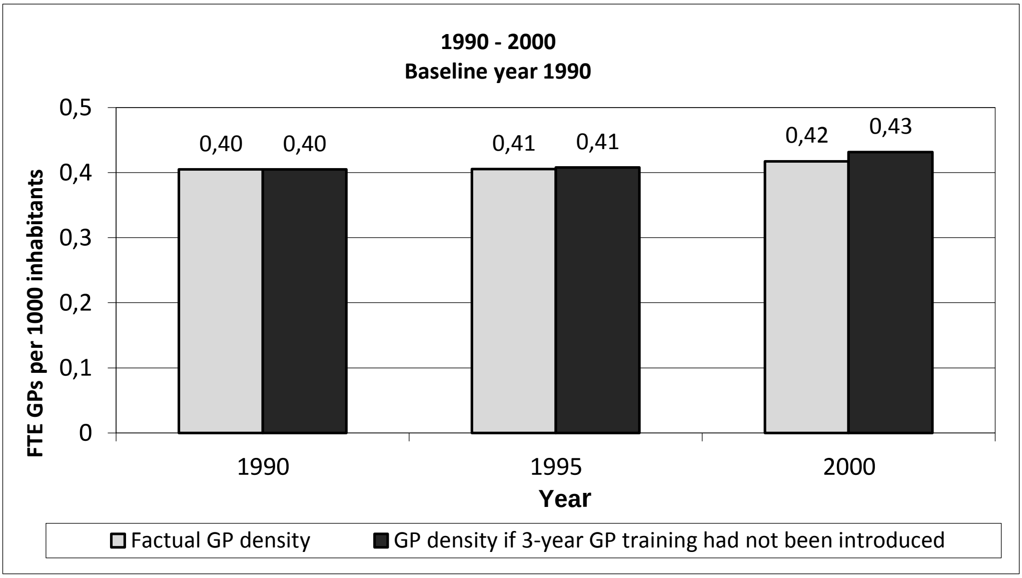
Between 1985 and 1992, a governmental policy was in force that had the objective of improving the distribution of general practice locations (29) by locally regulating the number of general practice locations. This policy had an additional effect; it tempered the rapid increase of the GP workforce because not all newly trained GPs were able to find a location they desired for their practice.

Difference between factual and counterfactual GP densities in 1990-2000

In 1994, GP training was extended from two to three years, and the annual student intake was gradually expanded from 280 to approximately 400. An evaluation committee concluded that two years of GP training was not adequate enough to train GPs for their role as gatekeeper (35).

Figure 4 shows that the factual GP density did not increase between 1990 and 1995 and only minimally between 1995 and 2000. If vocational GP training had not been extended with one year and student intake had not been expanded (but remained 280 per year), counterfactual GP density would have increased 3% more than the factual density. There would be 2,317 inhabitants per FTE GP in 2000 instead of 2,397.

Figure 4 Effect on GP density of three-year GP training and an expanding inflow (observed) compared with two-year GP training and a restricted inflow (counterfactual)



Circumstances of the implemented policy measure in 1990-2000

In 1992, the government abstained from health workforce planning and mainly focused on monitoring the workforce. Keeping the physician-to-population ratio constant was the main goal.

The National Council for Public Health advised the government on workforce planning for general practitioners (36).

During the 1990s, concerns arose about an increasing GP shortage (37, 38). Several societal developments were identified as influential in this perceived shortage, such as a growing number of female GPs (who generally work less FTE), a general tendency towards more part-time work and an increasing demand for GP care (37). To compensate for these developments, the GPs' professional association and National Council recommended increasing student intake in GP training (39). In 1994, GP training was extended, and the annual student intake was increased.

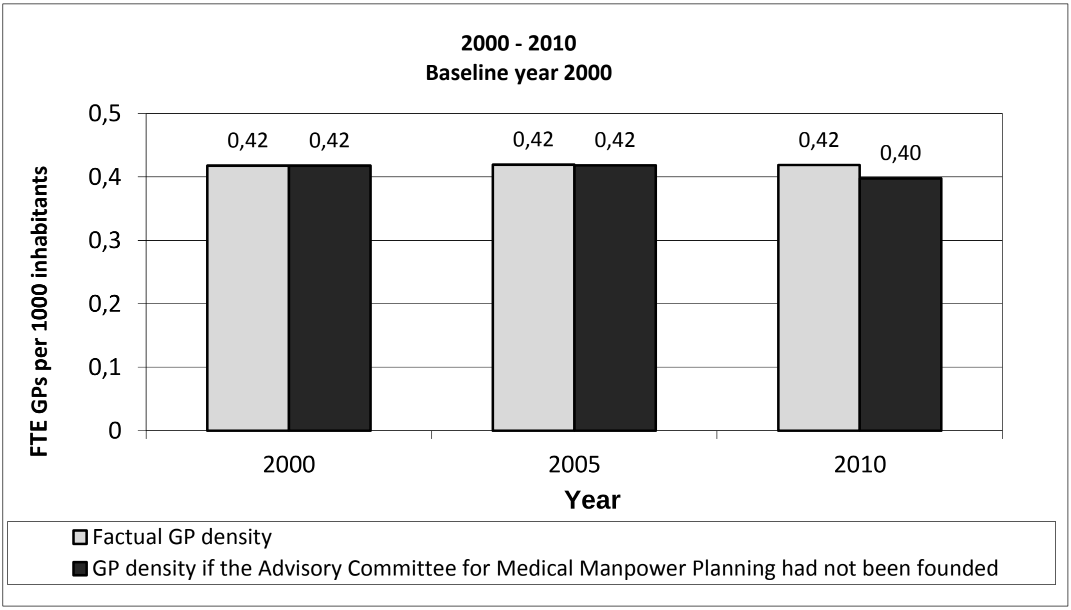
In 1995, the national council was abolished, and responsibility for health workforce planning was left to the professional association and educational institutions (27). No significant decisions were made regarding GP training intake, and intake was adapted to the funding level at the time.

Difference between factual and counterfactual GP densities in 2000-2010

In 1999, health workforce planning was re-centralized, and the initiative was again on the side of the government. The Advisory Committee on Medical Manpower Planning (ACMMP) was founded to advise the government and health care sector on the required intake in medical training to ensure that future supply and demand for health professionals were in accordance. The committee's first advice on GP training intake was published in 2001, which resulted in an increase in student intake from approximately 400 per year in 2000 to 600 in 2010.

Figure 5 shows that the factual GP density was stable between 2000 and 2010. If the ACMMP had not been founded, and the student intake had not been expanded according to their advice (but remained 360 per year), GP density would have decreased between 2005 and 2010, to a level 5% lower in 2010. There would have been 2,514 inhabitants per FTE GP in 2010 instead of 2,388.

Figure 5 Effect on GP density of expanding GP training inflow (observed), following the advice of the ACMMP, compared with not expanding GP training inflow (counterfactual)



Circumstances of the implemented policy measure in 2000-2010

Between 2000 and 2010, the ACMMP generally advised an increase of GP training intake to meet the demand for care in the future, but its advice was not always strictly implemented. Until 2005, the recommended student intake (by the ACMMP) was substantially higher than the realised intake. Because the GP student intake between 2000 and 2005 was not much greater than in the preceding period, the difference between factual and counterfactual density is not very large. Only after five years did the government increase the GP training intake (11).

Discussion

Between 1970 and 2010, in the Netherlands, several policy measures regarding GP training length and student intake were implemented during four specific periods in time. The relationship between these policies and Dutch GP density in these four periods was investigated using counterfactual analyses to discover the evolution of GP training policy in the Netherlands. The results can be summarised as follows.

Dutch GP density was kept relatively low by restricting training intake. Especially the introduction of a numerus clausus policy for medical schools had a restrictive effect on density. From the 1970s on, the government aimed at cost containment by restricting student intake. From 1985 until 2000, the government was mainly interested in maintaining the status quo in GP density without taking developments in demand for GP care into account. Additionally, governmental policy to improve the distribution of general practices restricted the growth of the GP workforce (21, 40). At the turn of the century, policy on GP training intake changed as a new system of health workforce planning was introduced, which was based on workforce projections that took developments in demand for care into account. After 2005, student intake increased following the recommendations of the ACMMP and GP density began to rise. The full effect of this increased intake is still to become apparent because it generally takes at least ten years before new policies have an impact on GP density (as is visible in figures 2 to 5).

From our literature review, we were also able to extract a number of underlying factors which most certainly have influenced GP training policies. Three new periods can be distinguished by combining the underlying factors with the results of the counterfactual analyses. These three periods represent the stages of evolution in Dutch GP training policies.

Ad hoc, supply-driven policy

Until 1985, policy decisions on GP training intake were generally ad hoc. Adjustments in training intake were frequently in reaction to contemporary shortages or oversupply. GP training intake was decreased in 1988 when the length of GP training was extended to two years. Although several committees advised decreasing intake, the main reason for the decrease was financial. It was not based on possible imbalances in the future workforce because it had to be budget neutral.
Altogether, these measures prevented a sharp increase in GP density, which was the aim of the government and in the GPs' professional interest. Additionally, the financial crisis of the 1980s had an impact on the training intake because it limited the availability of funds. This crisis also caused the number of unemployed GPs to increase. Decreasing GP student intake was, therefore, an appropriate measure.

Monitoring the health workforce and keeping the status quo

Between 1985 and 1991, the government monitored the health workforce to avoid the necessity of ad hoc decisions, but no long-term workforce projections were carried out. The aim was to keep physician and GP density constant, and student intake was adjusted to keep density stable.

The profession and training institutions became responsible for monitoring the GP supply when the government withdrew responsibility in 1991. The profession expected a shortage of GPs, but initially the government did not increase GP training intake. The government was spending relatively little on health care in the eighties and nineties (41).

GP training intake was increased, while, at the same time, training was extended to three years in 1994. This extension diminished the effect of increasing the intake. Between 1985 and 1992, GP density was also kept stable by governmental policy to improve the distribution of general practice locations. This period lasted until 2000.

Long-term workforce planning based on projections

Since 2000, decisions regarding GP training intake are based on long-term workforce projections. These projections became leading for decisions on GP student intake. Student intake adjustments were directed at preventing imbalances between future supply and demand instead of keeping the balance in current workforce and population numbers. In contrast to the preceding years, annual student intake and total GP workforce size increased slowly to compensate for forecasted shortages. However, until 2005 the ACMMP's advice was not always directly implemented. Since 2005, the government has followed the advice to increase GP training intake but available funding has set (and still is setting) hard limits on the number of new students.

Limitations

In this paper, we performed a number of counterfactual analyses using the Dutch health workforce planning model in which annual GP training intake was varied by counterfactual scenarios to investigate the net effect of intake policies. For the sake of this method, we assumed that other model elements were not changed by policies implemented between 1970 and 2010, and hence included them in the model as 'observed' or 'factual'. In reality, however, several of these factors indeed could have changed because of adjustments to training intake. Examples are the return on training or labour market return. Investigating the influence of other elements in this model, and the interaction between several elements would be an interesting case for future research.

The results of this study are based on historical data and a narrative literature review using the ‘snowball method’. To describe policy developments and their circumstances primary (policy documents of the Ministry of Health and professional organizations) and secondary sources were used. We believe we have given a comprehensive overview of GP training policy history but we acknowledge that a stakeholder analysis and, e.g. interviews with (former) policymakers and professional (training) organizations, would be a valuable addition to interpret and validate the findings of this study.

Conclusion

Restrictions on student intake generally slowed down the increase of Dutch GP density. This might be a seemingly obvious conclusion, but it actually confirms that physician density stabilized or increased at a slower pace in countries with central planning of medical school entry than in countries without. What can be showed by our analyses is that in making the final decisions on Dutch GP student intake, financial considerations of the government were deemed important. GP training policies in the Netherlands evolved from ad hoc supply-driven decisions to decisions based on long-term workforce planning. We also aimed to show the ‘net’ impact of GP training policies on the GP density, which remains difficult to assess. According to the results of this study, it seems that GP training policies can indeed be effective in influencing GP density as supported by our counterfactual analyses. However, it remains hard to quantify the size of this ‘effect’ as it probably differs between periods and policy measures. The results also show that it generally takes at least ten years before both ad-hoc and long-term training intake policies will affect GP density. To gain insight into the long-term consequences of training intake policies and to avoid ad-hoc decisions causing fluctuations in student intake and density, strategic health workforce planning based on long-term workforce projections is needed.

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Appendix I Calculating the counterfactual GP workforce inflow 1979-1985

counterfactual inflow into the general practitioner workforce = estimated number of medical school graduates based on increasing number of university graduates * 0,3

estimated number of medical school graduates based on increasing number of university graduates = number of medical school graduates *(1+5-year average % increase of university graduates)

% increase of university graduates per year = (number of university graduates in year x - number of university graduates in year x-1) / number of university graduates in year x-1

Given factors:
- Number of university graduates (1960-2010) retrieved from Statistics Netherlands database
- Number of medical school graduates (1960-2010) retrieved from Statistics Netherlands database
- Approximately 30% of medical school graduates became GP before GP training was introduced

Abstract

Background Health workforce projections are important instruments to prevent imbalances in the health workforce. For both the tenability and further development of these projections, it is important to evaluate the accuracy of workforce projections. In the Netherlands, health workforce projections have been done since 2000 to support health workforce planning. What is the accuracy of the techniques of these Dutch general practitioner workforce projections?

Methods We backtested the workforce projection model by comparing the ex-post projected number of general practitioners with the observed number of general practitioners between 1998 and 2011. Averages of historical data were used for all elements except for inflow in training. As the required training inflow is the key result of the workforce planning model and has actually determined past adjustments of training inflow, the accuracy of the model was backtested using the observed training inflow and not an average of historical data to avoid the interference of past policy decisions. The accuracy of projections with different lengths of projection horizon and base period (on which the projections are based) was tested.

Results The workforce projection model underestimated the number of active Dutch general practitioners in most years. The mean absolute percentage errors range from 1.9% to 14.9%, with the projections being more accurate in more recent years. Furthermore, projections with a shorter projection horizon have a higher accuracy than those with a longer horizon. Unexpectedly, projections with a shorter base period have a higher accuracy than those with a longer base period.

Conclusions According to the results of the present study, forecasting the size of the future workforce did not become more difficult between 1998 and 2011, as we originally expected. Furthermore, the projections with a short projection horizon and a short base period are more accurate than projections with a longer projection horizon and base period. We can carefully conclude that health workforce projections can be made with data based on relatively short base periods, although detailed data are still required to monitor and evaluate the health workforce.

Background

One of the major challenges in health-care systems worldwide is that of managing the health workforce to meet the demands of an accessible and effective health service. Shortages and imbalances of health-care personnel are a major concern of health policy-makers, professional bodies and patient organizations (1-5). Health workforce planning is an important instrument to prevent shortages and oversupply within the health-care workforce (6-9). An increasing number of countries apply different types of health workforce planning. Recently, Matrix Insight (10) conducted a study that provides an overview of health workforce planning in the European Union and shows a large variation across countries. Thirteen European countries, including the Netherlands, engage in model-based workforce planning, all of which use some form of supply-side projections.

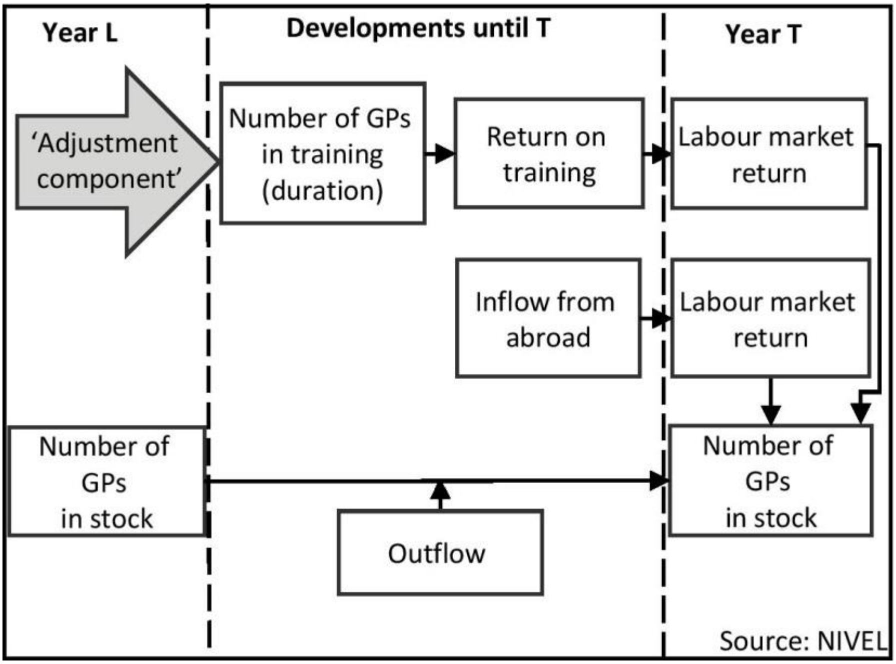
Health workforce projections require accurate and comprehensive information and careful accounting of stocks and flows of human resources for health (10). In most settings, the results and methods of workforce projections are not monitored and evaluated regularly and, consequently, it is hard to assess whether workforce planning has been successful and projections are accurate. This implies that shortcomings and room for improvement are difficult to identify (10). For the feasibility and further development of workforce projections in rapidly changing health systems, it is important to evaluate the accuracy of projections and their techniques (11). The increasing dynamics of the health workforce – through mobility (12), reduction of working hours, the ageing workforce, increasing number of female physicians, changing division of labour – implies that projecting the future workforce could become more difficult (13-16).

The accuracy of the Dutch simulation model

A simulation model had been developed in 2000 to support health workforce planning in the Netherlands. This model calculates the required number of health professionals in training to advise the Ministry of Health on the adjustment of the inflow numbers per year, to balance the supply and demand and to prevent a shortage or an oversupply of health professionals in the future (17-20).

Comparable with the techniques used for population projections, the Dutch workforce projection model is a cohort component model (21-23). The components consist of inflow to or outflow from the active workforce. Figure 1 shows the supply side of the conceptual Dutch simulation model, of which the projection accuracy is studied in this article. The model is divided into three different stages that are related to the current situation (launch year), the developments between the current situation and the future (target year), and the situation in the target year.

Figure 1 Supply side of the Dutch projection model for the health workforce



The launch year is the year of the latest data used as a basis to make a projection and the target year is the projection year. Other terms used in this article are the projection horizon, which is the interval between launch year and target year, and the base period, which is the period of data the projection is based on (the interval between base year and launch year, with the base year being the year of the earliest data).

In the Netherlands, general practitioners (GPs) are of high importance as they provide primary health care 24 hours a day, 7 days a week and are the 'gatekeepers' of the health-care system (13). Additionally, there is much data available about the Dutch GP, because the Netherlands Institute for Health Services Research (NIVEL) administers a GP database, which provides longitudinal information about all Dutch GPs regarding gender, age, position, moment of first-time accreditation, etcetera since 1975 (14,19,24,25).

The question of this article is: what is the accuracy of the current model for Dutch GP workforce projections? To answer this question, we will conduct a posteriori projections to backtest the current workforce projections and compare the projected ex-post number of GPs with the observed number of GPs. In practice, the Dutch GP workforce is projected with a base period of 15 years. Long-term data are used to prevent base data being influenced by fluctuations. Specifically, we will compare the accuracy of projections based on 15-year base periods and based on 5- or 10-year base periods to investigate if a shorter base period is as accurate as a 15-year base period.

There is no standard for workforce projection horizon lengths, but in European countries, a 10-year projection horizon is common (26,27). In the Netherlands, it is common to make projections with horizons of 10 and 15 years, because of the relatively long period of physician training. Furthermore, it takes one or two whole years to adjust the inflow in training, because of the decision-making process (20). The accuracy of different lengths of projection horizons is tested.

There is extensive literature available on the accuracy of population projections. In many of these studies, the projection horizon and base period are addressed. Based on these studies, we expect that the accuracy of the GP workforce projections is influenced by the lengths of the projection horizon (11,22,28-30), base period (22,30-32) and the combination of the two (22,32). The following expectations will be tested in this study:

1. The longer the projections, the lower the accuracy of the Dutch GP workforce projection model is.

2. The shorter the base period, the lower the accuracy of the Dutch GP workforce projection model is because short base periods could be influenced by fluctuating data.

3. The accuracy of the Dutch GP workforce projection model will be highest when the lengths of the base period and the projection horizon are similar. Hypothesis 3 is not dependent on hypotheses 1 and 2.

Methods

Backtesting (or hindcasting) is the process of evaluating a strategy, theory, or model by applying it to historical data. A key element of backtesting that differentiates it from other forms of historical testing is that backtesting calculates how a strategy would have performed if it had actually been applied in the past. This requires the backtest to replicate the conditions of the time in question in order to get an accurate result. In this article, the Dutch GP workforce projection model is backtested (33,34) by comparing a posteriori projections with the observed number of GPs in the target years. The projections of the GP workforce are made using the current version of the workforce simulation model and historical GP workforce data retrieved from the NIVEL GP database. The only way we can evaluate the current model is by using historical data to generate new projections. Original projections are not available to assess the performance of the simulation model.

All data and assumptions used in the projections are – depending on the length of the base period – based on 5-year averages from preceding periods (0 to 5 years, 0 to 10 years and 0 to 15 years back), except for the inflow in training. This inflow is not based on an average of historical data, but the observed inflow in training is used to test the accuracy of the modelling techniques. The reason for this is that the workforce simulation model actually has influenced the inflow in GP training in the past – as its results are taken into account by the Ministry and stakeholders in their decision about GP training inflow in the Netherlands (20). Hence, the observed inflow in training is used in the a posteriori projections to exclude past interference of policy decisions with regard to training inflow. Using inflow projections made in the past would obviously blur the method of backtesting as applied in this study.

The equation that lies behind the conceptual projection model (Figure 1) is as follows:

$$\hat{n}GP_{T,X,Y} = nGP_{T,X} - \hat{n}OUT_{T,X,Y} + \hat{n}IN_{T,X,Y} + \varepsilon_{T,X,Y}$$

nGP = number of GPs; nOUT = number of outflow; nIN = number of inflow; T = target year; X = projection horizon; Y = base period; ϵ = projection error.

The total estimated supply of GPs in the future ($\hat{n}GP_{T,X,Y}$) is calculated using the GPs in stock in the launch year ($nGP_{T.X}$), minus the estimated outflow ($\hat{n}OUT_{T,X,Y}$), plus the estimated inflow ($\hat{n}IN_{T,X,Y}$) of GPs in the years between launch and target year (T – X → T), based on a specific base period (T – X – Y → T – Y). For example, to predict the number of GPs in 2011 (e.g. 12,000), the number of GPs in stock in 2006 is used (e.g. 10,000). The estimated outflow between 2006 and 2011 (e.g. 2,000) is subtracted from the 2006 GP number and the estimated inflow between 2006 and 2011 (e.g. 4,000) is added to the 2006 GP number to predict the 2011 number. The estimated outflow and inflow numbers are based on observed data between 2001 and 2006.

The estimated inflow $(\hat{n}IN_{T,X,Y})$ is composed of several parts: the inflow from abroad and its labour market return, and the inflow from Dutch training and its return on training and labour market return. For example, the estimated inflow between 2006 and 2011 (e.g. 4,000) is calculated by multiplying the inflow from abroad between 2006 and 2011 (e.g. 250) with the labour market return of this inflow (e.g. 80%) and then add the inflow from Dutch training (e.g. 4,200) multiplied by the return on training (e.g. 95%) and its labour market return (e.g. 85%).

Several sources provide information for the projections. This is mainly the NIVEL GP database, which contains information about the GP stock (24). Other sources are the training institutions and the Medical Accreditation Committee, which provide data for elements of the model, such as return on training (20).

The GP database is administered according to Dutch privacy legislation. The privacy regulation was approved by the Dutch Data Protection Authority. According to Dutch legislation, approval by a medical ethics committee was not required for this kind of data collection.

Calculating the projection errors

The accuracy of the a posteriori GP workforce projections is backtested for three different projection horizons (X) and three different base periods (Y). By comparing the results of the projections with the observed number of GPs (for the target years 1998 to 2011), the mean absolute percentage errors (MAPE) are calculated. The MAPE is a summarizing measure to express the error during a certain period of time and ignores the direction of error. It has frequently been used in evaluations of population forecast accuracy (23,35,36).

It is calculated for three projection horizons ($MAPE_X$), three base periods ($MAPE_Y$) and all combinations ($MAPE_{X,Y}$). The equations are:

$$MAPE_{X,Y} = \frac{\sum^{T} \left| (projection_{T,X,Y} - observation_T) \right| \cdot 100\%}{\sum^{T} observation_T} = \frac{\sum^{T} \varepsilon_{T,X,Y}}{\sum^{T} nGP_T}$$

$$MAPE_{X} = \frac{\sum^{Y} \sum^{T} \left| (projection_{T,X,Y} - observation_T) \right| \cdot 100\%}{\sum^{T} observation_T} = \frac{\sum^{Y} \sum^{T} \varepsilon_{T,X,Y}}{\sum^{T} nGP_T}$$

$$MAPE_{Y} = \frac{\sum^{X} \sum^{T} \left| (projection_{T,X,Y} - observation_T) \right| \cdot 100\%}{\sum^{T} observation_T} = \frac{\sum^{X} \sum^{T} \varepsilon_{T,X,Y}}{\sum^{T} nGP_T}$$

nGP = number of GPs; T = target year; X = projection horizon; Y = base period; ϵ = projection error.

The first target year, 1998, is determined by the first year of available data, 1968, and the sum of 15 years of base data and a 15-year horizon.

Table 1 defines the years and time periods on which observations are based and which are used to calculate the projection accuracy. The number of GPs is projected for every target year between 1998 and 2011 for a 5-, 10- and 15-year projection horizon. These projections are based on GP stock data of 5, 10 or 15 years earlier (for each launch year, 1983 to 2006) and on base periods of 5, 10 and 15 years (data between 1968 and 2001). Table 1 also depicts the projection accuracy for each of these calculations, which are further discussed in the results section.

