CHAPTER 5

FORECASTING MODEL

The definition of a forecasting model and its implementation are core activities inside the planning process. The forecasting model and its results (projections' and scenarios' construction), allow the instauration of a political debate with the stakeholders' involvement, represent an essential instrument to support decisions and actions of the policy makers.

Defining the model of forecasting to be used is an important but also a very complex task to achieve.

The different aspects to be considered are: variables on supply and demand side, the algorithm to join them, the method to be used for the definition of the estimations, the assumptions to start from, the modalities for the presentation of the results (one ore more scenarios) etc.

It is essential to clearly outline the assumptions behind the planning tools, maintain a flexible approach and adapt the planning strategy as needed. Health workforce planning is not an exact science(22). To be most effective, health workforce planning and projections should be viewed as an iterative process in which the ability to measure and tell the performance story improves over time(23).

"The value of projections lies not in their ability to get the numbers exactly right but in their utility in identifying the current and emerging trends to which policy-makers need to respond. The requirements for providers are endogenously determined through the political or social choices that underlie the health care system. Only where the social and political choices about the access to care are explicit, can scientific methods be used systematically to derive requirements for health care providers in a particular population"(24).

(22) ONO T., LAFORTUNE G. AND SCHOENSTEIN M.: "Health Workforce Planning in OECD Countries: A Review of 26 Projection Models from 18 Countries", OECD Health Working Papers, No. 62, OECD Publishing, pag.11 – 2013 available at http://dx.doi.org/10.1787/5k44t787zcwb-en

(23) WHO, "Models and tools for health workforce planning and projections Human Resources for Health Observer", 2010

(24) Physician workforce supply in Belgium. Current situation and challenges. KCE reports 72C – pag. V - available at https://kce.fgov.be/sites/default/files/page_documents/d20081027309.pdf

Funded by
the Health Programme
of the European Union

Largely, each method can be linked to qualitative or quantitative methodologies. Both qualitative and quantitative approaches to health workforce planning have advantages and disadvantages. Individual methods should be chosen based on specific aims in the planning process. Beyond individual methods, however, integrating qualitative and quantitative approaches can strengthen the planning system.

FOR FURTHER DETAILS:

- *Focus on --> Insights --> Qualitative and quantitative forecasting methods in HWF planning: a brief discussion*

FINDINGS

The main approaches to health workforce forecasting include the supply projection approach, the demand-based approach and needs-based approach[25].

Each of the seven planning system has developed a specific model based both on the **supply projection** approach and on the demand side. Every system has a forecasting model based on supply projection: it means that, starting from the measure of the current stock and simulating the changes in the inflows and outflows, they forecast the future stock of health professionals.

From the **demand-based approach**, each forecasting model takes into account the population structure and estimates future changes of the population size. Then some models assume that the other demand patterns remain constant: i.e. health care utilization, the health service delivery, or the health expenditure growth. However, other models go further and try to estimate future changes in those patterns:

- *Simulation of future different levels of health service utilisation by age and sex, based on the health expenditure (a proxy for health service utilisation