Table 1. Years and time periods on which observations are based and which are used to calculate the projections' accuracy

		5-year base period	10-year base period	15-year base period	$MAPE_x$
5-year projection horizon	Base years	1988 - 2001	1983 - 1996	1978 - 1991	
	Base periods	1988 → 1993 – 2001 → 2006	1983 → 1993 – 1996 → 2006	1978 → 1993 – 1991 → 2006	
	Launch years	1993 - 2006	1993 - 2006	1993 - 2006	
	Projection horizons	1993 → 1998 – 2006 → 2011	1993 → 1998 – 2006 → 2011	1993 → 1998 – 2006 → 2011	
	Target years	1998 - 2011	1998 - 2011	1998 - 2011	
	$MAPE_{x,y}$	1.9 (14 tests)	3.0 (14 tests)	4.2 (14 tests)	3.0 (42 tests)
10-year projection horizon	Base years	1983 -1996	1978 - 1991	1973 - 1986	
	Base periods	1983 → 1988 – 1996 → 2001	1978 → 1988 – 1991 → 2001	1973 → 1988 – 1986 → 2001	
	Launch years	1988 - 2001	1988 - 2001	1988 - 2001	
	Projection horizons	1988 → 1998 – 2001 → 2011	1988 → 1998 – 2001 → 2011	1988 → 1998 – 2001 → 2011	
	Target years	1998 - 2011	1998 - 2011	1998 – 2011	
	$MAPE_{x,y}$	4.9 (14 tests)	7.0 (14 tests)	9.1 (14 tests)	7.0 (42 tests)
15-year projection horizon	Base years	1978 - 1991	1973 - 1986	1968 – 1981	
	Base periods	1978 → 1983 – 1991 → 1996	1973 → 1983 – 1986 → 1996	1968 → 1983 – 1981 → 1996	
	Launch years	1983 - 1996	1983 - 1996	1983 - 1996	
	Projection horizons	1983 → 1998 – 1996 → 2011	1983 → 1998 – 1996 → 2011	1983 → 1998 – 1996 → 2011	
	Target years	1998 - 2011	1998 - 2011	1998 - 2011	
	$MAPE_{x,y}$	9.0 (14 tests)	12.4 (14 tests)	14.9 (14 tests)	12.1 (42 tests)
	$MAPE_y$	5.3 (42 tests)	7.5 (42 tests)	9.4 (42 tests)	

Base year = earliest data year; base period = interval between base year and launch year; launch year = most recent data year; projection horizon = interval between launch year and target year; target year = projection years; number of accuracy tests = units of comparison between observed and projected number of GPs; MAPE = mean absolute percentage error. Example: to project the number of GPs for the target year 2011 with a projection horizon of five years, the projection is based on GP stock data from 2006 (launch year). The flow data used in the projection is based on data from 2001 to 2006 (five-year base period). 2001 is the base year.

Analyses

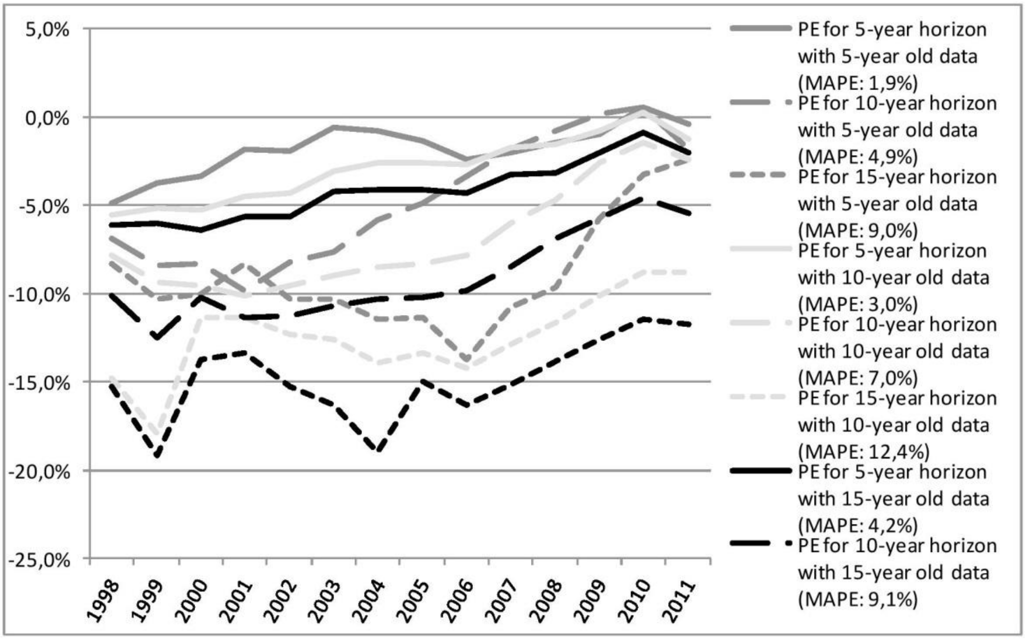
Analyses were made using STATA 12 software. The first and second hypotheses were tested using the Kruskal-Wallis equality-of-populations rank test and the two-sample Wilcoxon rank-sum (Mann–Whitney) test. The first test was used for testing the difference between the percentage errors of three different horizon lengths (first hypothesis) and three different base period lengths (second hypothesis). The second test was used to verify which of the three horizon and three base period lengths differ significantly. The third hypothesis was tested using the two-sample Wilcoxon rank-sum (Mann–Whitney) test. To test this hypothesis, the difference between, on the one hand, percentage errors of projections with similar horizon and base period lengths and, on the other hand, the percentage errors of projections with different horizon and base period lengths were tested.

Results

The MAPEs that resulted from the analyses range from 1.9% to 14.9%. This means that, on an average of 8 801 GPs in the period 1998 to 2011, the projection error equals 167 to 1311 GPs. These numbers show a large range and are equal to one-third to 2.5 times the size of the yearly inflow in GP training (almost 500 persons on average started the training every year between 1998 and 2011).

Figure 2 depicts the accuracy of three projection horizon lengths, each based on three base period lengths, for every year between 1998 and 2011. It shows that the number of GPs was underestimated in most years. Overall, the error of GP projections seems to be smaller in more recent years.

Figure 2 Accuracy (percentage error) of the Dutch projection model, by projection horizon length and base period length



Accuracy by length of projection horizon

To test the first hypothesis (the longer the projections, the lower the accuracy) the $MAPE_X$ of projections with 5-, 10- and 15-year horizons are compared, and the differences were tested. Table 1 shows that projections with a 5-year horizon have a higher accuracy than projections with a 10-year horizon, which subsequently have a higher accuracy than projections with a 15-year horizon.

The differences were significant according to the Kruskall-Wallis test ($\chi2 = 75.669$; $P = 0.0001$). According to the two-sample tests (Wilcoxon), projections with 5- and 10-year horizons are different ($z = 5.122$; $P = 0.0000$), as well as projections with 10- and 15-year horizons ($z = 5.896$; $P = 0.0000$) and 5- and 15-year horizons ($z = 7.497$; $P = 0.0000$). Consequently, hypothesis 1 is confirmed. This is in accordance with earlier research (11,22,28-30). In the present study, projections with a 5-year horizon are twice as accurate as projections with a 10-year horizon and four times as accurate as projections with a 15-year horizon.

Accuracy by base period length

The second hypothesis (the longer the base period, the higher the accuracy) is tested by comparing the $MAPE_Y$ of projections based on 5-, 10- and 15-year base periods (0 to 5 years, 0 to 10 years and 0 to 15 years before the launch year). Table 1 shows that projections with a 5-year base period have a higher accuracy than projections with a 10-year base period, which subsequently have a higher accuracy than projections with a 15-year base period. The differences were significant according to the Kruskall-Wallis test ($\chi 2 = 15.826$; $P = 0.0004$). According to the two-sample tests (Wilcoxon), projections with 5- and 10-year base periods are different ($z = 2.246$; $P = 0.0247$), as well as projections with 5- and 15-year base periods ($z = 3.865$; $P = 0.0001$). Projections with 10- and 15-year base periods are not different ($z = 1.923$; $P = 0.0544$). In conclusion, hypothesis 2 is not confirmed, because projections with a shorter base period are not less accurate.

Accuracy by similarity of projection horizon length and base period length

The $MAPE_{X,Y}$ of projections with three horizons based on 5-, 10- and 15-year base periods are compared to test the third hypothesis (the accuracy will be highest when the lengths of the base period and the projection horizon are similar). Table 1 shows that for every projection length, the projections with a 5-year base period have a higher accuracy than projections based on a 10-year period, which subsequently have a higher accuracy than projections based on a 15-year period. The differences between the errors of two groups were tested: projections with similar horizon and base period lengths and projections with different horizon and base period lengths. According to the two-sample tests (Wilcoxon), the errors of the two groups are not different ($z = 0.391$; $P = 0.6960$). Consequently, the accuracy is not highest when projection horizon length and base period length are similar, and the third hypothesis is not confirmed.

Discussion

The goal of this article was to evaluate the accuracy of the techniques of Dutch GP workforce projections by backtesting projections and comparing the a posteriori projections with the observed number of GPs in 1998 to 2011. Another goal was to test three hypotheses about the accuracy of different projection horizon and base period lengths.

According to the results of the present study, the projections with a short projection horizon and a short base period are more accurate than projections with a longer horizon and base period.

The Dutch health workforce projections usually have projection horizons of 10 and 15 years. According to the results, projections with a 5-year horizon are however the most accurate. This is in accordance with the results of studies regarding the accuracy of population projections (11,22,28-30). Large errors in supply projections could cause an imbalance between supply and demand, and, as a result, major adjustments in training inflow would be needed. To minimize the errors in projections with a longer horizon, it is recommendable to monitor the workforce continuously and to execute projections frequently. In practice, it is not feasible to execute projections with a shorter projection horizon, because there would only be a short period to match supply and demand. Dramatic fluctuations in yearly training inflow would be needed to reach a balance between supply and demand. It is undesirable to adjust the inflow number in training by large numbers each year because this would be practically impossible for training institutions, for example.

Dutch GP workforce projections that are carried out to advise the government are based on a 15-year base period. According to the results of the present study, projections with a 5-year base period are more accurate than those with a 10- or 15-year period. Consequently, a base period of 5 or 10 years also seems extensive enough to make reliable projections. It appears that the GP workforce of today is different from the past GP workforce and, therefore, we can conclude that base periods containing not only recent data but also older data are less representative for GPs in the target year. According to projections based on base periods including older data, we expected the GPs to leave the workforce at an earlier age than was observed. Current GPs stay in the workforce longer.

We can thus carefully conclude that health workforce projections can be made with data based on relatively short periods and fewer data, although detailed data are required to monitor and evaluate the health workforce (37).

The accuracy of the projections varies per year, and there seems to be a trend towards more accurate projections in more recent years for all base period lengths. Hence, forecasting the size of the future workforce did not become more difficult between 1998 and 2011, as we originally expected (13-15). This trend could be explained by two things. First, it seems that the GP workforce of 1980 to 1990 is less similar to the workforce of 1990 to 2000 than the workforce of 1990 to 2000 is similar compared to the workforce of 2000 to 2010. In other words, the GP workforce changed more extensively between 1980 and 1990 and 1990 and 2000 than between 1990 and 2000 and 2000 and 2010. Second, the Dutch GP workforce has become larger. Data based on a larger base population size have more stable averages than data based on smaller populations.

The errors of the Dutch GP workforce projections range from 1.9% to 14.9%. This is a large range, which illustrates the importance of doing projections with different projection horizon lengths and base period lengths.

The projection errors are mainly caused by bias and not by variance (38). The variance is low because data of all Dutch GPs is used to make projections. The projection error is mostly bias, caused by differences between the past GP workforce and the current and future GP workforce.

From a data availability perspective, it may be possible that there is significant scope for more countries to engage in model-based health workforce planning than is currently the case, and for countries already engaging in such planning to extend the reach of their current models, which was also concluded from the Matrix Insight report (10).

However, the successful application of a model similar to the Dutch workforce projection model is dependent on the health workforce planning system of a country. The output of the Dutch projection model is the required inflow in specialized training per year to balance the supply and demand for health professionals in the future (17-20). Hence, the height of inflow in specialized training is the ‘adjustment component’ of the Dutch health workforce. In other health workforce planning systems, other parts of the planning system are possibly used as the ‘adjustment component’, such as postponing retirement or increasing the return on training (Figure 1). In Belgium, for example, the inflow in initial medical training (not specialized training) is the ‘adjustment component’ (39). Future research is needed to investigate which type of health workforce planning fits with which type of health-care system (40).

Limitations

This study has several limitations. First, in the present study, we backtested the current GP workforce projection methods a posteriori. There are other methods to analyse the accuracy of workforce projections, which we did not use. For example, we did not evaluate the current projections by comparing the results of GP workforce projections that were done in the past, with the actual observations. This second method seems simpler, but with this method we would not evaluate the current model, but older versions of it. The only way we can evaluate the current model is by using old data to generate new projections. This is because future numbers are not yet known.

Second, the present study was limited to testing one health-care profession in the Netherlands: general practitioners. In practice, the model is used for all types of medical and allied health professionals, as the model is designed as ‘one size fits all’. This implies that the backtesting of projections is possible for all types of health professionals. However, for most of them there is less data available, and, therefore, it is harder to backtest.

Third, the accuracy of the demand side of the Dutch health workforce simulation model was not tested, because of a lack of data. However, this should be a topic of future research on the accuracy of the Dutch health workforce planning system (18).

Fourth, testing the accuracy of workforce projections can be done disaggregated by several factors, such as gender, region, cohort or type of GP. Although this would have been an interesting exercise, we limited this study to the total supply of GPs. It would be an interesting case for future research.

Conclusions

According to the results of the present study, forecasting the size of the future workforce did not become more difficult between 1998 and 2011, as we originally expected. Furthermore, the projections with a short projection horizon and a short base period are more accurate than projections with a longer projection horizon and base period. We can carefully conclude that health workforce projections can be made with data based on relatively short base periods, although detailed data are still required to monitor and evaluate the health workforce.

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Abstract

Background The high cost of training and the relatively long period of training for physicians make it beneficial to stimulate physicians to retire later. Therefore, a better understanding of the link between the factors influencing the decision to retire and actual turnover would benefit policies designed to encourage later retirement. This study focuses on actual GP turnover and the determining factors for this in the Netherlands. The period 2003–2007 saw fewer GPs retiring from general practice than the period 1998–2002. In addition, GPs' retirement age was higher in 2003–2007. For these two periods, we analysed work perception, objective workload and reasons for leaving, and related these with the probability that GPs would leave general practice at an early age.

Methods In 2003, a first retrospective survey was sent to 520 self-employed GPs who had retired between 1998 and 2002. In 2008, the same survey was sent to 405 GPs who had retired between 2003 and 2007. The response rates were 60% and 54%, respectively. Analyses were done to compare work perception, objective workload, external factors and personal reasons for retiring.

Results For both male and female GPs, work perception was different in the periods under scrutiny: both groups reported greater job satisfaction and a lower degree of emotional exhaustion in the later period, although there was no notable difference in subjective workload. The objective workload was lower in the second period. Moreover, most external factors and personal reasons that may contribute to the decision to retire were reported as less important in the second period. There was a stronger decrease in the probability that female GPs leave general practice within one year than for male GPs. This underscores the gender differences and the need for disaggregated data collection.

Conclusions The results of this study suggest that the decrease in the probability of GPs leaving general practice within one year and the increasing retirement age are caused by a reduction in the objective workload, a change in GPs' work perception, external factors and personal reasons. Based on the results of this study, we consider workload reduction policies are the most useful instruments to control retention and retirement.

Introduction

Many countries face challenges in matching the supply and demand for health professionals. With gaps already appearing between the supply of and the demand for health professionals in some countries, it is important to understand what future trends might affect supply and demand over the next 20 years (1). Since the beginning of this century, many policy reports mention shortages on health labour markets as one of the most urgent problems (2-5). The challenge of matching supply with demand for physicians and other health professionals include making the 'right' decisions on the inflow in training, on the retention and retirement of the existing stock of physicians, and on migration policies for physicians. Countries have a variety of additional policy instruments at their disposal to influence the supply of physicians including education and training policies, migration policies and policies affecting retention and retirement (1).

Health workforce planning

It is commonly acknowledged that workforce planning is an important policy instrument used to control shortages and oversupply within the health care labour market (6-11). In the Netherlands, a simulation model is used to match the supply and demand for health professionals. This model determines the required number of health professionals in training to meet the future demand for care (12). There are several factors that influence the future supply of health professionals : the present and future number of health professionals in stock (male/female), the amount of full-time equivalent (FTE) they work (present and future), the inflow from training, the inflow from abroad and the outflow of health professionals. The retirement age of physicians and other health professionals provides important information for workforce planning; after all, the projections of the future outflow of health professionals are based on the retirement age of health professionals in the past.

Ageing of the health workforce

The ageing of the physician population is likely to have a profound effect on the outflow of physicians and thus the future supply of physicians in many countries. The generation of doctors who were born during the 'baby boom' following World War II will be coming up to retirement and leave the profession during the next decade or two (1). Due to the high training cost and the relatively long training period for physicians, it is important to stimulate physicians to retire at an older age to maintain a sufficient number of physicians. In addition, a greater understanding of the link between the factors influencing the decision to retire and actual turnover would benefit policies designed to encourage later retirement.

Early retirement among Dutch general practitioners (GPs)

Dutch GPs are increasingly choosing to work part-time and are leaving their profession at a relatively young age (13,14). Early retirement among GPs reflects a wider societal trend towards early retirement seen in the past; however, this societal trend is now changing as the number of people who are willing to work until 65 (statutory retirement age) is increasing in the Netherlands (15). This raises the question whether Dutch GPs are also following this trend.

GPs are the focus of our study as they play an important role within the Dutch health care system (16) and represent one of the largest professional groups within the health workforce. They provide primary health care twenty-four hours a day, seven days a week. In addition, they are the gatekeepers of the Dutch health care system. In other words, it is important to have sufficient GPs in the Netherlands to meet the demand for care (17).

To investigate whether Dutch GPs' retirement age has become higher in the preceding years, firstly, this article explores the difference between the periods 1998–2002 and 2003–2007 regarding the probability of leaving general practice within one year (explained more extensively in the background section) and GPs' retirement age. Secondly, we investigate to what extent work perception (job satisfaction, emotional exhaustion, subjective workload), objective workload, external factors and personal reasons changed between these two periods and if these changes influenced the decision to leave general practice in 1998–2002 and 2003–2007. The reasons that can contribute to the decision to retire are described more extensively in the methods section of this article.

In this study, the focus lies on exploring the differences between 1998–2002 and 2003–2007. The aim of this study is not to test the relationships or interactions between the determining factors and the probability to leave or the retirement age, because these relationships have been examined extensively in earlier studies which will be presented in the background section and the methods section of this article.

The probability of leaving general practice, the retirement age and factors influencing the decision to retire are different for male and female GPs, and therefore the differences between male and female GPs are also looked into (18-22). The article focuses on GPs who have already left general practice. The following research questions are investigated:

1. Did the work perception (job satisfaction, emotional exhaustion, subjective workload) of GPs change between 1998–2002 and 2003-2007? Did male and female GPs report differently on work perception?

2. Did the objective workload of GPs change between 1998–2002 and 2003-2007? Did male and female GPs report differently on objective workload?

3. Which external factors and personal reasons do GPs report as being the most significant contributors to their decision to leave general practice in both periods? Did the extent to which external factors and personal reasons contributed to the decision to leave the profession change between 1998–2002 and 2003-2007? Did male GPs and female GPs report differently on these grounds in these periods?

4. Is there a relation between, on the one hand, the probability of retirement from general practice within one year and GPs' retirement age and, on the other hand, the reported reasons for leaving and work perception and workload?

In the following sections, the (inter)national context of this study is discussed, as well as the design of the study. Subsequently, the questionnaire is discussed, which was based on earlier research on work perception, objective workload, external factors and personal reasons that may influence the decision to leave general practice early. Then, the results of the analyses are described. Finally, the results are summarised, and conclusions are drawn.

Background

International context

Demographic changes in Europe, especially the on-going process of population ageing, increase demands for health services while simultaneously shrinking the pool of workers available to offer these services. The workforce in OECD countries is ageing as the 'baby boom' generation of health workers begins to reach retirement age (4,23). As these staff approach retirement age, they need to be replaced by sufficient younger health workers. Between 1995 and 2000, the number of physicians under the age of 45 across Europe dropped by 20%, whilst the number ages over 45 went up by over 50%, which means that the 'baby boom' generation accounts for a substantial share of the health workforce (24). Several studies have shown that the proportion of physicians working beyond the age of 60 years has fallen in most European countries over the past decade (25-27). Until recently, few OECD countries had implemented or planned specific policies to address this issue (28). But regarding the health workforce, there have been some attempts to reverse the trend towards early retirement and retain older workers within the workforce. In the United Kingdom, for example, a flexible retirement initiative, launched in 2000, enabled staff nearing retirement to move into part-time work while preserving pension entitlements (1). And in France, doctors who reach the statutory pensionable age can combine a pension and earnings up to an income limit. Also, elderly doctors can be exempted from night and weekend shifts (29).

Also in the Netherlands, in the near future, the demand for care is expected to increase due to the aging population and an increasing number of chronically ill patients (17). In combination with the shift from hospital care to primary care, this will put pressure on primary health care professionals, for example the general practitioner (GP), who is the gatekeeper of the Dutch health care system (30,31). These trends in health care demand are accompanied by developments in health care supply. There are likely to be reductions in the availability of physicians in most countries unless steps are taken to increase recruitment. That is mainly because of changes in lifetime hours worked, increasing female participation in the workforce, increasing specialisation, physician workforce ageing and a growing number of retirements (1,4,17).

Dutch health workforce planning system

The health care system in the Netherlands is rooted in the “Bismarckian” social insurance tradition. When the 2006 Health Insurance Act was introduced, the distinction between mandatory sickness fund insurance and voluntary private insurance, which had existed in the Netherlands since the Second World War, was changed to a system with a basic insurance for all citizens (16,17).

In the Netherlands, the Advisory Committee on Medical Manpower Planning (Capaciteitsorgaan), established in 1999, is an independent advisory committee which focuses on determining the medical training capacity required to meet the demand for care. The Advisory Committee is informed by a workforce forecasting model for physicians (developed by NIVEL). This model is based on realizing an equilibrium in projection (i.e. for 2020, 2025) based on assumptions, heuristics and statistics about the supply and demand side of the health care labour market. The output of the planning model is a calculation of the required yearly inflow in medical training within the next five to fifteen years. After these calculations, the results of the model are discussed within specialized platforms of the Advisory Committee on Medical Manpower Planning, which consists of representatives of professionals, health insurers and the medical training institutions (32). When the model simulations, including the different scenarios, have been carried out, the draft inflow recommendations are discussed by the plenary platform of the Advisory Committee. This platform determines the advice to give to the Ministry regarding the yearly inflow in training for health professionals. This advice is subsequently discussed with the Ministry of Health, Welfare and Sport. After the Ministry and national government have decided on the total budget for the training of all (academic) health professionals, this budget steers the advice medical faculties, schools and universities receive on their annual student enrolment number (12,16).

Among the key requirements for human resource planning in the health sector are accurate and comprehensive information systems on the actual number of health care workers and their distribution in the health care system (23). Data on a variety of topics is necessary for adequate workforce planning for health professionals, as there are many factors that influence the size of the workforces of GPs and other health professionals. NIVEL administers a large database with information about Dutch GPs, for example, their gender, age, retirement age, etcetera. This information is used to inform the planning of the Dutch GP workforce. In addition to this database, in-depth studies regarding different elements of the model are conducted to keep assumptions about the models' elements up-to-date.

Retirement and probability to leave general practice in 1998–2002 and 2003–2007
According to Van der Velden & Batenburg (22), between 1998 and 2002, 1,135 self-employed GPs left general practice in the Netherlands, 206 (18.1%) of whom were female and 929 (81.9%) male. Between 2003 and 2007, 998 self-employed GPs left general practice, 177 (17.7%) of whom were female and 821 (82.3%) male (22). Based on this information, the probability of retiring within one year was calculated. The probability of retiring is equal to the percentage of self-employed GPs that leave general practice (per year, and subdivided by age group and gender). There is a difference in the probability of leaving general practice in the Netherlands within one year for the periods 1998–2002 and 2003–2007 (22). In the period 1998–2002, this probability was 1.7% for GPs younger than 55. This means that of every 100 active GPs (younger than 55) at the beginning of a certain year, an average of 1.7 GPs had left general practice at the end of that same year. For GPs between 55 and 59 years old, the probability of leaving within one year was 7.6%, and between 60 and 64 years old it was 35.1%. The statutory retirement age in the Netherlands is 65. In the second period, 2003–2007, the probability of leaving was lower for all age groups: 0.9%, 5.2% and 21.3%, respectively. For female GPs, the difference between both periods was larger than for male GPs. In Appendix 1, the probability of leaving is presented.

Furthermore, according to the same study (22), the retirement age of both male and female GPs was higher in the second period (M: 58.8, F: 49.1) than in the first period (M: 56.5, F: 47.0). In summary, fewer GPs retired from general practice in the period 2003–2007 than in the period 1998–2002, and the retirement age of these GPs was higher in 2003–2007 than in the period 1998–2002. This information reflects the entire GP population in the Netherlands in those periods. Various reasons influence the decision to leave general practice. A changing probability to leave general practice could be based on an evolving influence of these explanatory factors on the decision to retire.

Several studies have investigated the relation between explanatory factors and both the physicians' intentions to leave practice and their actual leaving (21,33-35). In these studies, we found several factors that may help explain early retirement among GPs, for example, external factors (such as government policy), personal characteristics, job-related perception and objective workload. Job satisfaction and workload are measured in many different ways (36). In this study, job satisfaction and subjective workload are both a work perception-measure, while objective workload is a numeric measure: number of working hours. These measures are further described in the methods section.

Only a small number of studies have investigated the effect of job satisfaction or other possible factors on actual physician turnover, rather than examining their impact on the intention to leave (37-39). For example, Rittenhouse et al. (40) found that the strongest predictor of both intention to leave practice and actual leaving was, not surprisingly, advancing age. However, the intentions to leave and actual leaving may also be influenced by factors unrelated to the occupation, such as health, the need to care for a dependent relative or the desire to take a career break to raise children (34). The factors that may help explain early retirement among GPs are further described in the methods section of this article.

GP workload reduction policies in the Netherlands

Besides the use of GP workforce planning policies to realize an equilibrium between supply and demand, which is a long-term solution for avoiding shortages of GPs, other, short-term policies can be implemented to prevent the early retirement of GPs. Several workload reduction measures were introduced in the Netherlands at the start of the 21st century. These measures were implemented to reduce high workload among GPs. This was a response to the dissatisfaction among GPs regarding their workload, which led to a series of nationwide campaigns and even to a one-day strike (41,42). The introduction of these measures could also be a possible explanation for differences found between the two time periods, regarding GPs' retirement age and changes in the influence of explanatory factors. Both workload reduction measures are discussed below.

First, there was the nationwide introduction of central GP services for evening, night and weekend service. Traditionally, the GP used to work alone, but since the 1970s group practices have become popular. Until the late 1990s, out-of-hours care was organized by small groups of GPs, where each GP had night or weekend shifts on a regular basis. Since the early 2000s, out-of-hours care has become organized in a national network of so-called GP posts. A GP post is a centrally located office with a GP present after hours (43). This change from small- to large-scale service structures took place in the late nineties; in 2002, 80- 90% of all GPs were associated with a large GP service center (44). In earlier research, 80% of all GPs mentioned the evening, night and weekend shifts as a highly stressful job demand (45,46). Furthermore, these out-of-hours shifts in small-scale settings were mentioned as the most important reason to retire before the age of 60 (47). After the introduction of large-scale central GP services, the number of shifts per GP and the experienced workload reduced significantly (44,48). The reduction of out-of-hours shifts is thus associated with both a decrease in objective and subjective workload.

The second development was the introduction of general practice nurses in GP practices in 1999. This new type of function was one of the measures taken in a broader plan of job reallocation in health care. The underlying reasons were an increasing demand for care by an aging population, combined with a decrease in the number of health professionals and a growing number of part-time workers (49). Another reason for the introduction of task reallocation was the growing pressure to improve quality of care. A reduction in GP workload was expected if GPs could focus on their core tasks and the provision of care was shared with other health professionals.

The introduction of practice nurses is part of the trend that is commonly called "substitution". This can be defined as the (partial) vertical transfer of tasks from doctors to nurses, and horizontal task re-allocation between groups of health care workers. Substitution is mainly driven by efficiency, but can also be seen as inevitable in order to cope with the increasing physician workload (16,17).

In the following sections, the design of the present study and its results will be discussed.

Methods

Design and Subjects

To collect data in this study, a retrospective postal survey was sent to previously self-employed general practitioners in the Netherlands who had retired from their work as GPs before the age of 65, which is the statutory pensionable age in the Netherlands. This survey was sent to a random sample (520) drawn from the population of GPs that had retired between January 1998 and December 2002 (a total of 1,135 former GPs). Data were collected in the Netherlands in the winter of 2003/2004. The response rate was 60%.

The same survey was sent in the winter of 2008/2009 to a second group of previously self-employed GPs in the Netherlands. The GPs included in this random sample (405) were drawn from the population of GPs who had retired between January 2003 and December 2007 (a total of 998 former GPs). The response rate of this survey was 54%. Potential participants for both periods were identified using data files from the GP database of NIVEL.

In the Netherlands, there are different types of GPs: GPs who have their own practice are self-employed, and GPs who are employed by another GP and who do not have their own practice. The latter are called salaried GPs (16). The samples only comprised self-employed GPs and not salaried GPs, as the effects of early retirement are likely to be different for these two types of GPs. For salaried GPs, it is probably easier to leave general practice because they do not have their own practice, and another GP can easily take over their job. Analysis of the differences in personal characteristics between respondents and non-respondents showed that on average the respondents were somewhat older than the entire population of GPs leaving general practice (Table 1).

Table 1 Population and respondents: mean retirement age and gender

	Male		Female	
Period	Population (n = 1,135)	Respondents (n = 282)	Population (n = 998)	Respondents (n = 191)
1998-2002	56.5	58.0	47.0	53.9
2003-2007	58.8	61.0	49.1	53.5

Measures
The survey was constructed using input from different studies (referred to in the following paragraphs) and included the most relevant factors concerning early retirement and job satisfaction. The scales used in this study are also discussed in the next few paragraphs. GPs that had left general practice before they reached the retirement age of 65 were asked retrospectively to rate their work perception and their experience with external factors and reasons for leaving general practice, as well as to report on their hours worked. It is possible that their answers have been influenced by the time elapsed. However, we expect this bias to be minimal, because it has been shown that reports on jobs that respondents had five years ago do not exhibit greater unreliability than reports on jobs they had a few months ago (50,51). Respondents received the survey a maximum of 5 years after they retired.

Work perception
Several aspects of work perception have been thoroughly investigated as possible contributors to the intention and decision to leave general practice early.

1 Job satisfaction

Sibbald et al. (26) found that, in 2001, 22% of UK GPs intended to leave the profession before reaching the pensionable age; in 1998 this was only 14%. They also found that the overall job satisfaction decreased between those periods, and thus they identified overall job satisfaction as a key predictor of GPs' intention to leave. Other studies demonstrated the same relationship among general practitioners (26,35,52-56).

Job satisfaction scale in survey (α = .73)

The participants responded to eight statements about job satisfaction, originally derived from several studies (57,58). Likert scales were used, ranging from 1 = completely agree to 5 = completely disagree. An example of the statements is: "I was satisfied with the work I did."

2 Emotional exhaustion

Davidson et al. (33) investigated reasons for the early retirement of Scottish general practitioners. Of the respondents, 36.5% reported pressure of work/exhaustion or burnout as the main reason to retire early. Years later, these were again the most cited reasons (59). In the Netherlands, the process of burnout among GPs was studied, and this revealed that demanding patient contact produces a lack of reciprocity in the GP-patient relationship (60). The imbalance in relationship experienced by GPs caused feelings of exhaustion over time and initiated the process of burnout (61,62).

Emotional exhaustion scale in survey (α = .92)

In the survey, part of the UBOS (63), a Dutch version of the Maslach Burnout Inventory, was used to measure levels of emotional exhaustion. This scale consisted of seven items, with an answering format ranging from 1 = never to 7 = always. An example of a statement is: “At the end of a working day, I felt empty.”

3 Subjective workload

High workload is the principal source of job-related discontent among British doctors, including general practitioners (21,64). Additionally, a survey among general practitioners in Scotland indicated that 71% of older general practitioners (>55 years) plan to retire at or before the age of 60, with excessive workload cited as the main reason (65).

Subjective workload scale in survey (α = .78)

The participants completed six questions about subjective workload, originally derived from Karasek and Theorell (66). The answering formats of the items ranged from 1 = never to 4 = always. An example question is: “Did you have to work very fast?”

Objective workload/hours worked

Longer reported working hours were associated with lower levels of satisfaction (21,64). And part-time work is associated with generally lower levels of stress and higher levels of job satisfaction than full-time working (36,67,68).

The GP survey included two questions about the number of working hours of GPs: ”What was the average of total weekly working hours?” and “How many out-of-hours shifts a year did you have?”

External factors

Several external factors may have contributed to the decision to retire.

1 External control

There is evidence that physicians are experiencing an increased workload due to external factors, including financial deficits, audits, regulation, administrative policies and procedures. Spickard et al. (69) found that it is important for GPs to have a sense of control over the practice environment and external factors like those mentioned above. In the Netherlands, guidelines have been developed by the Dutch College of General Practitioners (NHG) (70).

External control scale in survey ($\alpha = .83$)

The GP survey included a scale (six statements) about the extent to which GPs experienced a burden caused by external control in six activities, for example, 'an increasing amount of regulations'. The scale consisted of six items. The items ranged from 1 = no burden at all to 5 = a great burden.

2 Demands from the government and health insurers

Government and health insurers create demanding procedures in GPs' work. For example, in 2006 the Dutch health insurance system changed from a system with privately and publicly insured patients to a system with a basic insurance for all citizens. At the same time, the remuneration system for GPs was changed to a system with a basic capitation fee, differentiated by age and deprivation area and supplemented by a fee-for-service system for each consultation (16,71).

Demands from the government and health insurers scale in survey ($\alpha = .81$)

The survey contained a scale about the extent to which GPs experienced a burden caused by demands from the government and health insurers, for example 'their influence on prescription behaviour or numbers of patients'. This scale consisted of four items, of which the answering format ranged from 1 = no burden at all to 5 = a great burden.

3 Demands from patients, media and society

The sources of job stress that could lead to early retirement among GPs is also related to increased and inappropriate demands from patients, society and the media (68,69). There are several studies that suggest that the increasing demands from patients may influence the GP-patient relationship and have a negative impact on GP job satisfaction and mental health (72). Furthermore, societal developments, such as the changing social status of GPs and the influence of the media (for example, information on the Internet) may influence patients' demands.

Societal developments scale in survey (α = .81)

The survey included a scale regarding the extent to which GPs experienced burden caused by societal developments, for example 'negative media reports'. This scale contained five items.

Demands from patients scale in survey (α = .80)

The survey also contained a question about the extent to which GPs experienced burden caused by demands from patients, for example 'the increasing independence of patients'. This scale consisted of four items. The items in the scales mentioned above all ranged from 1 = no burden at all to 5 = a great burden.

Personal reasons

The GP survey included three scales about personal reasons for the respondents to retire before the age of 65.

1 Health

Davidson et al. (33) found that for 19.6% of GPs maintaining good health or the desire to retire while still healthy are possible reasons for retirement. Although few studies have investigated the relationship between health and the intention or decision to retire, it is plausible that GPs retire early for health reasons, either due to poor health or because of the prospect of enjoying good health for several years.

Health scale in survey (α = .74)

Four statements highlight which reasons regarding personal health were part of the respondents' decision to leave general practice. 'The inability to work' or 'the possibility of enjoying several years in good health' are examples of such reasons. The answers in this scale ranged from 1 = was not part of the decision to 3 = was definitely part of the decision.

2 Family reasons and time for leisure

Davidson et al. (33) found that family reasons and time for leisure were reported as the second-most important reason to retire early (26.1%). In a later study, family reasons and the desire for more leisure time were again important factors for considering early retirement (55), which indicates that this reason remained important over time.

Family reasons and time for leisure scale in survey (α = .76)

Five questions in this scale ask which reasons related to life outside the work context (leisure time, family reasons) were part of the respondents' decision to leave general practice, for example 'more time for self' or 'more time for family'. The answers in this scale ranged from 1 = was not part of the decision to 3 = was definitely part of the decision.

3 Change of career

The intention of a career change as a reason for leaving general practice early was only mentioned by a small proportion (6.8%) of GPs in Davidson et al. (33). This implies that career change is not a major reason for GPs to retire early, which is confirmed by Brett et al. (59).

Change of career scale in survey (α = .70)

The participants completed six questions regarding the possibility that career change was part of the decision to leave general practice, for example 'the desire for a management position or a position outside the medical world'. The answers in this scale ranged from 1 = was not part of the decision to 3 = was definitely part of the decision.

Analyses

Analyses were made using Stata 11 software. First, descriptive statistics were calculated as well as the mean scores of the scales explained in the preceding paragraphs. To answer the first research question, two-sample t-tests were conducted to test the differences between the mean scores of the different groups (period and gender) on work perception. To answer the second research question, two-sample t-tests were conducted to test the differences between different groups (gender and period) regarding objective workload. To respond to the third research question, the mean scores of the scales that measured the external factors and personal reasons were used and two-sample t-tests were conducted to test the differences between the mean scores of the different groups (period and gender). Lastly, to answer the fourth question, the results of research questions one and two were combined with information about the probability of leaving within one year and the retirement age, from a study conducted by Van der Velden & Batenburg (22).

We did not test the relationships and interactions between the work perception, objective workload, external and personal factors and the retirement age or probability to leave because these relationships have been studied extensively in earlier research. In addition, the number of respondents was too small to conduct regression analysis, especially when disaggregated by gender.

Results

Work perception

Table 2 presents the mean scores of the scales that define three constructs of work perception in this survey: job satisfaction, subjective workload and emotional exhaustion. The respondents reported on job satisfaction in both periods. GPs who retired between 1998 and 2002 reported a significantly lower job satisfaction than GPs who retired between 2003 and 2007 ($p = 0.000$); this difference applies to both male and female GPs. In the first period, male GPs had a significant higher job satisfaction than female GPs ($p = 0.004$). In addition, male respondents reported significantly less emotional exhaustion in the second period than in the first period ($p = 0.000$). The difference for female GPs was not significant. There were also differences between male and female GPs in both periods: the emotional exhaustion of male GPs was significantly lower ($p = 0.027$ and $p = 0.045$). There were no significant differences regarding subjective workload.

Table 2 Mean scores (95 % CI) of three dimensions of work perception of GPs

	1998-2002			2003-2007			Δ
	Male (n = 256)	Female (n = 26)	Total (n = 282)	Male (n = 175)	Female (n = 16)	Total (n = 191)	
Work perception							
Job satisfaction (1–6)	1.24[12]	1.04[12]	1.22[1]	1.75[1]	1.55[1]	1.74[1]	+
	(1.20-1.28)	(0.89-1.20)	(1.18-1.26)	(1.67-1.83)	(1.29-1.83)	(1.66-1.81)	
Subjective work-load (1–4)	0.75	0.88	0.75	0.73	0.66	0.73	0
	(0.69-0.80)	(0.67-1.09)	(0.71-081)	(0.65-0.81)	(0.42-0.90)	(0.65-0.80)	
Emotional exhaustion (1–7)	3.05[12]	3.52[2]	3.09[1]	2.24[12]	2.87[2]	2.30[1]	-
	(2.92-3.18)	(3.07-3.98)	(2.97-3.22)	(2.06-2.42)	(2.12-3.63)	(2.12-2.47)	

1 difference between periods (p < .05) (t-test)
2 difference between men and women (p < .05) (t-test)

External factors and personal reasons for leaving general practice

There are different factors that may influence a GP's decision to leave general practice. Table 3 presents the mean scores of external factors burdening GPs and personal reasons for retirement. Male GPs experienced the highest burden from external control in both periods (1998–2002 and 2003–2007), while female GPs experienced the highest burden from demands by patients in the first period and from external control in the second period. For both male and female GPs, in the second period societal developments became less important than demands from the government and health insurers. Additionally, family reasons/wanting time for leisure was the most important personal reason for both male and female GPs in both periods. Health was rated as the second most important reason and career change as the third. However, for female GPs in the second period, health was cited as a less important reason for leaving general practice than a career change.

Table 3 Mean scores (95 % CI) of factors influencing the decision to retire

	1998-2002			2003-2007			Δ
	Male (n = 256)	Female (n = 26)	Total (n = 282)	Male (n = 175)	Female (n = 16)	Total (n = 191)	
External factors							
External control (1–5)	2.63	2.75	2.64	2.62	2.51	2.61	0
	(2.56-2.69)	(2.53-2.97)	(2.58-2.70)	(2.50-2.73)	(2.02-3.00)	(2.50-2.72)	
Demands from government and health insurers (1–5)	2.35[1]	2.44	2.35[1]	2.11[1]	2.23	2.12[1]	-
	(2.29-2.40)	(2.24-2.64)	(2.30-2.41)	(1.98-2.24)	(1.76-2.71)	(2.00-2.24)	
Societal developments (1–5)	2.54[1]	2.59[1]	2.55[1]	2.07[1]	1.99[1]	2.06[1]	-
	(2.48-2.60)	(2.37-2.82)	(2.49-2.61)	(1.97-2.17)	(1.65-2.33)	(1.97-2.16)	
Demands from patients (1–5)	2.56[1]	2.76[1]	2.58[1]	2.26[1]	2.28[1]	2.26[1]	-
	(2.49-2.62)	(2.52-3.00)	(2.52-2.64)	(2.16-2.35)	(1.95-2.61)	(2.17-2.35)	
Personal reasons							
Career change (1–3)	1.26[1]	1.31	1.27[1]	1.15[1,2]	1.38[2]	1.17[1]	-
	(1.21-1.32)	(1.12-1.50)	(1.22-1.32)	(1.10-1.20)	(1.01-1.76)	(1.12-1.23)	
Health (1–3)	1.57[1]	1.77[1]	1.59[1]	1.31[1]	1.28[1]	1.30[1]	-
	(1.50-1.64)	(1.48-2.06)	(1.52-1.66)	(1.23-1.39)	(1.04-1.52)	(1.23-1.38)	
Family reasons and time for leisure (1–3)	1.87[1]	1.92	1.87[1]	1.74[1]	1.57	1.72[1]	-
	(1.79-1.94)	(1.67-2.17)	(1.80-1.95)	(1.66-1.82)	(1.28-1.87)	(1.64-1.81)	

1 difference between periods (p < .05) (t-test)
2 difference between men and women (p < .05) (t-test)

The mean score of several external factors changed from one period to the next. Male GPs experienced less demand from government and health insurers in the second period than in the first period (p = 0.000). Both men (p = 0.000) and women (p = 0.002) experienced significantly less influence of societal developments in the second period compared to the first. Furthermore, both men (p = 0.000) and women (p = 0.017) experienced less burden of demands from patients in the second period.

In addition, the mean scores of several personal reasons influencing the decision to leave general practice changed from one period to the next. For male GPs, change of career was less important as a reason to retire in the second period than in the first period (p = 0.004). For female GPs, there was no difference between the two periods regarding career change as a reason for leaving general practice, but there was a difference between male and female GPs in the second period regarding career change (p = 0.018): female GPs reported career change as being more important than male GPs. Both male GPs (p = 0.000) and female GPs (p = 0.022) reported health as a more important reason for leaving general practice in the first period than in the second period. The mean scores of the family reasons and wanting time for leisure as a personal reason for retiring show that these factors were less important for male GPs in the second period than in the first period (p = 0.028). There was also a difference for female GPs, but this was not significant.

Relating work perception, reasons for retirement and the probability of leaving
The probability of leaving within one year decreased from one period to the next for both male and female GPs, with a stronger decrease for female GPs. Furthermore, the retirement age of Dutch GPs increased in the second period. There were not only fewer GPs leaving in the second period, but they were also older when they left. It is important to establish what factors are at play in these changes.

Female GPs
The work perception of female GPs changed between 1998–2002 and 2003–2007. Their job satisfaction was higher in the second period, and their degree of emotional exhaustion was somewhat lower in the second period (but not significantly so). However, during both periods their degree of emotional exhaustion was higher than that of male GPs. There was no change in the experienced subjective workload.

For female GPs, external factors that were burdening GPs and may have contributed to the decision to retire were less important in the second period than in the first period. The external factors were external control (not significant), demands from the government and health insurers (not significant), and demands from society (significant) and patients (significant).

Moreover, personal reasons that may have contributed to the decision to retire were somewhat less important for female GPs in the second period. Personal health as a reason to retire early decreased from one period to the next. In both periods career change, family reasons and time for leisure were reasons to retire from general practice; however, they did not become more or less important in the second period.

Male GPs

There were significant changes in the work perception of male GPs between 1998–2002 and 2003–2007. Their job satisfaction was higher, and their degree of emotional exhaustion was lower in the second period. However, their subjective workload did not change.

For male GPs, two external factors that were burdening GPs and that may have contributed to the decision to retire were significantly less important in the second period, namely demands from the government and demands from health insurers. In addition, demands from patients and developments in society became less important in the second period.

Moreover, in the second period personal reasons that may have contributed to the decision to retire were less important for male GPs. Personal health as a reason to retire, decreased from one period to the next. The same is true for a career change, for which there was also a difference between male and female GPs in the second period, in which career change proved less important for male GPs. For male GPs, family and time for leisure as reasons to retire were also lower in the second period.

Objective workload and probability of leaving

For both male and female GPs, there was no decrease in subjective workload from 1998–2002 to 2003–2007, but there was a higher job satisfaction and less emotional exhaustion in the second period. In Table 4, the objective workload is depicted for male and female GPs in both periods. The objective workload decreased significantly for male GPs, as they had significantly fewer out-of-hours shifts in the period 2003–2007 than in the period 1998–2002.

Table 4 Objective workload of self-employed GPs, mean (95 % CI)

	1998-2002			2003-2007			Δ
	Male (n = 256)	Female (n = 26)	Total (n = 282)	Male (n = 175)	Female (n = 16)	Total (n = 191)	
Objective workload							
Number of working hours	52.0[2]	45.6[2]	51.4	51.3[2]	39.8[2]	50.6	0
	(50.4-53.6)	(39.1-52.2)	(49.8-53.0)	(49.1-53.5)	(27.4-52.2)	(48.3-52.8)	
Number of out-of-hours shifts (evening) per year	51.3	36.6	50.2[1]	33.0[1]	29.5	32.9[1]	-
	(47.2-55.4)	(27.2-45.9)	(46.3-54.1)	(26.0-40.0)	(−9.3-68.3)	(26.1-39.6)	
Number of out-of-hours shifts (weekend) per year	11.7[1]	9.8	11.8[1]	9.8[1]	13.2	10.0[1]	-
	(11.2-12.7)	(7.8-11.7)	(11.0-12.5)	(8.6-11.0)	(−3.9-30.2)	(8.7-11.2)	

1 difference between periods (p < .05) (t-test)
2 difference between men and women (p < .05) (t-test)

Furthermore, there were no reasons for leaving general practice that were more important in the second period; by contrast, the majority of the external factors and personal reasons became less important. However, for female GPs the objective workload did not provide any evidence for the stronger decrease in the probability of leaving.

Discussion

This study investigated work perception, objective workload, external factors burdening GPs and personal reasons for leaving general practice among two groups of retired general practitioners: those that left general practice in 1998–2002 and those that left in 2003–2007. This was investigated to account for both the difference between these two periods in the probability for leaving general practice within one year, especially for female GPs and the different retirement ages in both periods.

The work perception of both male and female GPs was different for the period 1998–2002 and the period 2003–2007: both groups experienced a higher job satisfaction and a lower degree of emotional exhaustion, although the difference for female GPs was not significant. There was no difference in subjective workload, but the objective workload was lower in the second period, especially for male GPs because they had a lower number of out-of-hours shifts (evening and weekend) per year.

Furthermore, external factors that were experienced as a burden and that may have contributed to the decision to retire were less important for GPs in the second period than in the first period, with more significant differences for male GPs. In addition, personal reasons that could contribute to the decision to retire were somewhat less important for female and male GPs in the second period.

The probability of leaving within one year was lower in the period 2003–2007 than in the period 1998–2002 for both male and female GPs; however, this decrease was stronger for female GPs. Nevertheless, in the second period female GPs still had a higher probability of leaving general practice within a year than male GPs. Additionally, the retirement age of both male and female GPs was higher in the second period (M: 58.8, F: 49.1) than in the first period (M: 56.5, F: 47.0). Not only were there fewer GPs who retired from general practice in the period 2003–2007 than in the period 1998–2002, but the retirement age was also higher in 2003–2007. This reflects the changing wider societal trend of the increasing will to work until 65 (statutory retirement age) (15). To evaluate the policies that have been implemented to encourage later retirement, it is useful to understand the link between the factors influencing the decision to retire and the actual turnover in the medical and GP workforce. Although the subjective workload for both male and female GPs was not lower in the second period, the objective workload decreased from one period to the next for male GPs. In addition, both male and female GPs had a higher job satisfaction and less emotional exhaustion in the second period. Furthermore, a majority of external factors and personal reasons that may have contributed to the decision to retire were less important contributors to this decision in the second period. The general probability of leaving has decreased, but we found no evidence why this decline was stronger for female GPs than for male GPs. However, these findings underscore the differences between male and female GPs. To conduct workforce planning accurately and respond to the existing gender differences, it is important to understand the different reasons male and female GPs have to retire. Therefore, there is a need for gender disaggregated data collection. The information in the NIVEL GP database is disaggregated by gender.

There are differences between the two periods 1998–2002 and 2003–2007 regarding the moment and probability of retirement, as well as the reasons influencing the decision to retire. The introduction of several workload reduction measures in the Netherlands at the start of the 21st century, have possibly contributed to these differences. These measures were implemented to reduce high workload among GPs: the nationwide introduction of central GP services for evening, night and weekend service and the introduction of general practice nurses in GP practices. These measures were discussed more extensively in the background section of this article (41,42).

According to earlier research, the number of evening, night and weekend shifts per GP and the experienced workload reduced significantly after the introduction of large-scale central GP services (44,48). Also, the findings of the present study show that there was a decrease in evening, night and weekend shifts (Table 4).

A possible reduction in GP workload was expected because of the introduction of the general practice nurse if GPs could focus on their core tasks, and the provision of care was shared with other health professionals. During the present study, we acquired additional information about these practice nurses. We found that in the period 1998–2002, 6.7% of the respondents mentioned that a practice nurse was working in their practice, while this percentage had risen to 37.6% in 2003–2007.

It was confirmed by the results of the present study that these two workload reduction measures (central GP services for out-of-hours care and practice nurses) were more frequent in the second period.

Another possible explanation for the differences found between both periods are changing financial circumstances for GPs. Self-employed GPs can only retire from general practice when it is also financially attractive for them. The respondents in this study answered two questions about remuneration that could have influenced their decision to leave general practice: 'There were no financial stimulants to stay' and 'It was not necessary to continue working for financial reasons.' However, the answers to these questions were contradictory and, therefore, no conclusions could be drawn about the influence of remuneration. Landon et al. (73) did found that the income of physicians is not related to the decision of retirement.

Strengths and limitations of the study

This study has a number of limitations. The response rates of the surveys are moderate (60 and 54%). Analysis of the differences in personal characteristics between respondents and the population of retired GPs in these periods shows that the respondents were somewhat older than the overall population of GPs that left general practice. While the sample remained reasonably representative in terms of demographic characteristics, it cannot be ruled out that it was the most dissatisfied group that responded. However, it seems unlikely that the survey results do not represent the group of retired GPs. For the probability of leaving within one year and the retirement age, data from the entire GP population were used, and generally these data were comparable to the results of our survey.

A second limitation is that GPs who left general practice before they reached retirement age were asked retrospectively to mention their reasons for leaving general practice. It is possible that their answers were influenced by the time elapsed. However, we expect this bias to be minimal, because it has been shown that reports on jobs that respondents had 5 years ago do not exhibit greater unreliability than reports on jobs of a few months ago (50,51). Our respondents received the survey a maximum of five years after they retired.

After cleaning up the data, there were relatively few female GPs left, especially in the second survey. For this reason, the 95% confidence intervals for female GPs were mostly quite large. This was due to the fact that there are fewer self-employed female GPs than self-employed male GPs in the Netherlands (an average of 21.4% female self-employed GPs in 1998–2002 and an average of 27.1% in 2003–2007). Despite the small numbers, differences were found, and it is possible that we would have found more and larger differences if we had had more female respondents.

A strength of this study is the use of results from the two periods because these were the periods approximately before and after two major workload reduction measures were introduced in the Netherlands. Another strength of this study is the use of actual turnover as an outcome measure, rather than the intention to leave general practice. Other research suggests that intentions to retire do not necessarily translate into action (26,74). In several studies, the intention to retire represents the same construct as job satisfaction. According to Rittenhouse (40), job satisfaction is a better predictor of the intention to leave general practice than of actual turnover. In our surveys, both actual turnover and job satisfaction were used.

Implications for policy and future research

The reduction of the high (subjective ánd objective) workload of GPs is an important goal because a high workload may lead to a high probability of early retirement and of leaving general practice within one year. Both may have consequences for patients, and it is likely that the quality of care will suffer as a result (75). At the very least, it is important information for planning the GP workforce to meet the future demand for care. After all, projections of the future outflow of GPs are based on the retirement age of GPs in the past. Moreover, due to the high cost of training and the relatively long training period for physicians, it may be beneficial to stimulate physicians to retire at a later age. Several studies have shown that the proportion of physicians working beyond the age of 60 has fallen in most European countries over the past decade (25-27). Until recently, few OECD countries had implemented or planned specific policies to address this issue (28). A greater understanding of the link between the factors influencing the decision to retire and actual turnover would, therefore, be useful in the development of policies to encourage later retirement. The results of this study indicate that the implementation of workload reduction policies, such as reducing out-of-hours shifts, are an important contributor to encouraging policies for GPs to retire later.

There is evidence that physicians are experiencing an increased workload due to external factors, including financial deficits, audits, regulation, administrative policies and procedures (36,69). According to the results of this study, male GPs experienced the highest burden from external control in both periods (1998–2002 and 2003–2007) and female GPs experienced the highest burden from external control in the second period. These results show that external control (as a potential contributor to the decision to retire) did not (significantly) decrease between two periods. Implementing policy, that decreases external control, by for example decreasing the administrative burden for GPs, could potentially reduce GPs' workload even more.

Since 2006, a new health insurance act has been in force in the Netherlands. Our study only covers GPs that left general practice during two periods: 1998–2002 and 2003–2007. We expect that the introduction of the new health insurance act did not contribute to the decision to leave between 2003 and 2007. However, the first reactions by GPs to these system changes have not been very positive. GPs expect the new health insurance act to lead to increased administration and regulations, which will cause an increase in non-patient related activities (76,77) Therefore, it would be interesting to use the same survey for GPs that left general practice during the next five year period: 2008–2012. It would be especially interesting to investigate whether the administrative burden has changed and whether this has had any effect on the work perception, the reasons for leaving general practice and the probability of leaving within one year.

Conclusion

The results of this study suggest that the decrease in the probability of leaving general practice within one year and the increase in the retirement age have been caused by not only a reduction in the objective workload and a change in the work perceptions of GPs, but also by external factors and personal factors. It was confirmed by the results of the present study that the two workload reduction measures introduced by the Dutch government (central GP services for out-of-hours care and practice nurses) were more common in the second period. These changes therefore likely have been influenced by the implementation of these policies.

As stated in the introduction of this article, countries have a variety of additional policy instruments at their disposal to influence the supply of physicians. Based on the results of this study, we consider workload reduction policies are the most useful instruments to control retention and retirement.

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Appendix 1 Probability of leaving general practice within one year, by age, gender and period

	1998-2002				2003-2007				Δ			
Age	<=54	55-59	60-64	Total	<=54	55-59	60-64	Total	<=54	55-59	60-64	Total
Male	1.5%	7.4%	35.2%	3.3%	0.7%	5.2%	21.3%	3.0%	-0.8%	-2.2%	-13.9%	-0.3%
Female	2.3%	11.4%	34.8%	2.7%	1.3%	5.3%	21.3%	1.7%	-1.0%	-6.1%	-13.4%	-1.0%
Total	1.7%	7.6%	35.1%	3.2%	0.9%	5.2%	21.3%	2.7%	-0.8%	-2.4%	-13.9%	-0.5%

Source: Van der Velden LFJ, Batenburg RS: Stoppen als huisarts: trends in aantallen en percentages. Een analyse van de huisartsenregistratie over de periode 1998-2007. [Leaving general practice: Trends in numbers and percentages. An analysis of the GP registration for the period 1998-2007.]. Utrecht: NIVEL; 2009.

Abstract

Objectives In this paper, the feasibility and consequences of several oral health staff-mix scenarios of the Dutch oral health care workforce, which were recommended by a committee that investigated the possibilities for task reallocation in the oral healthcare workforce, are investigated. These recommendations were leading for the government's policy on the oral healthcare workforce. At that time, no workforce planning study was executed to investigate the feasibility of the recommendations.

Methods The feasibility of meeting the recommended oral health staff-mix in 20 years was evaluated using the Dutch health workforce planning model, including a task reallocation software tool that was developed to connect the health workforce planning models of multiple health professions. Two alternative scenarios were tested: the required annual student intakes to meet task reallocation targets in 2030, and the feasible amount of task reallocation in 2030 keeping the annual student intake constant. Finally, the available staff-mix of 2010, the targeted staff-mix of 2030 and the available staff-mix of 2030 (with current and adjusted intakes) were calculated.

Results The recommended task reallocation target (dental hygienists and oral preventive assistants taking over 50% of dentists tasks) is not met within 20 years with the current student intakes. The annual student intakes of all three professions have to be adjusted to meet the recommended target task reallocation by 2030. 27.4% task reallocation could be reached in 20 years, but also in this case, dental hygienist and oral preventive assistant intakes have to be adjusted.

Conclusions We can conclude that dramatically changing the staff-mix of a workforce will be a long-term process, because large adjustments of annual student intakes or implementation of alternative policies will most likely have adverse consequences, such as closing training institutions. By using integrated health workforce planning models, policy plans regarding workforce staff-mix can be evaluated ex-ante. Model simulations can thus support advisory committees' recommendations to estimate the consequences of policy plans and oversee long-term effects before policy is implemented.

Introduction

Many health care providers have work that can overlap or complement the work of other health professionals. This combination of different categories of workers is often referred to as staff-mix, which is the combination of all health care providers participating in care for an individual patient. Defining the 'optimal' staff-mix is often used to address shortage problems of single professions by task reallocation to existing or new professions, but changing the staff-mix can also be a strategy for improving the effectiveness and efficiency of health care (1, 2). The World Health Report 2000 (3) already noted that determining and achieving the 'right' mix of health personnel are major challenges for most health systems (Buchan & Dal Poz, 2002). Also in more recent publications, reaching the 'optimal' staff-mix is a widely discussed topic (4-11).

The task reallocation/staff-mix debate in Dutch oral health care
In the Netherlands, the 'optimal' staff-mix of the oral health workforce has been a debate for years (12-20). In the 1990s, large capacity problems for oral health care were predicted, after a period of a perceived oversupply of dentists. These predictions were based on research of the Dutch Steering Committee on Future Health Scenarios (21). During this decade, an increasing shortage of dentists had already led to an informal transfer of tasks from dentists to dental hygienists (16, 22). Since then, the debate on the 'optimal' staff-mix in Dutch oral health care and the role of dental hygienists has started. Worldwide, the role of dental hygienists is subject of many studies (22). To investigate the oral health care staff-mix in the Netherlands, two advisory committees were founded on different moments in time: the Committee for Capacity in Oral Healthcare in 2000 (23) and the committee Innovation in Oral Healthcare in 2006 (24).

These committees investigated the structure and capacity of the oral healthcare workforce and recommended to change the staff-mix to cope with capacity problems and to be able to provide tailored oral health care to the Dutch population. They also investigated the competencies required for each oral health professional involved in the changed staff-mix. To prepare the professionals for their changed roles, the content en length of training for several oral health professionals was reconsidered, as well as the required number of students. Also, the consequences of these changes in the oral healthcare workforce were explored.

Both committees recommended to the government to 1) stimulate task reallocation from dentists to dental hygienists and oral preventive assistants, and 2) made recommendations on annual student intake. The government followed these recommendations (25), but the consequences of the recommendations were not supported by workforce projections at that time. At that point, the oral health workforce data was not extensive enough to perform workforce projections.

Following the recommendations of the committees, the government introduced changes in the oral health educational and legal system to stimulate task reallocation. First, Dutch dental hygiene education was extended from a three-year curriculum to a four-year bachelor program in 2002. This new training offered additional competencies in both the diagnosis and treatment of caries. Compared with the education of the 'old style' dental hygienist the main differences were the supra-professional competencies and the broadened professional competencies regarding tertiary caries prevention (preparation and filling of primary caries lesions) (15, 16, 20, 22, 26). Second, the referral of a patient by a dentist to a dental hygienist was no longer obligatory (16, 26, 27). And third, Dutch dentist education was extended with one year to a six-year curriculum in 2009. This new program should prepare dentists for their new role of mostly coordinating patient's care and focussing on patients with complex dental problems (26).

The first recommendation referred to the amount of task reallocation from dentists to dental hygienists and oral preventive assistants. Uncomplicated oral care, such as removing calculus and plaque, could be performed as well by dental hygienists and oral preventive assistants as by dentists. More than 60% of Dutch population has mostly uncomplicated dental problems, especially young people (24). Half of the patients with uncomplicated problems could be taken care of by dental hygienists, 20% by oral preventive assistants and 30% by dentists. The committee recommended a radical change in the staff-mix of the Dutch oral health workforce while total workforce size could remain about the same. The number of dentists could be halved (50% task reallocation) while twice as much dental hygienists and oral preventive assistants are required to take over uncomplicated tasks from dentists. There was no time frame defined for achieving the numbers of dentists, dental hygienists and oral preventive assistants to form this 'optimal' staff-mix.

To meet this new staff-mix, the same committee made a second recommendation, which was about the student intakes. The intake of dental students was advised to decrease from 300 per year to 240 per year and the intake in dental hygienist training was advised to be maintained at a level of 300. Although the committee preferred to recommend a lower intake in dentist training and a higher intake in dental hygienist training, it was believed that a higher dental hygienist intake was not feasible due to a

lack of applicants. Therefore, the annual student intake was recommended to remain 300.
The annual student intake in both dentist training and dental hygienist training is regulated by budgets from the government. The intake in oral preventive assistant training is not regulated at all. No specific student intake in oral preventive assistants training was recommended, but it was recommended to increase the total number of oral preventive assistants. The committee Innovation in Oral Healthcare actually advised a greater increase of oral preventive assistants than strictly required to take over 25% of dentists tasks, because the position of oral preventive assistants at that time was stronger than the position of dental hygienists. A higher number of oral preventive assistants could compensate for a potential shortage of dental hygienists.
The three primary oral health professions taking part in this national policy are discussed in Table 1.

Table 1 Three professions in Dutch primary oral health care

Dentists	Are concerned with recognizing, preventing and treating diseases of the teeth and surrounding structures. Their main task is focused on general diagnosis and the coordination of a patient’s care and treatment by them and their team (26). They gather relevant information, diagnose, set treatment and care plans, and implement dental treatments, usually curative. They are registered in the “BIG-register” according to the Professions in Individual Health Care Act (46). Only those who are enrolled in this register are authorized by law to use the protected title of dentist. Dentist training length is six years.
Dental hygienists	Are able to provide basic dental care for a large proportion of patients. Their tasks focus on oral health screening and regular check-ups, prevention, treatment planning, and to some extent, curative care, including simple fillings. Dental hygienists in the Netherlands now have an independent status. They may work in premises separate to dentists if they wish to, and the referral of a patient by a dentist to a dental hygienist is no longer obligatory (26). Dental hygienist is a protected title by training. The training length is four years.
Oral preventive assistants	Are dental assistants that have acquired more knowledge on specific components. By following an oral preventive assistant training, the responsibilities of the dental assistant expanded. This is a complementary training of approximately 8 days. The tasks of the assistant are focused on primary prevention, on organizing the practice and assisting the dentist and the dental hygienist (26). Oral preventive assistant is not a protected title.

In this paper, the feasibility and consequences of the above-mentioned recommendations and the policy logic of the committees (the targeted staff-mix change of the Dutch oral health care workforce) are investigated in hindsight. Different oral health care staff-mix scenarios are evaluated, by using the Dutch health workforce planning model, including a software tool to connect multiple oral health workforce professions (i.e. dentists, dental hygienists and oral preventive assistants).

This leads to the following question:
What is the feasibility of Dutch oral health staff-mix recommendations as evaluated by using the Dutch health workforce planning model including a task reallocation software tool?

In the following sections, the methods of evaluating multiple staff-mix scenarios are discussed. The working of the Dutch workforce planning model and a task reallocation software tool to connect the projections of multiple oral health professions are also explained in the method section, as well as the assumptions to demonstrate its functioning. Subsequently, the results of the analyses are described, which are summarized and discussed in the last section where also conclusions are drawn.

Methods

The feasibility of the policy recommendations regarding the amount of task reallocation and annual student intakes, as described in the previous section, were evaluated by comparing the available and targeted FTEs of each of the three oral health professions in the future. The Dutch workforce planning model and a task reallocation tool were used to execute the analyses. With this method, several (alternative) staff-mix scenarios for three professions in oral health care were developed. We refer to Van Greuningen et al. (28) for the working of the model. In the next section, the model is explained briefly.

The Dutch model
The Dutch health workforce planning model (28-31) has initially been developed to support health workforce planning for separate health professions in the Netherlands and is suitable for planning the workforce of all Dutch health professionals. Since 2000 and based on this model, the Ministry of Health is advised on the adjustment of the annual student intake of all medical professions, to balance the supply and demand and to prevent shortages or oversupplies in the future workforce.

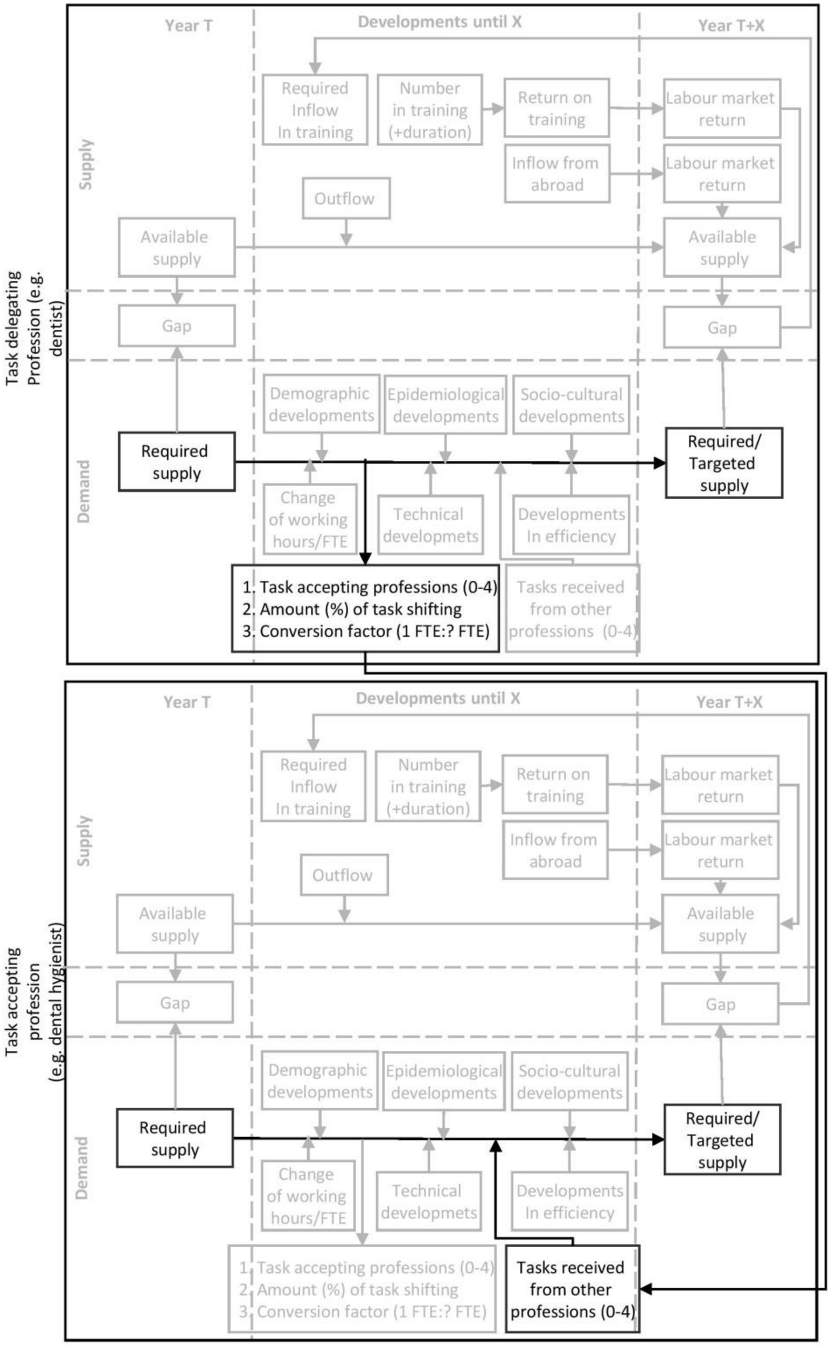
The health workforce planning model is based on realizing an equilibrium in projection (i.e. for 2020, 2025) based on assumptions, heuristics and statistics about the supply and demand side of the health care labour market. The output of the planning model is a calculation of the required annual intake in medical training within the next five to fifteen years (Van Greuningen et al., 2012). Comparable with the techniques used for population projections, the Dutch workforce projection model is a cohort component model (32-34). The components consist of inflow to or outflow from the active workforce. The model is divided into three different stages that are related to the current situation (launch year), the developments between the current situation and the future (target year), and the situation in the target year (Van Greuningen et al., 2013).

From the start, the Dutch workforce planning model included substitution elements for each profession, by which the (expected) reallocation of tasks could be taken into account. However, there was no direct, ‘automated’ link between the planning models of multiple professions, and the values of the substitution elements for different professions were not related. By including interactions between health professions in health workforce planning models, simulations of task reallocation are made possible. The developed task reallocation tool enables the connection of the models of multiple health professions.

Task reallocation software tool to connect professions in workforce planning

A software tool for the Dutch workforce planning model was developed to model task reallocation from one profession to another, in a direct, automated way. This tool comprises several elements and connects one task delegating profession with several task accepting professions. To do this, external information and data are required. The general working of the tool is as follows. First, up to four task accepting professions (e.g. new professions or professions with new roles) can be defined for each delegating profession, based on existing information about the staff-mix of the professions under scrutiny. Second, the amount of tasks shifted from the task delegating profession to these task accepting profession(s) is estimated by experts, as are also several demand elements of the Dutch health workforce planning model (28). The expert groups consist of representatives of professional associations, training institutions and healthcare insurers to avoid dominance of one interest group. The experts are instructed to base their estimations partly on their own experiences, but also use information from research on specific topics. The decision-making process of these expert groups does not take place via a predetermined route, but has been guided and supported intensively by the Advisory Committee on Medical Manpower Planning during the last years (Van Greuningen et al., 2012). The estimated amount of tasks shifted is entered in the model and expressed as a percentage of the total FTE of the delegating profession. Then, for each task accepting profession, a factor, estimated by experts, is entered in the model which converts one FTE of the delegating profession to the required amount of FTEs of the task accepting profession to substitute the first. This estimation is also partly based on their own experiences, but also on information from research. The amount of tasks that is shifted from the task delegating profession is then converted to the amount of FTE required to actually execute this new task load by the task accepting profession. Hence, the future total FTE of both delegating and accepting professions is estimated, after reallocation of tasks and during a specified period. In figure 1, it is visualized how the planning models of two professions are connected by the software tool for task reallocation.

Fig. 1 Task reallocation software tool connecting two health professions



Demonstrating the task reallocation tool – evaluating two main policy measures.
The Dutch planning model was used to project the Dutch oral health workforce and simulate different staff-mix scenarios to test the feasibility of the recommended task reallocation in oral healthcare by making workforce projections. The workforce planning model makes projections for a maximum period of 20 years, which is also applied in the present study.

Data
Although the advisory report of the committee Innovation in Oral Healthcare has been published in 2006 and the government adopted its recommendations from this moment on, in this paper, 2010 was used as launch year (where the projection starts). For this year, information about the workforces of dentists, dental hygienists and oral preventive assistants is most complete and most detailed, and it was also the first time an extensive data collection of these workforces was done. Thus, we evaluated the feasibility of national oral health workforce policy of shifting half of dentists tasks to dental hygienists and oral preventive assistants before 2030. Data used in these analyses are derived from the official 2010 projections by the ACMMP (35) and assumptions based on recommendations of the committee Innovation in Oral Healthcare.

Model elements based on 2010 projections
For the present analysis, several elements of the planning model were based on the specifications that were used for the official 2010 projections by the ACMMP (35): the number and FTE (available and required) of dentists, dental hygienists and oral preventive assistants in 2010, the return on training and the labour market return, as well as the gap between supply and demand in the launch year was also similar to the 2010 projections. The data for the 2010 projections was collected according to Dutch privacy legislation. According to Dutch legislation, approval by a medical ethics committee was not required for this kind of data collection.

Model elements assumed to remain constant
Several developments, at both the supply and the demand side, were assumed to remain constant at 0% change, i.e. the inflow from abroad, and the developments at the demand side, such as demographic developments. This is in accordance with the recommendations of the committee Innovation in Oral Healthcare; that did not take all developments included in the Dutch health workforce planning model into account. In addition, by doing this, the net influence of the task reallocation elements can be estimated, and the software tool can be demonstrated.

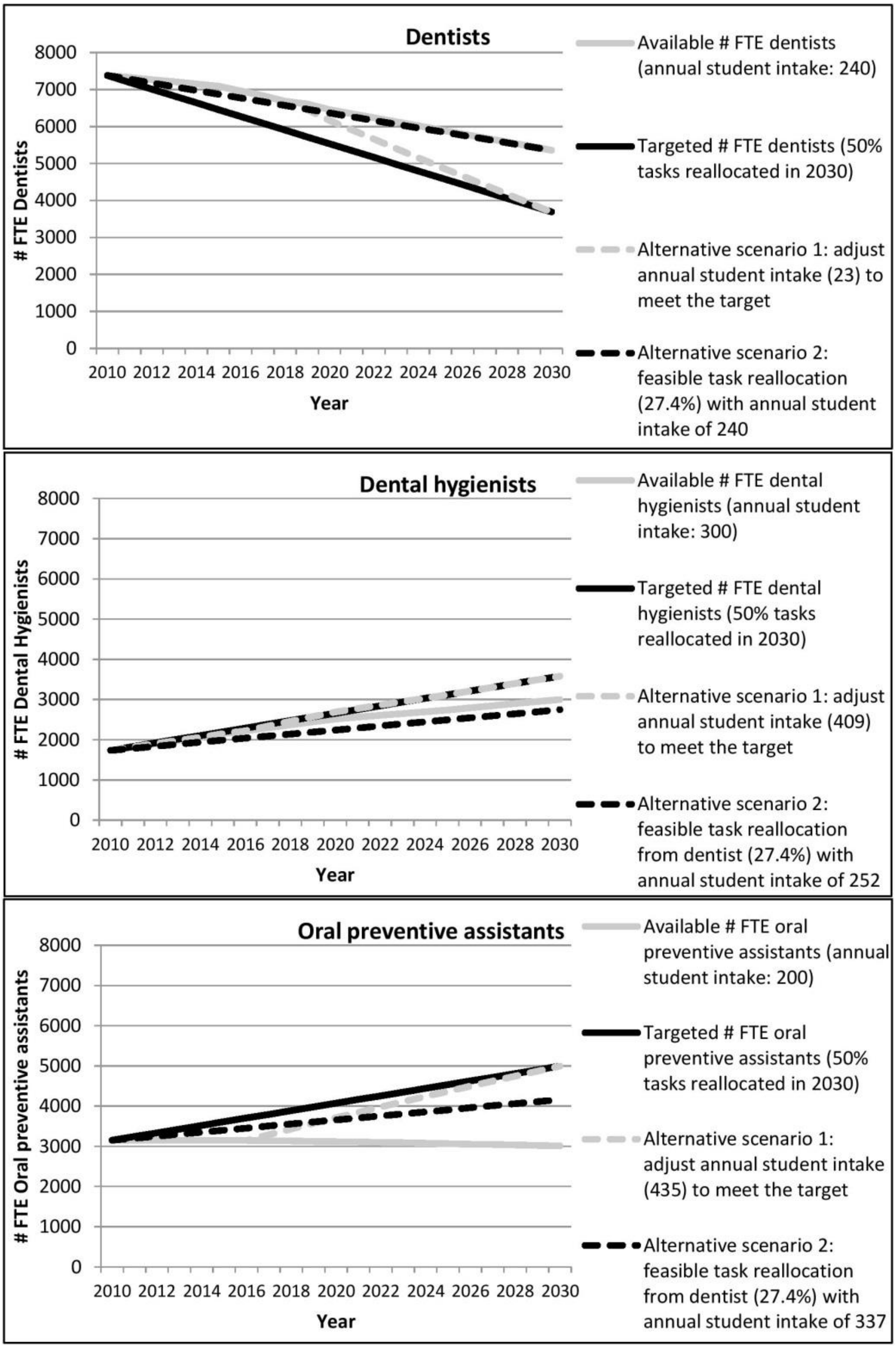
Assumptions about the model elements representing the two main policy measures
The components of the task reallocation software tool, as well as student intake, were defined according to current policy which is based on the committee's recommendations. The targeted annual intake in dentist training is 240, in dental hygienist training 300 and the intake in oral preventive assistant training was assumed to be 200. Derived from the committee's report, the conversion factor was assumed to be 1 to 1 and the amount of task reallocation from dentists to dental hygienists and oral preventive assistants is 50% from the current total dentist capacity in FTE.
It is assumed that the total FTE of dentists could be halved over a period of 20 years and that their tasks shift to dental hygienists and oral preventive assistants. The total amount of dentists FTEs would then reduce by 1.25% per year, because it is assumed that both dental hygienists and oral preventive assistants each take over half of the shifted tasks (50% substitution / 20 years / 2 professions).

Evaluation of several staff-mix scenarios
By the methods presented above, several staff-mix scenarios were evaluated. First, it was evaluated if the recommended oral health staff-mix could be met in 20 years if student intakes will remain constant or if it will take more years to meet this target. This was done by comparing the available FTEs of dentists, dental hygienists and oral preventive assistants with the targeted FTEs, for 2010-2030.
If it appears from the results of this analysis that the recommended task reallocation target will not be met in 20 years, additional analyses will be done to explore alternative scenarios. First, the required intake in dentist, dental hygienist and oral preventive assistant training to meet task reallocation targets, as recommended, in 2030 (within 20 years) will be estimated. Second, by changing the amount of task reallocation in the model (trial-and-error), the feasible amount of task reallocation in 2030 will be estimated when the annual student intake will remain constant. And finally, with the results of the analyses above, the available staff-mix of 2010, the targeted (or recommended) staff-mix of 2030, the available staff-mix of 2030 with current student intakes and the available staff-mix of 2030 with a feasible amount of task reallocation will be calculated.

Results

Figure 2 shows the results of the workforce planning analyses: the available FTE with the annual student intake as set by current government policy, the targeted FTE between 2010 and 2030 based on governmental policy (as also recommended by the committee Innovation in Oral Healthcare), and two alternative scenarios. These alternative scenarios show 1) the development of the total supply, if the annual student intake is equal to the required intake to meet the target FTE in 2030 and 2) the development of the total supply to meet the available FTE in 2030 keeping current annual student intake constant, but having a more feasible amount of task reallocation.

Fig. 2 Available and targeted FTE of dentists, dental hygienists and oral preventive assistants, and two alternative scenarios, 2010-2030



Feasibility of meeting the targeted task reallocation

The available FTE of dentists decreases from 7,378 FTE in 2010 to 5,357 FTE in 2030 if the dental student intake is 240 per year. The targeted (and recommended) FTE is however 3,689 FTE in 2030. Thus, we can conclude that the targeted FTE of dentists is not met in 2030.

The targeted FTE of dental hygienists increases from 1,736 FTE in 2010 to 3,581 FTE in 2030. However, if the annual intake in dental hygienist training remains at its current level (300), the available FTE of dental hygienists increases to 3,001 FTE in 2030. From this, we can conclude that the targeted FTE of dental hygienists is not met in 2030.

The available FTE of oral preventive assistants decreases from 3,150 FTE in 2010 to 3,007 FTE in 2030, if the annual intake in training will be kept at 200. However, the targeted FTE of oral preventive assistants increases to 4,994 FTE in 2030. From this results, we can conclude that with an intake of 200 oral preventive assistants, the available total FTE will not meet the targeted amount in 2030.

The target of dental hygienists and oral preventive assistants taking over dentists tasks so that the total FTE of dentists could be halved is not met within 20 years if the current student intake is maintained. The workforces of dentists and dental hygienists will eventually be able to meet the target FTEs without adjusting the student intake, but it will take more than 20 years. However, the workforce of oral preventive assistants will not meet the targeted FTE in the years following 2030 if the intake is not adjusted. Consequently, it is not possible to meet the targeted staff-mix, if current policy is followed.

This can be concluded from Figure 2, by extrapolating the uninterrupted gray lines in the graphs, depicting the available supply of each profession, to where they intersect the uninterrupted black lines, depicting the targeted supply. The uninterrupted black lines remain at a constant level after 2030.

Adjusted annual student intake to meet the targeted (and recommended) staff-mix

Figure 2 also depicts what the FTEs of dentists, dental hygienists and oral preventive assistants would be if the student intakes would be adjusted to meet the targeted FTEs in 2030. The annual dental student intake would then have to be 23, and thus would have to be extremely low to reduce the total FTE of dentists by half in 20 years. The annual intake in dental hygienist training would have to be 409 to meet the targeted FTE by 2030. With this intake, the targeted and available FTE of dental hygienists matches from 2019 on. The intake in oral preventive assistant training would have to be 435, to meet the targeted FTE in 2030.

Table 2 Summary of targeted and available annual student intake and supply

	Targeted supply (in FTE)	Recommended annual intake	Available supply with recommended annual intake (in FTE)	Required annual intake to meet targeted supply
Dentists	3,689	240	5,357	23
Dental hygienists	3,581	300	3,001	409
Oral preventive assistants	4,994	200	3,007	435

Feasible amount of task reallocation in 2030

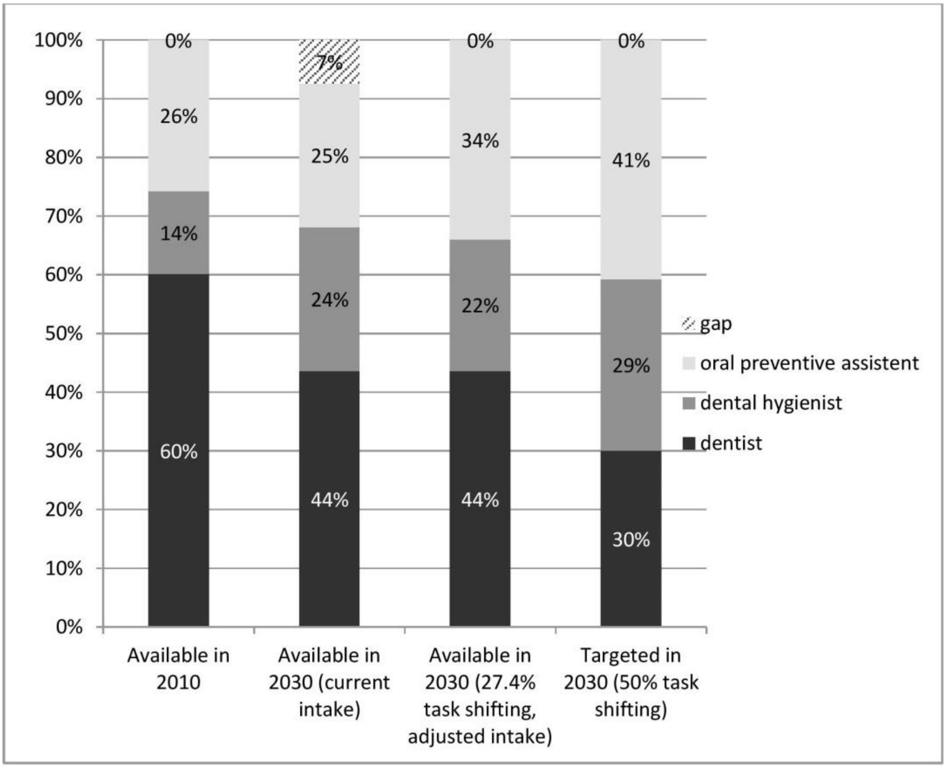
The model simulations found that a feasible quantity of task reallocation from dentists to dental hygienists and oral preventive assistants, to be reached in 20 years, is 27.4%, according to the assumptions of the committee. In Figure 2, the FTEs of the three primary oral health professions are depicted, when this percentage of the total FTE of dentists would be reallocated. For the dentist workforce that will be available in 2030, this would be a feasible amount of task reallocation. At the same time, there would be more than enough dental hygienists in 2030 to take over half of these tasks. However, the available FTE of oral preventive assistants would still be less than the FTE required to meet this scenario. To meet this scenario, the annual intake in dental hygienist training could be less than 300 (252). The intake in oral preventive assistant training would still have to be increased to 337.

The staff-mix of the Dutch oral health workforce

Figure 3 depicts the staff-mix ratios of the available oral health workforce in 2010 (launch year), the available oral health workforce in 2030 without adjusting student intake, the available staff-mix with the accompanying feasible task reallocation amount and the targeted (or recommended) staff-mix, in 2030. According to dental training policies, the targeted (total) workforce in 2030 should be the same size as the available workforce in 2010. However, from Figure 3, we can conclude that the available workforce in 2030 will be smaller than the workforce in 2010 if student intake will remain constant. To meet 27.4%, task reallocation from dentists to dental hygienists and oral preventive assistants and keep the same workforce size, annual student intakes of dental hygienist training and oral preventive training have to be adjusted (252 for dental hygienist training and 337 for oral preventive assistant training).

Taking all results in consideration, we can conclude that adjustments in intake are inevitable to meet not only the recommended amount of task reallocation but also a more feasible amount of task reallocation within 20 years.

Fig. 3 Available staff-mix in 2010 and 2030 and targeted staff-mix in 2030



Discussion

In this paper we have evaluated the feasibility of the recommendations of the committee Innovation in Oral health care by making oral health workforce projections based on information from the 2010 workforce projections and the 2006 committee Innovation in Oral Healthcare. The feasibility of several staff-mix scenarios was investigated. A software tool, that connected health workforce planning models of three oral health professions, was developed to make it possible to simulate task reallocation between these professions and investigate the future staff-mix.

The results of this study not only demonstrated the feasibility of staff-mix scenarios, but also showed that integrated health workforce planning models, connected through the task reallocation software tool, can be used to evaluate such policy plans.

Evaluation of Dutch oral health staff-mix policy

The workforce projections show that it is possible to half the total FTE of dentists and to double the total FTE of dental hygienists, maintaining the current annual student intake (as proposed in the recommendations), but that it will last more than 20 years. It is also demonstrated that the total FTE of oral preventive assistants will never be doubled if the current student intake is not increased.

To meet the target of 50% task reallocation in 20 years, large adjustments in the yearly intake in training for dentists, dental hygienists and oral preventive assistants need to be done. These dramatic changes in the annual intake will be problematic for different reasons. The annual intake in dental hygienist training would have to increase by a third, but according to the committee Innovation in Oral Healthcare, in 2006 the number of applicants to dental hygienist training would probably be smaller than the available number of training places. However, since 2009, according to the Advisory Committee on Medical Manpower Planning (36) and the annual reports regarding numeri clausi in the Netherlands (37-40), a more than sufficient number of applicants to dental hygienist training is available. Increasing the student intake in dental hygienist training does not seem problematic.

The intake in oral preventive assistant training needs to double to meet the targeted task reallocation (50%). It was believed that the number of oral preventive assistants would increase because of their short training and low costs. However, according to the results of the present study, the total FTE of oral preventive assistants will decrease if the annual student intake remains 200. More oral preventive assistants in training are required to keep even the total FTE stable. It is, however, unpredictable what the student intake will be for this training because it is not regulated. There is no numerus clausus for this training. This makes the future number of oral preventive assistants difficult to project.

The required dramatic decrease of the annual intake in dentist training will have large (adverse) consequences for the organization of dentist training, such as closing schools (possibly 2 out of the current 3). In general, large annual adjustments in annual student intake could have such profound implications. Furthermore, another adverse effect of training a minimal number of dentists is that the dentist workforce will age because of the limited inflow into the workforce. In conclusion, changing the annual student intake dramatically could have adverse consequences for training institutions and the future workforce.

Supporting policies can be implemented to make the required adjustments in student intake smaller. For example, to decrease the dentist workforce, supporting policies such as stimulating dentists to work part time or retire at an earlier age could be implemented. Unfortunately, a negative effect of these policies is for example that training funds would not be used optimally.

In sum, adverse consequences of dramatic adjustments of the student intake or negative aspects of the implementation of alternative policies make doubling or halving the size of the health workforce on short notice very unlikely. As a consequence, changing the size of the workforce will be a long-term process, when large adjustments have to be made.
This also illustrates that this kind of model simulations/workforce projections can support advisory committees' recommendations to estimate the consequences of the policy plans and oversee long-term effects.

Alternative considerations
Several elements that were part of the supply or the demand side of the oral health workforce projections were assumed to stay constant at 0% change, because the recommendations of the committee Innovation in Oral Healthcare were followed. However, for some of these model elements, alternative assumptions are very plausible as it appears from additional studies.
For example, one of the assumptions is that there is no inflow of oral health care providers from abroad. However, according to recent information from the Advisory Committee on Medical Manpower Planning (41), a yearly average of 220 dentists come from abroad. If this number were taken into account in the workforce projections, it would be even less feasible to half the number of dentists within 20 years. Even if dentist training were closed altogether, there would still be 7,509 FTE dentists (while the target is 3,689 FTE) in 2030 because of the inflow from abroad. Furthermore, fluctuations in the inflow from abroad could occur due to, for example, a changing economic situation in the countries of origin. Therefore, it is difficult to predict the inflow from abroad and to estimate the future influence of foreign trained dentists on the size of the dentist workforce. On the other hand, closing Dutch dental schools will probably lead to an additional number of young Dutch citizens who will go abroad for dental training and then return to the Netherlands to practice and will thus cause an additional inflow from abroad. An additional effect of an increasing number of foreign

trained dentists is that the amount of task reallocation could be influenced by a relatively high number of them. These dentists are probably less likely to shift tasks to the dental hygienist because they are not or less familiar with this profession (41). Also, developments in demand for oral health care were assumed to stay constant at a level of 0%, based on the committee's report. Socio-cultural developments, for example, were assumed to be 0% in the analyses. According to additional research, however, it is expected that the demand for dental hygienists will increase due to socio-cultural developments (42). Patients are expected to visit increasingly dental hygienists, which requires a 25% increase of dental hygienists in 10 years. To meet this demand, there should be 4,449 FTE of dental hygienists in 2030 (instead of 3,581 targeted FTE). The annual intake in dental hygienist training has to be 573 (instead of 409) to meet this number of dental hygienists. This could also have consequences for the required FTE of dentists.
Additional information on the return on dental hygienist training has a counter effect. In the present study, the return on training is assumed to be 60% (similar to the 2010 projections). In a recent report (41), however, return on training is found to be 70%. This change has its effect on the available FTE of dental hygienists in 2030 (3,266 FTE instead of 3,001 FTE) and the student intake to meet the target in 2030 (350 instead of 409).
Most results of the studies mentioned above indicate that meeting the recommended amount of task reallocation will probably be even more difficult than when projected based on the assumptions of the committee Innovation in Oral Healthcare. Additional research should be done to investigate the potential influence of other developments, such as those depicted in Figure 1.

Practical implications

The analyses in this paper answer questions about the feasibility of task reallocation taking into account the characteristics of the oral health workforce and inflow and outflow information. They do not decide on the viability of task reallocation in practice. Several studies found that task reallocation in Dutch oral health care is not yet developing according to the expectations/targets. Several additional studies (43-45) found that task reallocation from dentists to dental hygienists is stagnating, and that tasks are mostly shifted to oral preventive assistants, because training and hiring costs are lower for the latter. Stimulating task reallocation from dentists to dental hygienists by only changing the numerical ratios does not seem to be effective. Additional measures should be taken to reach the targeted amount of task reallocation.

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The aim of this thesis was to describe, analyze and evaluate the system of physician workforce planning in the Netherlands, as a relevant example of how countries aim to control the imperfections of their health labour markets. The Dutch projection model that has supported physician workforce policy and planning since 2000 is well documented and periodically applied for a large number of medical occupations. This provided the opportunities to analyze and evaluate the model and its policy system, from a health systems perspective. In this thesis, the focus was on the planning model for general practitioners and primary dental care professions. The previous chapters explore possibilities in alternative applications the model to evaluate possible policy scenarios. This final chapter summarizes the main findings and conclusions. Second, the implications of this study and the relevance of the findings for further research, policy and practice are discussed. Furthermore, the limitations of this study are considered leading to recommendations for further studies on improving the Dutch projection model and planning system.

Main findings and conclusions

Research questions

Health workforce planning is an increasingly important topic worldwide (1-7). Estimating whether human resources for health will be sufficient to meet the health needs of the population is one of the main purposes of health workforce planning (8). A second purpose of health workforce planning is to use training budgets efficiently as particularly specialist medical training is very expensive. On a more strategic policy level, health workforce planning can be used to change the ratio between different health care providers, for example between general practitioners and medical specialists to strengthen primary care (9).

Health workforce planning is supported by projection models that are mostly used to provide guidance for policy decisions on entry into health professional training. In some cases, they are also used to assess the impact of policy measures or re-organizations concerning the health workforce to better respond to changing health care needs. While there are diverse types of health workforce planning, little is known so far about its effectiveness or success. This lack of information about the performance of health workforce planning implies that shortcomings and improvement are difficult to identify (8). For the further development of workforce projections and workforce planning in rapidly changing health care systems, it is important to evaluate workforce projections and their techniques (10).

The Netherlands is one of the countries that have planned medical school intake for many years. Since 2000, the health workforce planning process is supported by a demand-based simulation model. This model calculates the required number of physicians in training, which is taken as the basis to advise the Ministry of Health on the adjustment of the entry numbers per year. The Dutch model is focused on training intake adjustment to balance the supply and demand and to prevent a shortage or an oversupply of health professionals in the future. The Dutch model can also be used for policy scenario planning and extrapolations (11).

In this thesis, we studied the Dutch health workforce planning model for physicians and its history. The focus was on projecting and planning the primary health care workforce in the Netherlands. It addressed four main questions to investigate Dutch health workforce planning policy and the application of the Dutch simulation model.

The first and second research question of this thesis were of descriptive nature:

1. *How does the Dutch health workforce planning model work and how does it support the health workforce planning system for physicians in the Netherlands?*
2. *How did Dutch health workforce planning for physicians historically develop?*

The third and fourth research question of this thesis focused on several types of evaluations of (parts of) the Dutch projection model, and on training policy before the introduction of this model:

3. *What was the impact of Dutch general practitioner workforce planning policy on the health workforce in the Netherlands, before and after the introduction of the health workforce planning model?*
4. *What is the projecting accuracy of the Dutch general practitioner workforce projections?*

The fifth and sixth research question of this thesis addressed recent developments and dynamics in the health workforce and their influence on workforce projections:

5. *How can the Dutch health workforce planning model take changing retirement patterns into account?*
6. *How can the Dutch health workforce planning model be adapted to developments regarding task reallocation in the health care sector?*

The seventh question of this thesis addressed the policy evaluating role of the projection model:

7. *How can health workforce policy measures be evaluated by using the Dutch projection model?*

The main answers to these questions are presented below, drawing on the findings of the chapters of this dissertation.

1. How does the Dutch health workforce planning model work and how does it support the health workforce planning system for physicians in the Netherlands?

The Dutch model was developed to advise the government on required student intake in medical training to meet the future demand for physicians in the Netherlands and has been used to make recommendations to the government since 2000. The recommendations are based on estimations of the current and future difference between the available and required number of health professionals (i.e. surplus or shortage of health professionals). The difference between future supply and demand is translated into advice about the required entry number of physicians in the first year of training. The model includes projections for a period of between 10 and 20 years. This projection horizon is used, due to the time between the start of initial medical training and entering the health workforce (9 years for GPs, 12 years for medical specialists).

Developments in the physician workforce that occur in the years between the baseline year and the target year are taken into account when estimating the future supply and demand. Developments influencing the available supply are the outflow of health professionals, the inflow of health professionals trained abroad, the number of students in training and return on training. The future demand for physicians can be influenced by multiple different developments. For the basic version of the model, demographic developments are taken into account to estimate the future demand.

Several elements that also affect the future demand for human resources for health can be added to the basic model to create different scenarios. The Dutch health workforce planning model applies three additional scenarios. Scenario 1 adds the impact of epidemiological and sociocultural developments to future demand, as well as developments regarding the profession: technical developments, developments in efficiency, and developments regarding horizontal substitution. Scenario 2 adds the change in working hours per FTE to the projection of the future demand. The third and last scenario 3 is based on developments regarding vertical substitution. The values of these developments is mostly difficult to quantify with data and therefore are estimated by groups of experts. These experts estimate the developments in terms of a percentage of change between the baseline year and the target year. The experts base their estimations on information from several sources and on their own experiences. Expert discussions regarding the estimation of the scenario elements are organized in several rounds and on several occasions.

The results of the model calculations (and the different scenarios) are discussed within specialized platforms ('chambers') of the Advisory Committee on Medical Manpower Planning (ACMMP), which consists of representatives of professionals, health insurers and medical training institutions (9,12,13).This platform determines the final advice to give to the government regarding the annual student intake for health professionals. The Ministry of Health and the Ministry of Education decide on the annual student intake, which is also dependent on the total budget for the training of all (academic) health professionals.

In sum, the Dutch health workforce planning model which is used to make recommendations on medical training entry numbers is a flexible model and can provide policy makers with extensive advice consisting of a range of scenarios: from a basic scenario to an extended scenario with a maximum of seven additional developments. The projections that the model builds on are based on an extensive amount of historical data, particularly in the supply side of the model. The system of health workforce planning in the Netherlands is characterized by the involvement of several stakeholders that take part in the decision-making process regarding annual training intake of health care providers. Strengths and limitations of the model and system are discussed later on in this chapter.

2. How did Dutch health workforce planning for physicians historically develop?

The answer to this question focuses on the development of health workforce policy and planning of general practitioners in the Netherlands. As mentioned earlier, this workforce was specifically studied in this thesis as it is one of the largest medical professions that is 'planned' by the Advisory Committee on Medical Manpower Planning (ACMMP), and is a well-documented profession. Furthermore, GPs in the Netherlands are important gatekeepers of the health care system, which makes planning especially this workforce important to ensure accessibility to health services.

Before the present model and system of health workforce planning for physicians in the Netherlands was introduced in the year 2000, several decades of health workforce policy had passed. Some of the important health workforce policies and GP training policies in the Netherlands were for example, the introduction of numerus clausus for medical schools in 1972 to limit student numbers and curb high training costs, and the introduction of vocational GP training.

In this thesis, three periods were distinguished representing the evolution and influence of Dutch GP training policy by doing a narrative literature review to extract possible underlying factors (such as developments in GP density and financial circumstances) during the period of policy implementation and counterfactual analyses to analyze what would have happened to GP density in absence of the policies. The analyses showed that between 1970 and 2010, policy measures regarding GP training evolved from ad hoc supply-driven decisions to decisions based on long-term workforce planning.

Ad hoc, supply-driven policy
From 1972 until 1985, policy decisions on GP training intake were generally ad hoc. Adjustments in training intake were frequently in reaction to contemporary shortages or oversupply. During this period, GP training intake was generally decreased. Several committees advised to decrease intake, but the main reason for the decrease was financial. Decreasing intake was not based on possible imbalances in the future workforce but on the availability of budgets. The financial crisis of the 1980s limited the availability of funds.

Monitoring the health workforce and keeping the status quo
Between 1985 and 1991, the government did not use advisory committees. Instead, it published white papers on health workforce and training, which aimed at maintaining the status quo in the GP workforce and medical specialist workforce density. The government monitored the health workforce to avoid the necessity of ad hoc decisions, but no long-term workforce projections were carried out. From 1992 onwards, concerns arose about an increasing GP shortage (14,15). The government followed the recommendations of the professional association and the national council for public health to increase student intake and to extend GP training (16,17). However, in 1995, the responsibility for health workforce planning was left to the professional associations and educational institutions (12). No significant decisions were made regarding GP training intake, and it was adapted to the funding level at the time. This period lasted until 2000.

Long-term workforce planning based on projections
Since 2000, decisions regarding GP training intake are based on long-term workforce projections. Health workforce planning was re-centralized by founding the Advisory Committee on Medical Manpower Planning (ACMMP), which is composed of three stakeholder groups: the medical profession, medical training institutes and health insurers. The committee advises the government and health care sector regarding

student intake in medical training using long-term workforce projections. These projections became leading for decisions on GP student intake. Student intake adjustments were directed at preventing imbalances between future supply and demand instead of keeping the balance in current workforce and population numbers. In contrast to the preceding years, annual student intake and total GP workforce size increased slowly to compensate for forecasted shortages. However, until 2005 the ACMMP's advice was not always directly implemented. Since 2005, the government has followed the advice to increase GP training intake but available funding has set (and still is setting) hard limits on the number of new students.

The analyses showed that between 1970 and 2010, policy measures regarding GP training evolved from ad hoc supply-driven decisions to decisions based on long-term workforce planning. Until 1999, financial considerations were important in decision-making regarding GP training. This restricted GP training intake, and accordingly, kept GP density relatively low. This was especially the case in the 30 years between 1970 and 2000. In the 10 years between 2000 and 2010, developments regarding GP training accelerated and GP training intake increased faster. Remarkably, the stakeholders (policy makers, professional associations, training institutions) have accepted the use of long-term health workforce projections to guide training intake in health care education in a relatively short period of time.

3. What was the impact of Dutch health workforce planning policy on the general practitioner workforce in the Netherlands, before and after the introduction of the health workforce planning model?

Similar to the preceding research question, this question also focuses on the workforce of general practitioners in the Netherlands. This workforce was specifically studied in multiple parts of this thesis, partly because data well available for this profession, partly as GPs in the Netherlands are carefully monitored and planned as gatekeepers of the Dutch health care system.

Before introduction of the Dutch health workforce planning model for physicians

Before the introduction of the health workforce planning model, the restrictions on student intake generally slowed down the increase of Dutch GP density. This might be a seemingly obvious conclusion, but it confirms that physician density stabilized or increased at a slower pace in countries with central planning of medical school entry than in countries without central planning. Student intake numbers generally decreased, and budget cuts were not unusual. Financial circumstances caused ad-hoc policy decisions regarding adjustments in student intake at that time.

Between 1972 and 1985, in the first period of GP training policy, policy measures prevented GP density from increasing sharply, which was the aim of both the government and the profession. Also, the financial crisis of the 1980s had an impact on training intake and thus GP density, because limited funds were available.
The second period, between 1985 and 2000, was characterized by maintaining the status quo in the GP workforce. The profession expected a shortage of GPs, but training intake was only increased when, at the same time, training length was extended. Therefore, the effect of increasing the intake was diminished. Between 1985 and 1992, GP density was also kept stable by governmental policy to improve the distribution of general practice locations.

After introduction of the Dutch health workforce planning model for physicians
After the introduction of long-term health workforce planning for general practitioners, GP density was more stable. According to several workforce indicators, there was a slight oversupply of GPs since the introduction of the health workforce planning model. First, the estimated unmet demand for care has decreased since the introduction of the health workforce planning model; second, the number of vacancies decreased after 2010 to less than 1 per 100 GPs; and third, the proportion of GPs that were searching for their desired type of practice increased in the second half of the period (although the largest part was working as locum GP).
GP density, however, did not continue to rise after 2008, and actually decreased slightly. GP density was quite stable around 2,350/2,450 patients per 1 FTE GP. In general, GP density was around or below standard patient list size for general practice when this was 2,350 per 1 FTE GP, and thus does not indicate an oversupply of GPs. However, since 2014, the standard list size has been set at 2,168 per 1 FTE (18). There would have to be more GPs to reach this new density, while, in 2010, GP density was almost equal to the standard patient list size. This indicates that an apparent over- or undersupply is also normative and dependent on policy decisions on the desired balance between supply and demand.
It seems possible that through the recommendations for GP training intake policy resulting from the projection model, GP density remained quite stable, but also relatively low, throughout this period. Since the introduction of the projection model (in 2000) student intake in GP training was gradually increased, which could have led to an increasing GP density. An alternative explanation could be that the financial crises of 2008-2014 caused vacancies for GPs to decline. This shows that also the labour market of GPs is sensitive to macroeconomic forces and using a health workforce planning model does not make the health labour market immune to external factors. It is important to monitor the developments in the GP workforce.

Regarding macroeconomic developments, but also regarding the expansion of GPs tasks (http://www.tkv2022.nl/).

In general, we can conclude that before the introduction of the health workforce planning model (in 2000), policy regarding the Dutch physician workforce was conservative and generally based on ad-hoc decisions to sustain the status quo. From 2000 onwards, since the foundation of the ACMMP and introduction of the planning model, policy making was rationalized, aimed at adjusting training intake by estimating and matching the supply and demand for physicians in the Netherlands. GP density slightly increased after 2000, but this can not only be explained by the introduction of health workforce planning. Inevitably, other policies and developments in the Dutch health care system have also influenced the absolute and relative size of the GP workforce at that time. It remains difficult to determine the exact effect of health workforce planning and policies on the size of the health workforce. Training policies are also dependent on factors such as the political preferences of the government and the influence of lobbying parties. These factors also influence policy decisions to train less or more health professionals. However, the actual effects of these factors are likewise difficult to measure and to monitor.

4. What is the projecting accuracy of the Dutch general practitioner workforce projections?

Health workforce projections are the basis for formulating training intake recommendations based on the Dutch health workforce planning model for physicians. It is crucial that these recommendations are based on accurate and comprehensive information and projections of human resources for health. Large "errors" in supply projections could cause an imbalance between supply and demand if used to inform policy regarding training intake for health professionals.

We constructed multiple 5-, 10- and 15-year GP workforce "projections" for the period 1998-2011 to "hindcasting" the GP workforce and determine the accuracy of the projections. Data covering 5, 10 and 15 years was used as a basis for these projections. To measure the accuracy of the model projections, we compared the projected, or hindcasted, GP workforce size with the observed size of the GP workforce between 1998-2011. For the total GPs workforce, the predicted numbers were on average 3% lower than the observed numbers for the 5-year projections, 7% lower for the 10-year projections and 12% lower for the 15-year projections. The mean absolute percentage errors ranged from 1.9% to 14.9%, with the projections being more accurate in more recent years. In hindsight, it can be concluded that the model systematically underestimated the total size of the Dutch GP workforce. The underestimation is smallest for the 5-year projections. As the projected GP workforce size was underestimated, this could have resulted in a recommended student intake that was actually ‘too high’ leading to an oversupply of Dutch GPs. We saw, however, that during the period 1998-2011 according to several indicators, not an oversupply but rather a slight undersupply was present. One explanation is that the realized student intake during this period was systematically lower than the recommended intake based on the planning model. Hence, fewer students were trained than was advised. In practice, the Dutch health workforce planning model is applied on a regular basis to ensure that the recommendations on student intake are regularly updated to incorporate changing factors and conditions. The fact that during the period under study no oversupply of GPs has emerged despite the ‘underestimation’ of the workforce of GPs by the model projections, can be understood from the regular updates of the planning system.

An unexpected result of the analyses regarding the models’ accuracy was that projections with a shorter base period (data period used as a basis for the projections) have a higher accuracy than those with a longer base period. Based on this, we conclude that health workforce projections like these can be made with data based on relatively short base periods. A base period of 5 or 10 years seems long enough to make reliable projections. Originally, the Dutch GP workforce was projected with a base period of 15 years. Longer base periods were used to prevent base data being influenced by fluctuations. It seems however that longer base periods containing recent ánd older data are less representative for GPs in the target year. The composition of the GP workforces with 10 to 15 years between them differ too much from each other to make the most accurate projections. It seems most accurate to use only recent data, even if this means the projections are based on fewer data.

Overall we can conclude that the accuracy of the GP workforce projections as part of the planning system is satisfactory, although accuracy levels vary by period and projection horizon and base period. . Projections based on relatively short periods with recent data seem most accurate. Because accuracy varies between years, and advice regarding training intake are not followed one on one, it is recommended to do health workforce projections regularly.

5. How can the Dutch health workforce planning model take changing retirement patterns into account?

The answer to this question focuses on the workforce of the Dutch general practitioner, as were most other research questions in this thesis. As mentioned before, the GP workforce was specifically studied as a well-documented profession and because GPs in the Netherlands are important gatekeepers of the health care system.

The retirement age of health professionals provides valuable information for workforce planning. In most cases, the projections of the future outflow of health professionals are based on the past retirement age of health professionals. Up-to-date knowledge about the retirement age of physicians is valuable information for guiding the direction of health workforce policy. For example, using workforce planning policies to realize an equilibrium between supply and demand, which is a long-term solution for avoiding shortages of GPs. Also other, short-term policies can be implemented to influence the retirement age of health professionals. To inform such policies, a greater understanding of the link between the factors affecting the decision to retire and actual turnover is useful.

In the Netherlands, at the start of the 21st century several measures were introduced that aimed at, among other reasons, a workload reduction for general practitioners: the nationwide introduction of central GP out-of-hours services and the introduction of practice nurses in GP practices. Next to workload reduction, these measures were also intended to improve the quality of care in general practice.

In this thesis, the introduction of these workload reduction policies was investigated. Retirement patterns and factors influencing actual turnover among general practitioners were compared between two periods (1998-2002 and 2003-2007) that were approximate before and after the introduction of the workload reduction measures. The general probability of leaving the profession within one year decreased and retirement age increased between those two periods (first period: M: 56.5, F: 47.0; second period: M: 58.8, F: 49.1) (19). The factors influencing actual turnover were also compared. Based on the above-mentioned results it seemed that short-term workload reduction policies were useful instruments to control retention and retirement and to influence the workforce at relatively short notice.

The Dutch health workforce planning model appeared capable of taking into account new developments in the Dutch health workforce. To take a changing retirement age of health professionals into account, it is, however, necessary to collect additional data on actual turnover by using for example complementary surveys or sources that provide recent data on actual turnover. Because recent data is required, it is recommended to collect additional data for every time new health workforce projections are done.

6. How can the Dutch health workforce planning model be adapted to developments regarding task reallocation in the health care sector?

The answer to this question focuses on the Dutch oral health workforce. In the Netherlands, the 'optimal' staff-mix of the oral health workforce has been a debate for years.

An increasing number of publications underline the importance of taking into account the potential overlaps and reallocation of activities between professions of the same educational level or across different educational levels in workforce planning models (9,20,21). This implies a shift from planning separate occupations to planning teams of health professionals (i.e. staff-mixes) and integrating workforce planning models for multiple health professionals (21). Interactions between health professions should be included in health workforce planning models to make it possible to simulate task reallocation between professions.

Since the last decennium, the Dutch workforce planning model included substitution elements for each separate profession. The (expected) reallocation of tasks could be taken into account by using a percentage of change. However, there was no direct, 'automated' link possible between the projections of various (related) professions, and the values of the substitution elements for different professions were not related. Simulations of task shifting or reallocation are made possible when interactions between health professions in health workforce planning models are included. In chapter six, the task reallocation tool that was developed to enable the connection of planning models of multiple health professions was demonstrated and used to project the available and targeted staff mix of the workforce.

According to the results in chapter six, the Dutch health workforce planning model seems capable of taking into account new developments in the Dutch health workforce. In some cases additional information is enough (when projecting the outflow of health professionals for example), but in this specific case of task reallocation, the development of an extra software tool was required to take task reallocation between multiple professions into account. Furthermore, up-to-date information and data are necessary for accurately projecting new dynamics in the workforce, such as task reallocation between professions, in the workforce. In the particular case of task reallocation in the health care sector it is important to collect information about which professions are involved which and how many tasks are reallocated and if different professions need the same amount of time to perform these tasks.

The development of a software tool to model task reallocation between health professions is a first step towards integrated health workforce planning. It enables the shift from uni-professional to multi-professional health workforce planning. This is important in the primary care sector, where roles and responsibilities of different providers (GPs, nurses, paramedics) are integrating and rapidly evolving (9). This is further discussed in one of the next sections: on recommendations for future research.

7. How can health workforce policy measures be evaluated by using the Dutch projection model?

The primary goal of the Dutch health workforce planning model discussed in this thesis is to support policy decision-making on the balance between supply and demand in the physician workforce. This is done by calculating the annual required entry into medical training to reach a balance in the future. The model does this as policy-neutral as possible. The projection model provides policymakers with a range of scenarios to achieve future balance between supply and demand by adjusting the required annual student intake. By using a range of scenarios, policy makers can decide which scenario fits best with the norms of current policy. The scenarios are not normative as such, as they consist of projections of several different developments that could occur.
The model does not explicitly test policy plans. However, it is plausible that implemented policy measures will influence the developments of supply and demand, and it is an interesting exercise to take policy measures explicitly into account in modeling the health workforce developments.

In this thesis, the capability of the Dutch health workforce planning model to evaluate policy measures (ex-ante and ex-post) has been tested. It showed that the model can also be used to assess the impact of several sorts of health workforce policy on the health workforce, before and after the implementation of policy (ex-ante or ex-post). By doing this, the model can be used to show the feasibility of policy measures or particular norms that exist.

Ex-post analyses of policy

We investigated the impact of GP training policy on GP density (between 1970 and 2010), by using the Dutch health workforce planning model. This study showed that we can investigate the influence of such policy measures with ex-post (counterfactual) analyses using the Dutch health workforce projection model. Counterfactual analysis is “a comparison between what actually happened and what would have happened in the absence of the intervention” (22).The observed and counterfactual GP densities were compared over several periods in which (a combination of) GP training policies have changed. The influence of the implemented policy changes was estimated by investigating the difference.

We learned about the evolution of GP training policy in the Netherlands, and these analyses showed that long-term workforce projections can be very useful to avoid ad-hoc decisions and fluctuations in student intake and eventually also in GP density. They also showed that it takes at least ten years before an adjustment in training intake (or implementation of new policy) will affect GP density. Furthermore, the maximum effect of student intake adjustments on the total GP workforce is as large as the initial adjustment in student intake: a small adjustment can never have a large impact. Thus, policy aimed at changing the health workforce size will eventually show effects, but policy makers and other stakeholders such as professional organizations have to be patient.

Ex-ante analyses of policy

In the Netherlands, the optimal staff-mix of the oral health workforce, in particular, has been a debate for years (23-31). Several advisory reports regarding the oral health workforce and its staff-mix were published, which made recommendations to the government to change the staff-mix in the primary oral health workforce. At that time, the recommendations were not supported by health workforce planning to investigate the potential consequences. We now have performed a workforce planning analysis to look at the implications of these recommendations (ex-ante) by using the Dutch health workforce planning model including the task reallocation software tool. Different oral health care staff-mix scenarios were evaluated by comparing the available and targeted FTEs of each of the three oral health professions in the future.

The results of this study showed that the recommended staff-mix change in the primary oral health workforce will not be met within 20 years. It also showed that it will be very unlikely to reach large adjustments in the oral health workforce size or staff-mix within 20 years because dramatic adjustments in the student intake will have adverse consequences and the implementation of alternative policies will have negative aspects. If these adverse consequences have to be avoided, changing the size of the workforce will be a long-term process. This study not only investigated the feasibility of staff-mix scenarios but also showed that integrated health workforce planning models, connected through the task reallocation software tool, can be used to evaluate such policy plans. Model simulations can thus support advisory committees' recommendations to estimate the consequences of policy plans and oversee long-term effects before policy is implemented.

In this thesis, we showed that by using the Dutch health workforce planning model, training policy for several types of health professionals can be evaluated ex-ante to inform policymakers - from the government, but also from professional organizations, training institutions or health insurers - about the feasibility of their policy plans on the long term. Ex-ante evaluations provide valuable information on the potential impact of policy in an early stadium.

Implications for policy and practice

The results of this thesis could also have implications for policy and practice regarding the health workforce or give the opportunity to extend the results to other policies that could be implemented to influence the health workforce.

Complementary policy measures and testing these policy plans
In many countries, adjusting the student intake or inflow is the primary health policy action to control health workforce size and supply. This measure is used in many countries because it is the easiest manageable way to steer the size of the health workforce. It will, however, take many years before the effect of this action will be visible. Long-term health workforce planning should be part of a long-term vision on health and health care. A workforce projection model is a useful instrument to support health workforce planning.

The Dutch projection model that is used for physician workforce planning consists of a vast number of elements that together determine the size of the current and future available and required health workforce. These other elements could also be subject to health workforce policy and are for example: inflow of health professionals from abroad, the moment at which health professionals retire, the number of working hours of health professionals, the amount of task reallocation to other professionals and the number and length of patient contacts. To influence these characteristics, specific policies have to be designed. For example by making it more attractive for health professionals from abroad to work in the Netherlands or allow GPs above a certain age to abstain from evening, night and weekend shifts (32). Although the effect of these measures could be noticeable on the short term, some measures will be harder to manage and monitor than adjusting the student intake.

Earlier in this chapter, some complementary policies were already discussed. For example, the workload reduction measures for GPs, which reduced their probability to leave practice within one year. Relatively short-term policies, such as introducing central GP services for out-of-hours care, can (directly or indirectly) influence the health workforce size or specific parts of the health workforce on shorter notice. For example by encouraging or discouraging the following aspects that are also present in the Dutch model: inflow of health professionals from abroad, the moment at which health professionals retire, the number of working hours of health professionals, the amount of task reallocation to other professionals and the number and length of patient contacts. Although these short-term policies can be helpful, long-term projections and policies remain necessary to match the future supply and demand to prevent the health workforce size from fluctuating too much, which would probably be the case if ad-hoc policy measures predominate. Therefore, it is also crucial to monitor developments of different aspects of the health workforce to be able to base new projections on reliable information and to investigate the particular impact of implemented ad-hoc policy on the health workforce.

Results of this thesis demonstrated that the Dutch health workforce projection model can be used to test policy plans ex-ante and ex-post and investigate the influence of several sorts of policy measures. Policy plans that are related to elements of the model can be tested using the Dutch workforce projection model. For example, what has been (or will be) the effect of policy that focuses on encouraging health professionals to retire at an older age? By testing the impact of policy, advisory committees' recommendations are supported by estimating the consequences of the (complementary) policy plans and oversee long-term effects. This alternative application of the Dutch health workforce planning model will be further discussed in the next section of this chapter.

Adverse effects of different policy measures on practice

Both changing student intake and other policy measures can have adverse effects in practice. Large adjustments in health workforce size or workforce composition could be required to meet the future demand for care. When such large numerical changes have to be made in a relatively short period, the necessary adjustment of student intake numbers is also of significant size. Especially when student intake is the only health policy measure to influence health workforce size. Changing the annual student intake by large numbers could have adverse consequences for training institutions and the future workforce. Dramatically decreasing student intake within one year will have large (adverse) consequences for the organization of training, such as closing schools. Increasing student intake by large numbers at once will cause capacity problems for medical schools. If this results in a larger physician workforce this may lead to 'overproduction', i.e. 'supply induced demand', and thus higher costs given the high elasticity of demand for health care. Furthermore, especially decreasing the annual student intake by large numbers can affect the health workforce negatively. When only a minimal number of physicians is trained for several years in a row, the workload of physicians will increase with potentially negative effects for the quality or accessibility of care.

Complementary policies can be implemented to make the required adjustments in student intake smaller and limit the fluctuations in student numbers and workforce entry numbers. Unfortunately, also the implementation of these complementary policies can have disadvantages. An example is that with, for example, stimulating health professionals to work part time or retire early, training costs of these health professionals are not fully exploited.

In sum, adverse consequences of dramatic adjustments in student intake or negative aspects of the implementation of alternative policies make changing the size of the health workforce radically on short notice very unlikely. Significantly changing the size of the workforce will be a long-term process. Policy makers have to be patient, and when using supporting policies, the effects of these policies on the workforce should be monitored.

It is difficult to say if supporting or complementing policy measures have more negative than positive effects. That also depends on the relative size of, for example, the adjustment in training intake and the direct effects on training institutions and the workforce.

Acceptance of the long-term projection models' method and results by policy makers
Policy makers need to be patient to minimize adverse consequences of short-term policies which are implemented to support a faster increase or decrease of a specific health workforce. This was also explained in the preceding section. Dramatically changing the staff-mix or size of the workforce will be a long-term process if negative consequences are to be avoided. Additionally, it could be disruptive for the effect of long-term projections when ad-hoc policies are implemented at the same time. When policymakers expect long-term projections to contribute to a balance between supply of and demand for health professionals, it is important that they accept the advice following the results of health workforce projections. If the differences between the recommendations and the realized student intake are large, the benefits of long-term workforce projections are not fully exploited. This could lead to more ad-hoc decisions

because the health workforce size will not develop as projected. Of course, there will always be macro developments that will influence the health workforce.

Furthermore, this thesis showed that it takes at least ten years before an adjustment in training intake will affect GP density. Thus, policy aimed at changing the health workforce size should be implemented more than 10 years before the target year. This requires a long-term vision from the government, professional organizations and other stakeholders working in the health care sector.
The health workforce planning system and its projections need to be supported by stakeholders, such as training institutions, health providers, health insurers and policymakers to make the health workforce planning system valuable for planning the health workforce.

Implications of the results for the Dutch health workforce projection model and system of health workforce planning

Several results that have been discussed in the preceding chapters of this thesis have implications for both the methodology of the Dutch health workforce projection model and the Dutch system of health workforce planning. These implications will be further discussed in the sections below.

Recent data in base periods is better than more data
This thesis investigated the accuracy of Dutch general practitioner workforce projections. The results showed that health workforce projections are most accurate when they are based on recent data periods (not more than five-year-old base data). Although a longer base period (from 10 or 15 years) provides more data to base the workforce projections on, the data in these periods is less representative for future health professionals. Projections with a shorter base period have a higher accuracy than those with a longer base period. The accuracy of projections between 2006 and 2010, based on short data periods of 5 years, has been increasing.

Until recently, the Dutch health workforce was projected with a base period of 15 years. Nowadays, Dutch health workforce projections are also based on a five-year base period, because these are the most accurate. Data in longer base periods (of 15 years) is less representative for the future health workforce because longer base periods contain not only recent data but also older data. Moreover, it seems that the GP workforce of today is different from the past GP workforce. An example of such a difference is that it was expected that GPs would leave the workforce at an earlier age than was observed based on base periods also containing older data. Current GPs stay in the workforce longer. In any case, it remains very important to base the estimations on regularly updated information, disaggregated by different specialties, types of GPs (self-employed, salaried GPs, locum GPs), gender (see also chapter five), etcetera, to take new developments into account.

Consequences for data collection

The conclusion that projections with a shorter base period are most accurate is promising for countries that aim to be engaged in model-based health workforce planning but do not have long-term workforce data. While relatively short base periods seem accurate enough to base health workforce projections on (8), to project specific (new) developments in the health workforce, more detailed data should be collected at the same time. For example, for developments in task reallocation between multiple profession and the possibility to connect the projection models of multiple professions. The connection between multiple projection models will benefit from a detailed description of the tasks of each professional group involved in the projections, as well as an assessment of the possible scope for a reallocation of tasks (9). At least, it requires information about the amount of task reallocation between various professions and information about the amount of FTE required of one profession to substitute the other.

Although the Dutch projection model is suitable to take new developments in the health workforce into account, it is important to reconsider model parameters through additional research. A number of the model parameters are estimated using expert advice. The reliability and objectivity of this approach can be questioned, but alternative methods also have their limitations as data and evidence are lacking to operationalize these parameters. Additional research to provide reliable and up-to-date data for the model elements involved can increase the reliability of the model parameters. These elements are, for example, return of Dutch medical training or labour market return of medical professionals trained in the Netherlands and of health professionals from abroad. Return on training, for example, could change because of developments in student intake or a change in the length of training. A change of the return on training will affect the number of graduates that will enter the workforce. A significant change of workforce size could then lead to an adjustment in annual student intake.

If such developments remain unknown, health workforce projections, conducted using the Dutch health workforce projection model, could become less accurate in projecting the future health workforce developments. Additional research is important but given the uncertainty of many future projections advice from experts in the field will remain necessary.

To assure that health workforce projections are accurate, developments and trends in model elements have to be regularly investigated and data collection should be expanded for model items that are not part of the standard annual GP database questionnaire (which collects data for the NIVEL GP database). Additional data collection should accompany the Dutch health workforce projections done every three years. Model elements for which additional data collection would be useful are outflow from the workforce, the size of the workforce trained abroad, and elements for which the elements are estimated by expert groups (discussed earlier in this chapter). The latter are epidemiological developments, socio-cultural developments, change of working hours per FTE, technical developments regarding the profession, developments regarding efficiency, developments regarding vertical substitution and horizontal substitution.

Projecting the future staff-mix using a software tool to connect multiple professions
In several health care areas, there is a move towards a more integrated type of health care provision. According to several studies regarding task reallocation in primary health care (33), it appeared that integration of health care is especially stimulating the quality of care but does not necessarily cause more efficient and effective health care provision. The Dutch oral health workforce is a good example of an area where is aimed for task reallocation since over a decade and for which several advisory committees made recommendations regarding changing the staff-mix.

The Dutch health workforce planning model can be used to investigate the optimal staff-mix and the feasibility to reach this staff-mix in a particular period,. This was demonstrated in this thesis by linking multiple projection models of three primary oral health care professions with a task reallocation software tool. The task reallocation tool that was developed enables the connection of the models of various health professions, to project the available and targeted staff mix of the workforce. With this tool, the feasibility of a particular staff-mix can be investigated. The results showed that the use of the task reallocation software tool is very useful to test the consequences of policy intentions and to evaluate if the intended staff-mix can be reached within a definite period.
Similar to the Dutch health workforce model itself, the task reallocation software tool is of a “one-size-fits-all” nature and can thus be used for other ‘groups’ of health professionals (in other areas of health care). It does, however, require detailed information which might not always be available. Firstly, it requires accurate

information about the interaction between the professions involved. For example, what the amount of task reallocation is and between which professionals tasks are reallocated. Furthermore, the conversion factor between the different health professionals is required: how much time does each health professional need to perform a particular task.
The tool is especially useful in testing policy goals regarding the aim towards a certain amount of task reallocation. This application of the model is further discussed in the next section.

Alternative application of the workforce planning model – testing policy plans
The Dutch health workforce projection model is designed to support decision-making on health workforce policy and provide policymakers with a range of scenarios regarding annual student intake to achieve future balance between supply and demand. The results of this thesis show that besides this primary function, the Dutch health workforce projection model can also be used as a projection model for testing policy plans regarding the health workforce, ex-ante or ex-post.
Model simulations can thus support advisory committees' recommendations to estimate the consequences of policy plans and oversee long-term effects before and/or after policy is implemented. By doing this and especially if policy is not implemented yet, policy plans can be altered if the projected results of the policy plan are not meeting the policy plans' targets in the future.

Policy regarding annual student intake, as well as several other specific elements of the simulation model could be subject to such a policy plan test. For example, policy plans that aim to either increase or decrease inflow of health professionals from abroad, the moment at which health professionals retire, the number of working hours of health professionals, the amount of task reallocation to other professionals and the number and length of patient contacts.

Recommendations for future research

Investigate future possibilities of the model
There are several developments and factors that are currently not incorporated in the Dutch health workforce planning model but are possibly relevant for planning the future health workforce. Ono et al. (9) studied the main features and the results of 26 health workforce projection models in 18 OECD countries. Inspired by this overview and by studying the Dutch context of health workforce planning, several characteristics

of the Dutch workforce model, which was investigated in this thesis, are discussed below. Further research on developments and factors that are currently not part of the model under scrutiny is required to investigate the possibilities of in the context of the Dutch health workforce system.

Improving the demand side of the Dutch model: from expert estimations to projections?

Besides demographic developments, the demand-side of the Dutch workforce projection model for physicians consists of several elements for non-demographic changes. They can encompass several types of developments and are modeled as expected percentages of annual change.

Currently, the values of these elements are estimated by experts in terms of relative change, not in absolute numbers. The development of health care demand in the Dutch model for physician planning is calculated as a combination of demographic, epidemiological, socio-cultural and other developments and projections. The values of these developments are based on many different sources. These developments and their potential consequences for the demand projections in the model are presented to expert groups. The experts are subsequently invited to estimate the actual (annual) growth- or decline percentages of the developments, on the basis of consensus. In some situations, a bandwidth rather than a point estimate is determined, because there are too many uncertain factors. Hence, experts make the future estimates, not only by extrapolation of the current demand for care, but by estimating the potential effect of different developments that influence the demand for care (34).

The experts base their estimations on information from several sources and on their own experiences. The experts meet to discuss what should be the final percentage of annual change of the non-demographic developments. The meetings are organized several times and on several occasions, not via a predetermined route.

The effect of demographic developments on the future demand for care is based on population data and not determined by expert groups.

The elements for non-demographic changes can encompass several types of developments that are modeled as expected percentages of annual change (delta). Although the estimated values of the non-demographic demand developments are based on several data sources, compared to the supply side of the Dutch projection model, the demand estimations are ‘soft’. For outsiders, it is not entirely clear on what data sources or experiences these estimations are based, because they are the results of a group discussion.

The model elements representing the demand developments in the Dutch health workforce planning model were not evaluated in this thesis. However, the evaluation of these elements and the possibilities for improvement of these elements should be a topic of future research regarding the Dutch health workforce planning system. Since 2010, a couple of studies were conducted by Dutch organizations in which the methods of the workforce planning model have been investigated (35-37). According to the results of these studies, improvements in the decision-making process taking place in the expert groups and the estimations of the non-demographic demand elements would be useful. One of the recommendations was, for example, that the estimation of demand factors could be based on recent trends, similar to the estimations of the supply side of the Dutch projection model (36-37). One study noticed that although demand factors were not based on macro trends, the involvement of several stakeholders in the health care sector is a positive element of the Dutch health workforce planning model and system (36).

Future research could focus on investigating the possibility of basing the elements on the demand side of the Dutch health workforce on projections based on historical data (similar to the estimations on the supply side), instead of relative estimates. Another possibility is to base the projections on in-depth studies regarding the developments which should be updated regularly. Alternatively, future research could also focus on the decision-making process in the expert groups. This may be improved by following a more standardized method, in which the route is the same for every panel of experts working with the ACMMP.

Future research on exploring the possibilities for the demand side of the Dutch health workforce model can be conducted, by for example studying other projection models and forecasting studies nationally (Nature Outlook (38), Dutch Public Health Status and Foresight study (PHSF) (39), RIVM chronic disease model (40)) and internationally (9). The national outlooks on nature and public health and the chronic disease model are based on the same demand projections and make several scenarios that are based on historical data of different sources (e.g. from Statistics Netherlands). These scenarios are also presented to various stakeholders for consultation.
Also in a Dutch report on the future of primary care (33) the future development of the demand for care was estimated based on demographic and epidemiological developments. However, there were some remarks to these estimations (that the authors also mention in their report). For example, the epidemiological development data on which the national epidemiological estimations were based were mostly from one Dutch region and thus possibly not representative for the rest of the country. Furthermore, trends were extrapolated. In the meantime, the NIVEL Primary Care Database (NIVEL Zorgregistraties eerste lijn) has developed into a database with

routinely recorded data from health care providers about utilization of health services in a representative sample of the Dutch population.

Currently, the Advisory Committee Innovation Health care professions and Training Research (41) investigates the possible future developments in health care demand. This committee advises the Minister of Health, future-oriented and cross-sector, on the innovations and improvements of professions and training in Dutch health care. The aim is to develop a new professional structure and an accompanying training continuum. The demand for care in 2030, together with the expected social and technological developments, are supposed to be met by the new professional and training system. The results of these investigations also could give direction to the further development of the demand side of the Dutch projection model.

The inclusion of macroeconomic forces

Elaborating on two studies mentioned in the preceding section (36,37), the Dutch health workforce planning model does not explicitly incorporate macroeconomic forces, neither on the supply side nor on the demand side of the model. Also internationally, health workforce projections are not commonly linked with health expenditure projections or do not explicitly include other macroeconomic developments (9). However, it is very plausible that macroeconomic developments play an important role in determining the future supply of and demand for health professionals (9), for example, financial crises causing training budgets to decline. Moreover, these developments can also affect other developments that can also be incorporated in health workforce planning models, such as socio-cultural developments or the development of the retirement age of health professionals.

The Dutch model does not take macroeconomic developments into account explicitly, but implicitly it takes these developments into account by incorporating its influence (interaction) in other demand developments. These demand developments, for example, socio-cultural developments and unmet demand for care, are modeled as expected percentages of yearly change. Macroeconomic developments can lead to policy initiatives aimed at, for example, more efficiency, increasing task reallocation or limiting the demand for care. The results of these policy measures affect the estimations of the Dutch projection model elements regarding non-demographic developments (36,37).

It is very relevant to think thoroughly about the consequences of such implemented policy measures for various model elements, before estimating the size of the non-demographic (demand) developments. This process is part of the expert estimations, which are explained above. Alternatively, health care policy (before or after implementation) can be taken into account in the planning model by using policy scenarios (what would happen to the model elements if a specific policy would be implemented).

Macroeconomic developments can interact with developments in both health care demand and health care supply. On the supply side, macroeconomic developments can affect the retirement age of health professionals because health professionals need to work longer before they can retire for financial reasons, or the student intake in training, because the government decides to spend less money on training health professionals. Macroeconomic developments could affect the demand for care because health care use might decrease if more health care costs are is not compensated for by health insurance (because of budget cuts), and people have less money to spent. Most of the time, the interaction between macroeconomic developments and developments in health care supply and demand is influenced by policy measures (such as budget cuts).
To get more insight into the influence of macroeconomic developments on the development of the health workforce, future research can firstly focus on studying health workforce planning models which include macroeconomic developments in different ways, for example the health workforce planning models from Finland, Israel, Norway, and the UK (9). In Norway, for example, GDP growth and its impact on the demand for physician services is taken into account by assuming that economic growth will create higher expectations and utilization of health services beyond the impact of demographic changes alone. Moreover, in Finland, the model assumes that a more optimistic GDP growth scenario will lead to health care reforms and an increased productivity of health workers.
To study the specific macroeconomic developments in the Netherlands, it would be useful to consult several reports about forecasted health expenditures and economic forecasts in the Netherlands which could influence the future supply of and demand for health services, for example, the economic outlook 2011-2015 of CPB (42), Forecasting public health expenditures in the Netherlands (43) and the CPB Policy Brief on Trends in health and health care (44). Besides information about macroeconomic developments in the Netherlands, these documents (or related documents) also can provide valuable information about the modeling techniques that were used.

Including provider payment

The Dutch physician workforce planning model, as well as most health workforce planning models internationally do not include fees/wages and provider payment or other incentives as a factor affecting the future supply and demand for physicians. Such incentives can be expected to play an important role in determining the supply

and demand of professionals in health care, as in any other sector. A lack of reliable prognostics on wages may be a reason why provider payment as a factor affecting demand for health professionals is not included in health workforce planning models (9).
In addition, the development of health professional wages will be determined by negotiations for a large part. Outcomes of these negotiations are hard to predict (9). Negotiations regarding payment are also dependent on macroeconomic developments and health care expenditures in general. These developments make including remuneration in health workforce projections very difficult, there are too may assumptions to be made.

On the supply side, payment, but also various other incentives can be expected to affect the attractiveness of different specialties, the choice of practice location, or retention rates and retirement patterns. Additional research is required to investigate the possible influence of different kinds of incentives.

Integration of multiple health professions in health workforce modeling
Traditionally, health workforce projections are done separately for each group of health professionals. In many cases, a possible interaction between different health professionals was not taken into account (9). However, to take into account possible new roles and responsibilities of different providers (that can overlap), health workforce requirements should be analyzed in a more integrated way. The integration of health workforce planning of multiple health professional groups is particularly important in the primary care sector.
In this health care sector and in some countries, roles are changing, and tasks are reallocated between doctors, nurses and other providers (9). According to Ono et al. (9), the degree of integration in modeling health workforce planning varies among OECD countries. In an intermediate approach task sharing and substitution are modeled for de demand for separate disciplines by making explicit assumptions about task reshuffling between provider disciplines.
The Dutch model that was studied in this thesis is an example of a model that uses this intermediate approach, especially since the development of a task reallocation software tool that was introduced in this thesis. With this tool, workforce projection models of separate professions can be connected to simulate task reallocation between those professions and estimate the future staff-mix.
However, models with an intermediate approach, such as the Dutch model, rarely make a completely integrated projection of demand and supply of all health professionals involved. According to Ono et al. (9), a full integration of the supply and demand of several health professionals requires information on the current and

estimated future supply and demand of the health professionals involved. This should also take into account possible re-organizations in the health care sector. This does not clarify if there should be a staff-mix approach (like the Dutch health workforce planning model) or a skill-mix approach. Dubois et al. (45) argue that a staff-mix approach (achieving a particular workforce mix consisting of different professionals) is not the most optimal re-organization. They conclude that this approach fails to make effective use of health professionals' skills and is, therefore, a restrictive approach. To be fully effective, a wider perspective on the organization of the health workforce needs to be considered, for example by focusing on staff members' skills and the effective use of those skills and focusing on the total required team and its skills to provide a specific type of health care (skill-mix) instead of staff-mix. Future research is required regarding modeling the health workforce skill-mix in the Dutch context is required, because the Dutch model is not yet capable of fully simulating the supply and demand of various medical professions in conjunction and estimate the future required health care team. However, this will be a difficult exercise as tasks and skills of health professionals are often subject to change. For example, because of changing health care demands of a population with increasing multimorbidity. Ideally, the integration of multiple professions in a team requires a detailed description of the current scope of tasks of each professional group and an assessment of the possible scope for developments in tasks. It would be interesting to investigate what team (size and content) is most efficient and effective in delivering care to a changing population.

Regional health workforce planning

Health workforce planning models in many countries make health workforce projections on a national level to inform national workforce policies. However, it is quite common that there are regional differences with regard to the health workforce: shortages of health professionals is certain regions, surpluses in others (9). The fact that workforce planning in the Netherlands also occurs at a national level can be considered a limitation. It might become more difficult to prevent regional labour market tensions. For instance, in 2013 signals emerged from the province of Drenthe that GPs were having difficulty finding successors for their practices.

Some countries have planning systems at a local level to deal with regional labour market tensions, for example, Germany and Italy (9). Some countries with national health workforce planning try to take regional labour market developments into account by accounting for the mobility of health care providers within the country (e.g. United States) or for differences in training capacity across regions (e.g. France). The latter is based on the assumption that health professionals are more likely to work in the region where they have been trained (9).

Future research is required to explore the extension of the Dutch workforce projection model with local or regional health workforce projections. Van der Velden & Batenburg (46) started to investigate regional planning for a specific group of health care providers: medical support and specialized nursing professions for which the training is financed by the Fund Hospital Training. These health care providers are trained regionally.
It would be interesting to explore the regional workforces of other health care providers to study the differences between regions. Differences in the balance between supply and demand between different regions are probably related to geographical differences in populations, medical institutions, and other socio-cultural or socio-economic conditions – both on the supply side and the demand side. Although the regional differences are not large in the Netherlands, there are a couple of peripheral areas in the Netherlands that are having a declining population as well as difficulties in finding specific health care providers. This indicates that there might be imbalances between supply and demand.

An example of particular parts of the Netherlands that are interesting to study in a regional perspective are the parts where the population is declining, or will decline substantially in the next thirty years. These are also the parts of the country where the workforce population will potentially decline. Therefore, it is a relevant question what the balance between supply and demand of regional health care is and will be. In the Netherlands, three peripheral regions currently have a declining population. In the North-Eastern part the 'Eemsdelta', in the South-Eastern part 'Parkstad Limburg' and the South-Western part 'Zeeuws-Vlaanderen' (49).

Additionally, in the Netherlands, policy initiatives are increasingly taken to organize health care at the level of municipalities. For example, in 2015, municipalities are becoming responsible for the guidance and support of their inhabitants with physical and mental limitations (47).This implies that local governments, health care providers and health care insurers should be enabled to match supply and demand as locally as possible. Detailed data about the health workforce is required for instance regarding, inflow in and outflow out of a particular region. For planning the workforce at a local or regional level NIVEL already developed the Demand Supply Analysis Monitor, which uses a spatial microsimulation model to estimate the provision of primary care and demand of local populations for local areas in the Netherlands. It also identifies under- and oversupplies (48). It does not, however, take into account all elements of supply and demand in health care that are incorporated in the national physician workforce planning model in the Netherlands.

A big challenge of studying the possibilities of modeling regional variation is to define the appropriate geographical unit for projecting the regional health workforce: are regions, provinces or municipalities the most appropriate unit? By all means, it is important to realize that Health workforce projections at a regional level have a larger margin of error because of smaller workforce numbers.

Sharing knowledge internationally

Other countries that are starting or re-evaluating workforce planning in health care can learn from the strengths and weaknesses of the Dutch model and the experiences as presented in this thesis. Vice Versa, the Netherlands can also learn from experiences with health workforce planning abroad. The Joint Action on European Health Workforce Planning and Forecasting that is running since 2013 is an important platform and initiative in this respect (50). The general objective of the Joint Action is to create a platform for collaboration and exchange between European Member States have a better peparation for the future of the health workforce. This cooperative study will support Member States and Europe to take effective and sustainable measures to prevent and correct for imbalances in the health workforce on the European and national level. The Joint Action focuses on health workforce planning and forecasting mechanisms because these are recognized mechanisms to support evidence-based policy regarding the health workforce and planning the health workforce. More specifically, the following goals to gain knowledge about European health workforce planning and forecasting are formulated: 1) a better understanding of terminology; 2) better monitoring of the health workforce by access to timely data; 3) updated information on mobility and migration trends in the EU; 4) guidelines on quantitative and qualitative health workforce planning methodology; 5) increased quantitative and qualitative planning capacity; 6) an estimation of the future skills and competencies needed in the health workforce; 7) a platform for cooperation to find possible solutions for the expected shortage in the health workforce; 8) a higher impact of the health workforce planning and forecasts on policy decision-making (further information is available on http://euhwforce.weebly.com/). The Handbook on Health Workforce Planning Methodologies across EU countries (51) shows results of the Joint Action. It demonstrates how health workforce planning is used in several EU countries and shows that planning the health workforce is feasible and adds value in those countries. This handbook also shows the strengths and weaknesses of the planning systems studied. The strengths are believed to be: the involvement of stakeholders in the forecasting process; the development of the forecasting models; and how data is collected. The weaknesses found are: the goals of the forecasting models are not always specific; several forecasting models do not take into account current imbalances; a lack of certain data, such as international mobility data and data about wages; most countries do not implement policy actions besides regulating student intake; and the planning process and forecasting exercise is not often evaluated.

Within initiatives as the Joint Action program, an important notion is that health-care systems and health labour markets in different countries deviate from each other at many points. This implies that the application of a specific health workforce planning or projection model is dependent on the health workforce planning system of a country. It is valuable to compare different health care systems and health labour markets and investigate which type of health workforce planning fits with which type of health-care system (20). Promising is that international comparative research is growing, and can contribute to the exploration of further improvement of the Dutch health workforce projection model as well. Next to the Feasibility Study by Matrix in 2009, the OECD study of Ono et al. provides valuable data and insights (9).

Conclusion

The studies presented in this thesis demonstrated that the Dutch workforce planning model for physicians is an accepted projection model by policy makers and stakeholders. It incorporates many relevant health workforce factors and developments to determine the gap between health care supply and demand and the required training intake to close this gap within a certain time period for one or several health professionals at the same time. The model is described in this thesis and evaluated from different perspectives.

This thesis also demonstrated that the model is capable of projecting the Dutch GP health workforce accurately. Furthermore, the model is flexible in different ways. Firstly, while its primary goal is to support recommendations on the required student intake to balance the future health care supply and demand, the model can also be used to evaluate policy plans regarding the health workforce, as was also described in this thesis. Secondly, the model is generic: it is suitable to project the workforces of all types of health care professionals. Preferably, the projections are based on a complete dataset that supports the estimations of the model. However, the availability of these workforce data is a difficulty in many countries around the world and for some professions more than for others. In this regard, the values of the model elements can also be based on short historical data periods (which is found to be more accurate), or be estimated by experts, if data is not available. However, this is not the preferred option. It should be noted, however, that expert estimations are an important part of the demand projections in the Dutch health workforce planning model. As it is crucial that experts are capable and reliable in making these estimations, the experts and their estimation tasks need to be supported by research. The ultimate goal is that as many model elements as possible are based on historical trends so that health workforce projections are not dependent on expert estimations. Furthermore, several aspects which are part of the current version of the Dutch model for physician workforce planning need additional research, in particular at the demand side of the model. Future research is needed to investigate the necessity of developments that are currently not part of the model, such as macroeconomic developments and conditions and the further integration of planning multiple professionals.

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Summary

Introduction

Health-care labour markets in many countries are being confronted with a cyclical pattern of over- and undersupply as a result of delayed responses to changes in the market, for example in student intake numbers. This cyclical pattern is also known as the ‘pork cycle’. For policy makers, avoiding these cyclic variations and keeping a balance in the health workforce is a major challenge. Determining what will be the “right” number and mix of different categories of doctors and other health professionals is a very complicated task because health care supply and demand are subject to hard-to-predict changes and developments.

In health services labour markets of many countries, there are strong limitations to the working of market mechanisms and the supply of health professionals is influenced by many different factors: economic, social, technological, legal, demographic and political factors. From an economic perspective, it is important to note that balance on the health labour market does not emerge ‘spontaneously’. Selection, allocation and employment mechanisms in the field of healthcare do not comply to what can be assumed as ‘perfect’ labour market conditions.

Matching supply and demand of health services to stabilize the health labour markets in general and for physician labour markets in particular, is a complex challenge, but unavoidable as both over and undersupply cause high financial and societal costs. A wide range of interventions can be used to regulate imbalances. Examples are restricting entry to the labour market or education, or creating coercive measures to direct health professionals to specific areas. Health workforce planning with projections are used in many countries, particularly to reach a balance between supply and demand in the workforce for physichians. It can be expected that an increasing number of countries will apply health workforce planning to cope with their health system challenges, taking into account the attention there is for health workforce planning in the European Union.

Anticipating on developments in the health care supply and demand is an important part of workforce planning and projections but also a challenge, because the size and composition of the health workforce are influenced by different societal, political and technological developments. Hence, workforce planning is not an isolated technical exercise; it is important to understand which developments influence health care supply and demand and how future trends will develop in a broader perspective. The system of workforce planning needs regular adaptation to new developments and changing structures, such as task redistribution and the ageing of the population and the health workforce.

Evaluating health workforce planning and projections and their policy effect
While there are diverse types of health workforce planning and different kinds of projection models that support planning, little is known so far about the performance of health workforce planning and the position of health workforce projections and planning in general health services policy. This lack of information about the performance of health workforce planning and policy implies that existing shortcomings and room for improvement are difficult to identify. Therefore, evaluating the impact of planning and the accuracy of the projections involved, as well as investigating the policy value of the projections, is very useful.
The main goal of health workforce planning and projection models is to provide guidance for policy decisions on entry into health professional training. Accurate workforce projections are important to make this guidance useful. Health workforce projections can also be used to understand the impact of policies, by testing different policy-relevant scenarios about health care supply and demand.

The health workforce planning model and system in the Netherlands
In this thesis, we studied the Dutch health workforce planning model and its history. The Dutch health workforce planning model has been used since 2000, and the Netherlands has planned medical school intake since 1972. Also, student intake for specialist medical training has been regulated for years. The introductory chapter of this thesis (**Chapter 1**) elaborates further on the Dutch health workforce planning system by, first, discussing the reasons for health workforce planning; second, briefly discussing the methods on which health workforce planning is based; and third, explaining the importance of evaluating health workforce planning and its policy effect.

In this thesis, we study the topic of matching and planning health workforces by focusing on the current Dutch system of health workforce planning for physicians. As this system consists of both a model-based and policy-driven approach, and is well monitored and documented, it provides an interesting case to explore and evaluate. New policy applications of the Dutch model for physician workforce planning are explored.
These subjects are discussed from a health systems perspective, rather than from an economic labour market perspective. So it is essentially applied research, ultimately meant to improve the Dutch health care planning model.

Ten years of health workforce planning and projections in the Netherlands
In **Chapter 2** of this thesis, the Dutch model and system of health workforce planning is explained more extensively, using the Dutch general practitioners as an example. After the different steps in the model are clarified, it is shown how elements can be added

to arrive at various versions of the model, or: ‘scenarios’. A comparison is made of the results of different scenarios for different years. In addition, the subsequent stakeholder decision-making process is considered. An important part of the modeling process remains the acceptation of the model projections by the different stakeholders. After calculating the balance between supply and demand, there needs to be an agreement between the stakeholders to implement the advised training intake.

The discussion of this paper shows (through indicators) that it seems plausible that Dutch health workforce planning has resulted in a balance between supply and demand of general practitioners. One of the strengths of the Dutch model is that it can be used for different types of medical and allied health professionals. A weakness is that the model is, in its basic form, not yet fully capable of including substitution between these types of professionals. It can also be concluded that health workforce planning has become an accepted instrument in the Netherlands for calculating the required supply of health professionals on a regular basis and that the model is suitable to be used for policy objectives.

The evolution of Dutch GP training policy and its influence on GP density
Several countries have implemented policies to control physician training intake (such as numuri clausi) and physician density to ensure a balance between supply and demand. Little is known about the effect of these policies. In **Chapter 3** of this thesis, Dutch training intake policy for General Practitioners (GPs) is studied, which has changed several times between 1970 and 2010. The relationship between policy and density was evaluated, by an ex-post comparison of the factual and counterfactual GP density, i.e. the density if policy would not have been implemented. The Dutch model for health workforce projections (as explained in chapter 2) was used to perform these analyses.

A historical overview in this chapter shows that GP training policies evolved from ad hoc supply-driven decisions to decisions based on long-term workforce planning. The counterfactual analysis demonstrated that restrictions on student intake slowed down the growth rate of Dutch GP numbers and kept GP density relatively low. Despite the difficulty of retrospectively assessing the ‘net’ impact of policies, this chapter shows that it is possible to investigate the relationship between GP training intake policies and GP density ex-post successfully by using counterfactual analysis. The chapter also demonstrates that new GP training intake policies take at least 10 years to affect GP density. Long-term workforce projections are useful in obtaining insight into long-term policy consequences and avoiding ad-hoc decisions and fluctuations in student intake.

The accuracy of general practitioner workforce projections
Health workforce projections are important instruments to prevent imbalances in the health workforce and support health workforce planning. For both the tenability and further development of these projections, it is important to evaluate their accuracy. In the Netherlands, health workforce projections to support health workforce planning have been done since 2000. In **Chapter 4** of this thesis, the accuracy of the techniques of these workforce projections is tested, specifically for the Dutch general practitioner workforce.
The workforce projection model is backtested by comparing the ex-post projected number of general practitioners with the observed number of general practitioners between 1998 and 2011. Averages of historical data were used to make these ex-post projections. In the projections, there is an exception for annual training intake. As the required training intake is the key result of the workforce planning model and has actually determined past adjustments of training intake, the accuracy of the model is backtested using the observed training intake and not an average of historical data. This is to avoid the interference of past policy decisions.

It appears from the results that the workforce projections underestimated the number of active Dutch general practitioners in most investigated years. The mean absolute percentage errors range from 1.9% to 14.9%, with the projections being more accurate in more recent years. Furthermore, projections with a shorter projection horizon have a higher accuracy than those with a longer horizon. Unexpectedly though, projections with a shorter base period have a higher accuracy than those with a longer base period.
According to these results, forecasting the size of the future workforce did not become more difficult between 1998 and 2011, as we originally expected. Additionally, we can carefully conclude that health workforce projections can be made with data based on relatively short base periods, although detailed data are still required to monitor and evaluate the health workforce.

Motives for early retirement of self-employed GPs in the Netherlands
Changes in the retirement age of physicians and the changing age structure of the health workforce are likely to affect the outflow of physicians and thus the future supply of physicians. A greater understanding of the link between the factors affecting the decision to retire and the moment of actual turnover would benefit policies designed to influence the moment of retirement. Knowledge about the retirement age of physicians and other health professionals provides valuable information for health

workforce planning, because the projections of the future outflow of health professionals are based on the retirement age of health professionals in the past.

Chapter 5 focuses on actual GP turnover and the determining factors for this in the Netherlands. The period 2003–2007 saw fewer GPs retiring from general practice than the period 1998–2002 and GPs' retirement age was higher in 2003–2007. For these two periods, we analyzed work perception, objective workload and reasons for leaving, and related these to the probability that GPs would leave general practice at an early age.
Both male and female GPs reported a different work perception between periods: they reported greater job satisfaction and a lower degree of emotional exhaustion in the later period, although there was no notable difference in subjective workload. The objective workload was lower in the second period. Moreover, most external factors and personal reasons that may contribute to the decision to retire were reported as less important in the second period.

The results of this study suggest that the decrease in the probability of GPs leaving general practice within one year and their increasing retirement age are caused by a decrease in the objective workload, a change in GPs' work perception, and changing external factors and personal reasons. Based on the results of this study, we consider workload reduction policies useful instruments to control retention and retirement.

Modeling task reallocation to integrate health workforce planning models of multiple professions

In **Chapter 6**, the feasibility and consequences of several oral health staff-mix scenarios of the Dutch oral health care workforce are investigated, which were recommended by a committee that investigated the possibilities for task reallocation in the oral healthcare workforce. These recommendations were leading for the government's policy on this topic. At the time that the recommendations were made, no workforce planning study was executed to investigate the feasibility of the recommendations.

In this chapter, the feasibility of meeting the recommended oral health staff-mix in 20 years is evaluated using the Dutch health workforce planning model. The model is extended with a task reallocation software tool that was developed to connect the health workforce planning models of multiple health professions. Besides the recommended staff-mix, two alternative scenarios are tested: the required annual student intakes to meet task reallocation targets in 2030, and the feasible amount of task reallocation in 2030 keeping the annual student intake constant. Finally, the available staff-mix of 2010, the targeted staff-mix of 2030 and the available staff-mix of 2030 (with current and adjusted intakes) are calculated.

From the results of this chapter we learn that the recommended task reallocation target (dental hygienists and oral preventive assistants taking over 50% of dentists tasks) is not met within 20 years with the current student intakes. The annual student intakes of all three professions have to be adjusted to meet the recommended target task reallocation by 2030. According to the projections, 27.4% task reallocation could be reached in 20 years. However, dental hygienist and oral preventive assistant intakes still need to be adjusted in this scenario.

Following these results, we can conclude that dramatically changing the staff-mix of a workforce will be a long-term process. Large adjustments of annual student intakes or implementation of alternative policies will most likely have adverse consequences, such as closing training institutions. Policy plans regarding workforce staff-mix can be evaluated ex-ante by using integrated health workforce planning models. Model simulations can thus support advisory committees' recommendations to estimate the consequences of policy plans and oversee long-term effects before policy is implemented.

General discussion

The final chapter, **Chapter 7**, provides a discussion of the main findings in this thesis and conclusions are drawn to answer the seven research questions of this thesis. Secondly, the implications of this study and the relevance of the findings for science, policy and practice are discussed. Furthermore, the limitations of this study are considered leading to recommendations for further studies on improving the Dutch projection model and planning system.

Implications for the Dutch health workforce projection model and system

Recent data is better than more data

Until recently, the Dutch health workforce was projected with a base period of 15 years. Nowadays, Dutch health workforce projections are based on a five-year base period, because these are the most accurate.

Consequences for data collection

To assure that health workforce projections are accurate, (new) developments and trends in model elements have to be investigated regularly and data collection should be expanded for model elements that are not part of the standard annual GP database questionnaire. This data collection should accompany the Dutch health workforce projections done every three years.

Projecting the future staff-mix using a software tool to connect multiple professions
A task reallocation tool was developed that enables the connection of the models of various health professions. By using this tool (and the Dutch health workforce planning model), the feasibility of a specific health workforce staff-mix can be investigated. The results showed that the use of the task reallocation software tool is very useful to test the consequences of policy intentions and to evaluate if the intended staff-mix can be reached within a definite period. The tool is especially useful in testing policy goals regarding the aim towards a certain amount of task reallocation.

Alternative application of the workforce planning model – testing policy plans
The results of this thesis show that besides the primary function of making recommendations on student intake, the Dutch health workforce projection model can also be used as a projection model for testing policy plans regarding the health workforce, ex-ante or ex-post.
Model simulations can thus support advisory committees' recommendations to estimate the consequences of policy plans and oversee long-term effects before and/or after policy is implemented.

Implications for policy and practice
Complementary policy measures and adverse effects of policy measures on practice
Adjusting annual student intake is the primary health policy action to influence the health workforce size. The consequence of using this kind of long-term health workforce planning is that policy makers and health professionals have to be patient, because the size of the workforce cannot be adjusted very fast. Besides adjusting annual student intake, relatively short-term policies can also (directly or indirectly) influence the health workforce size or specific parts of the health workforce on shorter notice.
Short-term policy measures, as well as dramatic adjustments of annual student intake in a short timespan, can have adverse effects. These effects make radically changing the size of the health workforce on short notice very unlikely. Significantly changing the size of the workforce will, therefore, be a long-term process. Additionally, when complementary policies are implemented, the effects of these policies on the workforce should be monitored to be aware of the consequences of these policies on the health workforce size.

Acceptance of the long-term projection models' method and results by policy makers

When policymakers expect long-term projections to contribute to a balance between supply of and demand for health professionals, it is important that they accept the advice following the results of health workforce projections. If the differences between the recommendations and the realized student intake are large, the benefits of long-term workforce projections are not fully exploited. Policymakers and other stakeholders have to realize that most policy measures will not have an immediate impact on the size of the workforce.

Recommendations for future research

Some parts of the Dutch health workforce planning model or new possibilities for the model were not covered by the scope of this thesis. Furthermore, several developments and factors that are possibly relevant for planning the future health workforce are currently not incorporated in the Dutch health workforce planning model. Further research on these topics in the context of the Dutch health workforce system is required to investigate the possibilities of the model.

Examples for future research are: 1) evaluation of the demand side of the Dutch model and investigating new possibilities for demand projections or improving the current decision-making process; 2) investigating which factors, that are currently not (explicitly) incorporated in the Dutch model are possibly relevant for health workforce projections; 3) explore possibilities of adapting the Dutch model to current and future developments in health care delivery and the health workforce, such as health workforce skill-mix or regional developments; 4) international comparative research can contribute to the exploration of further improvement of the Dutch health workforce projection model as well.

Conclusion

The studies presented in this thesis demonstrated that the Dutch health workforce planning model is an accepted projection model by policy makers and stakeholders. It incorporates many relevant health workforce factors and developments to determine the gap between health care supply and demand and the required training intake to close this gap within a certain time period for one or several health professionals at the same time. The model is described in this thesis and evaluated from different perspectives.

This thesis also demonstrated that the model is capable of projecting the Dutch GP health workforce accurately. Furthermore, the model is flexible in different ways. Firstly, while its primary goal is to support recommendations on the required student intake to balance the future health care supply and demand, the model can also be used to evaluate policy plans regarding the health workforce, as was also described in this thesis. Secondly, the model is generic: it is suitable to project the workforces of all

types of health care professionals. Preferably, the projections are based on a complete dataset that supports the estimations of the model. However, the availability of these workforce data is a difficulty in many countries around the world and for some professions more than for others. In this regard, the values of the model elements can also be based on short historical data periods (which is found to be more accurate), or be estimated by experts, if data is not available. However, this is not the preferred option. It should be noted, however, that expert estimations are an important part of the demand projections in the Dutch health workforce planning model. As it is crucial that experts are capable and reliable in making these estimations, the experts and their estimation tasks need to be supported by research. The ultimate goal is that as many model elements as possible are based on historical trends so that health workforce projections are not dependent on expert estimations.
Furthermore, several aspects which are part of the current version of the Dutch model for physician workforce planning need additional research, in particular at the demand side of the model. Future research is needed to investigate the necessity of developments that are currently not part of the model, such as macroeconomic developments and conditions and the further integration of planning multiple professionals.

Samenvatting (summary in Dutch)

Introductie

In veel landen wordt de arbeidsmarkt van de gezondheidszorg geconfronteerd met een cyclisch patroon van overschotten en tekorten. Dit patroon ontstaat als gevolg van vertraagde reacties op veranderingen in de arbeidsmarkt (in bijvoorbeeld de opleidingsinstroom). Deze cyclus wordt ook wel de 'varkenscyclus' genoemd. Het is een belangrijk doel van beleidsmakers in veel Europese landen om deze schommelingen te vermijden. Door het 'juiste' aantal zorgverleners op te leiden wordt zo veel mogelijk geprobeerd het evenwicht tussen zorgvraag en zorgaanbod te vinden. Het bepalen van het 'juiste' aantal zorgverleners, maar ook het bepalen van de 'juiste' mix van verschillende soorten zorgverleners is geen gemakkelijke taak. Zowel de vraag als het aanbod van zorg zijn namelijk onderhevig aan veel ontwikkelingen.

Op de arbeidsmarkt van de gezondheidszorg wordt marktwerking belemmerd en wordt het aanbod aan zorgverleners door verschillende economische, sociale, technische, juridische, demografische en politieke factoren beïnvloed. Vanuit een economisch perspectief, is het belangrijk om op te merken dat Evenwicht tussen vraag en aanbod in de gezondheidszorg niet uit zichzelf tot stand zal komen. De arbeidsmarkt van de gezondheidszorg voldoet niet aan de 'perfecte' arbeidsmarkt omstandigheden, door bijvoorbeeld selectie in de instroom in veel opleidingen, allocatie, en prijsafspraken over de kosten van geleverde zorg.

Het vinden van evenwicht tussen vraag en aanbod op de arbeidsmarkt voor de gezondheidszorg in het algemeen en op de arbeidsmarkt voor artsen in het bijzonder, is niet gemakkelijk. Het is echter wel nodig dat geprobeerd wordt een balans te vinden, omdat zowel een tekort als een overschot aan zorgverleners negatieve financiële en sociale gevolgen heeft. Om ervoor te zorgen dat er toch een evenwicht ontstaat met genoeg zorgverleners (met de juiste specialisatie, op de juiste plek en met de juiste vaardigheden) om aan de toekomstige zorgvraag te kunnen voldoen, is de invloed van beleid nodig.

Overschotten en tekorten van zorgverleners kunnen op verschillende manieren bestreden worden. Voorbeelden zijn restricties in toegang tot de arbeidsmarkt of opleiding, of maatregelen om zorgverleners in specifieke delen van het land te laten werken.

Veel landen maken gebruik van personeelsplanning op basis van projecties om een evenwicht tussen vraag en aanbod in de gezondheidszorg te bereiken, en dan met name in de medische beroepsbevolking. Op basis van de aandacht die er is voor personeelsplanning in de gezondheidszorg in de Europese Unie, ligt het in de lijn der verwachting dat een toenemend aantal landen personeelsplanning in de gezondheidszorg zal gaan toepassen om om te gaan met de uitdagingen in hun gezondheidszorgsystemen.

Een belangrijk onderdeel van personeelsplanning is het anticiperen op toekomstige ontwikkelingen zoals verschillende maatschappelijke, politieke en technologische ontwikkelingen die de omvang en de samenstelling van de arbeidsmarkt van de gezondheidszorg beïnvloeden. Personeelsplanning is geen op zichzelf staande technische exercitie, het is ook belangrijk om te begrijpen welke ontwikkelingen zorgvraag en zorgaanbod beïnvloeden en hoe toekomstige trends zich zullen ontwikkelen in breder perspectief.

Het systeem van personeelsplanning moet geregeld worden aangepast aan nieuwe ontwikkelingen en veranderende structuren, zoals taakherschikking en de vergrijzing van de bevolking en zorgverleners.

Het evalueren van personeelsplanning en arbeidsmarktprojecties in de gezondheidszorg en het effect op beleid

Wereldwijd zijn er verschillende manieren van personeelsplanning in de gezondheidszorg gebaseerd op projecties. Helaas is er tot nu toe weinig bekend over het functioneren en het succes van deze soort planning en de plaats die arbeidsmarktprojecties en planning innemen in algemeen gezondheidszorgbeleid. Door het gebrek aan deze informatie over het functioneren van personeelsplanning en -beleid in de gezondheidszorg is het moeilijk om bestaande tekortkomingen te identificeren en mogelijkheden voor verbetering te signaleren. Om zicht hierop te krijgen is het van belang dat het effect van personeelsplanning op de arbeidsmarkt wordt onderzocht, evenals dat de nauwkeurigheid van de projecties die daaraan ten grondslag liggen en de waarde voor beleidsmakers worden geëvalueerd.

Het belangrijkste doel van projectiemodellen gericht op personeelsplanning in de gezondheidszorg is richting te geven aan beleidsbeslissingen over de jaarlijkse instroom in medische beroepsopleidingen. Het is belangrijk dat de projecties waarop deze modellen gebaseerd zijn nauwkeurig zijn, zodat het advies dat wordt gegeven accuraat is. Naast deze adviserende functie, kunnen deze projectiemodellen ook worden gebruikt om de impact van beleid ten aanzien van de arbeidsmarkt in de gezondheidszorg te begrijpen/te toetsen.

Het Nederlandse planningsmodel en systeem voor de arbeidsmarkt van artsen

In dit proefschrift bestuderen we het Nederlandse planningmodel voor de arbeidsmarkt van de gezondheidszorg en haar geschiedenis. Dit model wordt gebruikt sinds 2000 om advies te geven over de instroom in de opleiding geneeskunde en de

medische en tandheelkundige vervolgopleidingen. Sinds 1972 geldt er al een numerus fixus voor de studie geneeskunde in Nederland.
In het inleidende hoofdstuk van dit proefschrift **(hoofdstuk 1)** wordt dieper ingegaan op het Nederlands planningsmodel door 1) de redenen voor personeelsplanning in de gezondheidszorg te bespreken; 2) kort de methoden te bespreken waarop personeelsplanning voor de gezondheidszorg in het algemeen en artsen in het bijzonder is gebaseerd; en 3) het belang van het evalueren van personeelsplanning onderstrepen en uitleggen, evenals het effect van planning op beleid.

In dit proefschrift bestuderen we personeelsplanning in de gezondheidszorg en focussen daarbij op het Nederlandse systeem van personeelsplanning voor artsen. Dit systeem is gebaseerd op modelmatige projecties, en is tegelijkertijd gericht op het maken van beleid rondom dit onderwerp. Het is een goed gemonitord en gedocumenteerd model en systeem en is daarom interessant om uitgebreider te bestuderen en evalueren. Ook worden nieuwe toepassingen van dit Nederlandse model onderzocht.
Deze onderwerpen worden vooral besproken vanuit het perspectief van gezondheidszorgonderzoek, en niet specifiek vanuit een economisch of arbeidsmarktperspectief. Het is dus met name toegepast onderzoek dat wordt beschreven, uiteindelijk bedoeld om het Nederlandse planningsmodel te verbeteren.

Tien jaar personeelsplanning in de gezondheidszorg in Nederland
Sinds 1970 heeft de Nederlandse overheid verschillende methoden uitgeprobeerd om de benodigde instroom in de opleiding geneeskunde te bepalen. In 2000 werd een simulatiemodel ontwikkeld om de benodigde en beschikbare capaciteit van medische en tandheelkundige beroepen in Nederland in te schatten. In **hoofdstuk 2** van dit proefschrift wordt dit Nederlandse simulatiemodel toegelicht en geïllustreerd aan de hand van Nederlandse huisartsendata. Het model bestaat uit een aantal basisstappen die moeten worden doorlopen om tot de uitkomst van de berekeningen te komen: de benodigde jaarlijkse instroom in opleiding om een evenwicht tussen vraag en aanbod te bereiken in de toekomst. In de basisversie van het model wordt aan de vraagkant rekening gehouden met demografische ontwikkelingen. Het model kan uitgebreid worden met verschillende vraagontwikkelingen om zo tot verschillende ‘scenario’s’ te komen.

In het hoofdstuk worden de resultaten getoond van verschillende scenario’s in verschillende jaren. Daarnaast wordt het besluitvormingsproces uitgelegd dat volgt op de berekeningen die met het model gemaakt worden. Dit proces is ook een heel belangrijk onderdeel van het planningsproces. Het is niet alleen belangrijk om te berekenen welke instroom in de opleidingen er nodig is om een balans tussen vraag en aanbod te bereiken, maar het is ook belangrijk om alle betrokken partijen zoals de overheid, opleidingsinstituten en beroepsgroepen in te laten stemmen met de berekende instroom omdat invoering afhankelijk is van hun inzet.

Uit dit hoofdstuk blijkt ook dat het aannemelijk is dat personeelsplanning tussen 2000 en 2010 heeft bijgedragen aan het ontstaan van een evenwicht tussen vraag en aanbod van huisartsen in Nederland. Uit de resultaten van dit hoofdstuk kan worden geconcludeerd dat personeelsplanning in de gezondheidszorg in Nederland is uitgegroeid tot een geaccepteerde manier om de benodigde instroom in de medische en tandheelkundige opleidingen te berekenen en dat het model geschikt is om gebruikt te worden voor beleidsdoelstellingen.

De evolutie van beleid gericht op de Nederlandse huisartsenopleiding en de invloed daarvan op huisartsendichtheid

Verschillende landen hebben beleid geïmplementeerd om de instroom in de opleiding geneeskunde te regelen en de artsendichtheid te controleren. Tot op heden was er weinig bekend over het effect van dit soort beleid op de ontwikkeling van de artsendichtheid en het evenwicht tussen vraag en aanbod.

In **hoofdstuk 3** van dit proefschrift wordt het Nederlandse beleid ten aanzien van de huisartsenopleiding, dat meerdere malen is veranderd tussen 1970 en 2010, bestudeerd. We evalueren de relatie tussen dit beleid (en de veranderingen daarin) en de huisartsendichtheid in Nederland in deze periode. Daarvoor vergelijken we de feitelijke en ‘counterfactual’ huisartsendichtheid in Nederland ex-post. ‘Counterfactual’ wil zeggen: wat zou de dichtheid zijn geweest als het beleid niet was uitgevoerd. Om deze analyses uit te voeren, hebben we het Nederlandse simulatiemodel voor personeelsplanning in de gezondheidszorg gebruikt (zoals uitgelegd in hoofdstuk 2).

Uit het historische overzicht in hoofdstuk 3 blijkt dat het beleid ten aanzien van de Nederlandse huisartsenopleiding is geëvolueerd van ad hoc beleid vanuit het perspectief van de aanbodkant van de arbeidsmarkt naar beleid gebaseerd op lange termijn personeelsplanning waar ook de ontwikkeling van de zorgvraag een belangrijke rol speelt. De analyses in dit hoofdstuk hebben aangetoond dat de instroombeperkingen in zowel de opleiding geneeskunde als de huisartsenopleiding de groei van het aantal huisartsen in Nederland heeft vertraagd. Hierdoor bleef de huisartsendichtheid in Nederland relatief laag.

Het blijft moeilijk om het ‘netto’ effect van beleid te bepalen. In dit hoofdstuk hebben we laten zien dat het gebruik van ‘counterfactual’ analyse goed bruikbaar is om de relatie tussen het beleid ten aanzien van de instroom in de huisartsenopleiding en de huisartsendichtheid in Nederland achteraf te onderzoeken. Dit hoofdstuk toont ook aan dat het ten minste 10 jaar duurt voordat net ingevoerd beleid een zichtbaar effect heeft op de huisartsendichtheid. Lange termijn arbeidsmarkt projecties zijn zeer nuttig om inzicht te verkrijgen in de gevolgen van nieuw beleid. Zo kunnen deze projecties helpen voorkomen dat er schommelingen ontstaan in de instroom in opleidingen door het nemen van ad hoc beleidsbeslissingen.

De nauwkeurigheid van de arbeidsmarktprojecties van Nederlandse huisartsen
Arbeidsmarktprojecties zijn belangrijke instrumenten om een disbalans tussen zorgvraag en zorgaanbod te voorkomen. Voor zowel de houdbaarheid als de verdere ontwikkeling van deze projecties is het belangrijk om de nauwkeurigheid van arbeidsmarktprojecties te evalueren.
In Nederland worden arbeidsmarktprojecties voor de gezondheidszorg uitgevoerd sinds 2000 en sindsdien ondersteunen ze ook personeelsplanning in de gezondheidszorg. In **hoofdstuk 4** van dit proefschrift wordt de nauwkeurigheid getest van de techniek die wordt gebruik om arbeidsmarktprojecties te maken van Nederlandse huisartsen.

In dit hoofdstuk worden de projecties, gemaakt met het Nederlandse planningsmodel ‘gebacktest’: de projecties worden getest met waarden uit het verleden. Dit wordt gedaan door een ex-post vergelijking te maken van een geschat aantal huisartsen (geprojecteerd) en het waargenomen aantal huisartsen tussen 1998 en 2011. Om het geschatte aantal huisartsen te bepalen worden gemiddelden van historische gegevens gebruikt. De jaarlijkse instroom in de opleiding vormt hier een uitzondering op. De benodigde jaarlijkse instroom in de opleiding is de belangrijkste uitkomst van het Nederlandse planningsmodel en heeft er daadwerkelijk voor gezorgd dat de instroom in de opleiding in het verleden is bijgesteld. Omdat dit specifieke onderdeel het beleid heeft beïnvloed wordt voor de projecties in dit hoofdstuk een geobserveerde waarde gebruikt en niet een projectie gebaseerd op historische gemiddelden.

De resultaten laten zien dat het Nederlandse model het aantal actieve huisartsen in Nederland onderschat in de meeste onderzochte jaren. De gemiddelde afwijking (mean absolute percentage error) varieert van 1,9% tot 14,9%. In de meest recente jaren waren de projecties nauwkeuriger.
Zoals verwacht, bleken projecties met een kortere projectiehorizon nauwkeuriger te voorspellen dan die met een langere horizon. Onverwacht was dat juist projecties met

een korte basisperiode (historische data waarop de projecties zijn gebaseerd) nauwkeuriger zijn dan de projecties met een lange basisperiode. De combinatie van een korte projectiehorizon met een korte basisperiode (allebei 5 jaar) bleek het meest nauwkeurig. Op basis hiervan kunnen we voorzichtig concluderen dat projecties voor de arbeidsmarkt van de gezondheidszorg kunnen worden gemaakt op basis van data uit relatief korte basisperiodes. Deze data moet wel gedetailleerd zijn, om een zo nauwkeurig mogelijk te kunnen projecteren.
Het voorspellen van de toekomstige arbeidsmarkt voor huisartsen is, volgens de resultaten in dit hoofdstuk, niet moeilijker geworden tussen 1998 en 2011. Dit werd van tevoren wel verwacht.

Waarom zelfstandige Nederlandse huisartsen met vervroegd pensioen gaan
Een veranderende stopleeftijd van artsen heeft gevolgen voor de leeftijdsopbouw van de totale artsencapaciteit. Als artsen bijvoorbeeld langer aan het werk blijven, duurt het langer voordat ze uitstromen. Als gevolg daarvan is er minder instroom in de opleiding nodig. Voor de ontwikkeling van beleid gericht op het moment van pensionering is het van belang om beter te begrijpen wat het verband is tussen de stopleeftijd en verschillende factoren die de beslissing om te stoppen met werken beïnvloeden. Kennis over de stopleeftijd van artsen en andere zorgverleners levert belangrijke informatie voor personeelsplanning in de gezondheidszorg. De geschatte toekomstige uitstroom van zorgverleners is gebaseerd op gemiddelden van hun stopleeftijd in het verleden.

Hoofdstuk 5 richt zich op de werkelijke stopleeftijd van Nederlandse huisartsen en de factoren die daaraan ten grondslag liggen. In de periode 2003-2007 trokken minder huisartsen zich terug uit de huisartsenpraktijk dan in de periode 1998-2002. Daarnaast was de stopleeftijd van huisartsen hoger in de periode 2003-2007. Voor elk van deze twee periodes analyseren we de werkbeleving, objectieve werklast en de redenen om te stoppen met het werk als huisarts. Daarnaast relateerden we deze factoren aan de kans dat huisartsen de praktijk voor hun 65ste zouden verlaten.
Zowel mannelijke als vrouwelijke huisartsen meldden een grotere tevredenheid met het werk en een lagere mate van emotionele uitputting in de tweede periode, hoewel er geen verschil was in de ervaren werklast. De werkelijke werklast was echter wel lager in de tweede periode. Bovendien werden de meeste externe factoren en persoonlijke redenen, die bij kunnen dragen aan het besluit om vervroegd met pensioen te gaan, minder gerapporteerd in de tweede periode.
De resultaten van deze studie suggereren dat de verminderde kans om de huisartsenpraktijk binnen een jaar te verlaten en de toegenomen stopleeftijd worden beïnvloed door een afname van de werkelijke werklast, en een verandering van

werkbeleving, externe factoren en persoonlijke redenen om te stoppen met werken. Dit impliceert dat beleid om de werkdruk onder huisartsen te verminderen heeft bijgedragen aan een vermindering van de werklast en gebruikt kan worden om de pensioenleeftijd te beïnvloeden.

Het modelleren van taakherschikking om de planning van verschillende beroepsgroepen te integreren

In **hoofdstuk 6** worden de haalbaarheid en gevolgen van verschillende staff-mix scenario's onderzocht zoals geadviseerd door de commissie Innovatie in de Mondzorg. Deze commissie onderzocht de mogelijkheden voor taakherschikking in de Nederlandse mondzorg. Deze aanbevelingen hebben geleid tot landelijk beleid ten aanzien van de arbeidsmarkt van de mondzorg en de opleidingen van tandartsen en mondhygiënisten. De aanbevelingen werden op dat moment niet ondersteund door arbeidsmarktprojecties.

In dit hoofdstuk wordt onderzocht of de staff-mix in de mondzorg, zoals aanbevolen door de commissie, haalbaar is in 20 jaar. Dit wordt geëvalueerd met behulp van het Nederlandse planningsmodel voor beroepen in de gezondheidszorg. Als toevoeging op het bestaande model is een software tool ontwikkeld om taakherschikking te modelleren en de modellen van verschillende beroepsgroepen aan elkaar te verbinden.
Naast het testen of de aanbevolen mate van taakherschikking haalbaar is in 20 jaar, worden twee alternatieve scenario's getest: 1) de benodigde jaarlijkse instroom in de opleidingen van tandartsen, mondhygiënisten en preventieassistenten om de aanbevolen mate van taakherschikking te behalen in 2030 (20 jaar); 2) de mate van taakherschikking die kan worden behaald in 2030 (20 jaar) met een gelijkblijvende jaarlijkse instroom in de opleidingen. Verder wordt er ook een vergelijking gemaakt tussen de beschikbare mondzorg staff-mix in 2010, de beoogde mondzorg staff-mix van 2030 en de beschikbare mondzorg staff-mix in 2030.

Uit de resultaten kunnen we de volgende conclusies trekken. De door de commissie aanbevolen mate van taakherschikking (dat 50% van de tandartstaken worden overgenomen door mondhygiënisten en preventieassistenten) kan niet binnen 20 jaar worden bereikt met de huidige instroom in de betreffende opleidingen. De jaarlijkse instroom in deze opleidingen zou moeten worden aangepast om de aanbevolen mate van taakherschikking in 2030 te halen. In plaats van 50% taakherschikking in 20 jaar, kan wel 27,4% taakherschikking worden bereikt. Maar ook in dit geval is het nodig om de jaarlijkse instroom in de opleidingen van mondhygiënisten en preventieassistenten aan te passen.

Volgend uit deze resultaten kunnen we verder concluderen dat het drastisch veranderen van de staff-mix een langdurig proces is. Om het proces te versnellen zouden er grote aanpassingen in de jaarlijkse instroom in de opleidingen moeten plaatsvinden. Dit soort maatregelen hebben een grote kans op negatieve gevolgen. Wanneer er bijvoorbeeld opeens veel minder tandartsen mogen worden opgeleid, dan zullen er opleidingsinstituten moeten sluiten. Met behulp van een planningsmodel kunnen beleidsplannen voor veranderingen in de staff-mix in de gezondheidszorg ex-ante worden geëvalueerd. De simulaties die met een planningsmodel gedaan worden kunnen de aanbevelingen van bijvoorbeeld een adviescommissie ondersteunen en de lange termijn gevolgen daarvan inschatten voordat het beleid daadwerkelijk wordt ingevoerd.

Discussie

Het laatste hoofdstuk, **hoofdstuk 7**, biedt een overzicht van de belangrijkste bevindingen in dit proefschrift en conclusies worden getrokken om de zeven onderzoeksvragen van dit proefschrift te beantwoorden. Ten tweede worden de implicaties van dit onderzoek voor zowel de wetenschap, het beleid ten aanzien van de arbeidsmarkt van de gezondheidszorg en de praktijk besproken. Ten slotte worden de beperkingen van deze studie besproken die leiden tot suggesties voor toekomstig onderzoek naar het verbeteren van het Nederlandse model en systeem voor personeelsplanning in de gezondheidszorg, specifiek voor medisch personeel.

Implicaties voor het Nederlands projectiemodel en het systeem voor arbeidsmarktplanning

Aanvullende beleidsmaatregelen en eventuele negatieve effecten van beleidsmaatregelen op de praktijk

Het bijstellen van de instroom in de opleiding is het primair gebruikte instrument om te sturen op het totale aantal zorgverleners. Dit instrument vereist een lange termijn planning en vraagt daarom ook om geduld bij beleidsmakers en zorgverleners zelf. De omvang van het personeelsbestand kan immers niet heel snel en met grote aantallen worden aangepast.

Naast het aanpassen van de instroom in opleiding, kan ook beleid gericht op de korte termijn (direct of indirect) van invloed zijn op de omvang van het personeelsbestand of op specifieke onderdelen van de arbeidsmarkt, zoals de uitstroom van zorgverleners. Dit soort beleid heeft dan meestal op de kortere termijn effect.

Grote aanpassingen in de instroom op de korte termijn en flankerende beleidsmaatregelen gericht op veranderingen op korte termijn hebben vaak negatieve consequenties voor de praktijk. Daarom zal het lastig zijn om het totaal aantal zorgverleners (van een specifieke soort in Nederland) op de korte termijn sterk te veranderen en zal er een langere periode nodig zijn om het aantal zorgverleners aan te passen. Verder betekent dit dat wanneer er extra (korte termijn) beleidsmaatregelen worden geïmplementeerd, de mogelijke effecten van deze maatregelen ook gemonitord moeten worden en (liefst ex-ante) getest met bijvoorbeeld een simulatiemodel.

Acceptatie van het gebruik en de resultaten van lange termijn projecties
Wanneer beleidsmakers verwachten dat lange termijn projecties bijdragen aan een afstemming tussen vraag en aanbod in de arbeidsmarkt van de gezondheidszorg, dan is het belangrijk dat zij zich ook kunnen vinden in het advies dat hierover wordt gegeven op basis van de resultaten van arbeidsmarktprojecties. Als de verschillen tussen deze adviezen en de werkelijke instroom in opleiding te groot zijn, dan worden de voordelen van lange termijn planning niet ten volle benut. Daarom moeten beleidsmakers en andere belanghebbenden zich ervan bewust zijn dat dit soort maatregelen niet een onmiddellijk effect op het aantal zorgverleners zullen hebben.

Implicaties voor het Nederlands planningsmodel en –systeem
Recente data beter dan meer data
Tot voor kort werden de arbeidsmarktprojecties voor de Nederlandse arbeidsmarkt voor artsen gebaseerd op een historische dataperiode van 15 jaar. Omdat uit de resultaten van dit proefschrift bleek dat projecties gebaseerd op dataperiodes van 5 jaar nauwkeuriger zijn, worden deze arbeidsmarktprojecties tegenwoordig ook op korte dataperiodes gebaseerd.

Gevolgen voor dataverzameling
Om arbeidsmarktprojecties zo nauwkeurig mogelijk te maken is het belangrijk dat ze gebaseerd zijn op up-to-date data. Ontwikkelingen en trends die de basis vormen voor de verschillende model-elementen moeten daarom geregeld worden onderzocht en worden onderbouwd met zoveel mogelijk gegevens. Dit betekent dat soms aanvullende gegevens nodig zijn die geen deel uitmaken van het planningsmodel maar dit wel ondersteunen (bijv. informatie over de pensioenleeftijd van zorgverleners). De Nederlandse projecties die uitgevoerd worden met betrekking tot de arbeidsmarkt van huisartsen worden gebaseerd op de Nederlandse huisartsenregistratie waarin gegeven worden verzameld over Nederlandse huisartsen en hun werkzaamheden door middel van een vragenlijst.

Het verbinden van de projecties van verschillende beroepen door middel van een software tool

Om projecties van verschillende beroepen met elkaar te verbinden is een software tool ontwikkeld.

Met deze tool en het Nederlandse model voor personeelsplanning in de gezondheidszorg kan de haalbaarheid van een specifieke staff-mix (mix van verschillende beroepen) worden onderzocht. Met deze tool kan bijvoorbeeld worden onderzocht wat de gevolgen zijn van beleidsmaatregelen gericht op verandering van de staff-mix en evalueren of specifieke beleidsvoornemens haalbaar zijn binnen een vastgestelde periode.

Alternatieve toepassing van het arbeidsmarktplanningsmodel: het testen van beleidsplannen

Naast de primaire functie die het model heeft (het doen van aanbevelingen over de instroom in opleidingen), kan het model ook worden gebruikt voor een ander doel: het testen van beleidsplannen met betrekking tot de arbeidsmarkt van de gezondheidszorg, zowel voor als na de implementatie van het beleid.

Dit soort modelsimulaties kunnen adviescommissies en de overheid inzicht geven in de lange termijn gevolgen van beleid en de invoering van beleid ondersteunen.

Aanbevelingen voor toekomstig onderzoek

Niet alle onderdelen van het Nederlandse planningsmodel dat wordt gebruikt voor arbeidsmarktprojecties voor artsen zijn onderzocht in dit proefschrift. Ook zijn er diverse ontwikkelingen en factoren die mogelijk relevant zijn voor het plannen van de toekomstige arbeidsmarkt van artsen in het bijzonder, en de gezondheidszorg in het algemeen, maar die momenteel geen onderdeel uitmaken van het Nederlandse planningsmodel. Zowel de niet onderzochte delen van het model, als de mogelijkheden om extra of nieuwe ontwikkelingen en factoren op te nemen in het model zouden verder moeten worden onderzocht.

Voorbeelden voor toekomstig onderzoek zijn: 1) de evaluatie en het verbeteren van de vraagkant van het Nederlandse planningsmodel en het onderzoeken van nieuwe mogelijkheden voor zorgvraagprojecties of het verbeteren van het huidige besluitvormingsproces inclusief de inschattingen gemaakt door experts; 2) onderzoeken welke factoren, die op dit moment niet (expliciet) zijn opgenomen in het Nederlandse model, mogelijk wel relevant zijn voor arbeidsmarktprojecties voor de gezondheidszorg, zoals macro-economische ontwikkelingen; 3) de verdere mogelijkheden onderzoeken om het Nederlandse model uit te rusten voor het inschatten van huidige en toekomstige ontwikkelingen in de gezondheidszorg en haar arbeidsmarkt; 4) internationaal vergelijkend onderzoek kan bijdragen aan verdere verbetering van het Nederlandse model en systeem voor personeelsplanning van artsen.

Conclusie

Uit de resultaten van dit proefschrift blijkt dat het Nederlandse model voor arbeidsmarktplanning van artsen een in Nederland algemeen geaccepteerd model is. De meest relevante ontwikkelingen in de gezondheidszorg zijn opgenomen in het model die nodig zijn om vraag en aanbod te integreren voor één soort zorgverlener of meerdere soorten zorgverleners tegelijk. Bovendien zijn de projecties die met model gedaan kunnen worden nauwkeurig, zeker wanneer zij gebaseerd zijn op korte historische basisperiodes.

Het model is flexibel op verschillende fronten. Bijvoorbeeld in de toepassing. Het primaire doel van het model is het vormgeven van een advies ten aanzien van de benodigde hoeveelheid instroom in geneeskundige opleidingen om zo tot een toekomstig evenwicht in vraag en aanbod te komen. Maar daarnaast kan het model ook gebruikt worden om beleid ten aanzien van de arbeidsmarkt van gezondheidszorg te evalueren. Het model is generiek en daarin dus ook flexibel: het is geschikt om projecties te maken van alle soorten zorgberoepen.

Het model is ook flexibel omdat het bruikbaar is gebaseerd op verschillende hoeveelheden data. In principe is er niet heel veel data nodig om alle elementen van het model in te vullen. Er kunnen ook inschattingen van bijvoorbeeld experts worden gebruikt wanneer er niet genoeg data beschikbaar is (zoals in Nederland ook aan de vraagkant van het model wordt gedaan). Het heeft echter wel de voorkeur om zoveel mogelijk (historische) data te gebruiken om de modelelementen op te baseren, omdat dit de projecties nauwkeuriger maakt. De historische data perioden waarop de projecties zijn gebaseerd hoeven echter niet heel lang te zijn; het is belangrijker om recente gegevens te hebben dan veel gegevens, voor het maken van nauwkeurige projecties. Het uiteindelijke doel is wel om alle elementen van het model te baseren op historische gegevens en ontwikkelingen zodat deze specifieke elementen niet alleen afhankelijk zijn van de inschattingen van experts.

Sommige onderdelen van het Nederlandse model voor arbeidsmarktplanning van artsen hebben meer aanvullend onderzoek nodig. Dit geldt vooral voor de vraagkant van het model. Ook is er meer onderzoek nodig naar het eventueel includeren van bepaalde ontwikkelingen die in de huidige versie van het model niet opgenomen zijn, zoals macro-economische ontwikkelingen of omstandigheden en het verder integreren van arbeidsmarktplanning van verschillende soorten zorgverleners.

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Curriculum Vitae

Malou van Greuningen was born in 1982 in Woerden, the Netherlands. She studied Psychology at Leiden University and specialized in Social & Organizational Psychology. She graduated in 2007. In 2007, she started working at NIVEL - the Netherlands institute for health services research, in Utrecht. She worked on several research projects, initially within the research programs Patient Centered Care and Pharmaceutical Care, later within the research program Professions in health care and manpower planning. During these years, she acquired experience in various studies regarding patient experiences, but mainly regarding medical professions and medical manpower planning.
In 2010, she started the research described in this Ph.D. thesis, under the supervision of prof. dr. Dinny de Bakker, dr. Lud van der Velden and dr. Ronald Batenburg.
Since 2014, she is working at Vektis, as a researcher on the topic of mental health care.

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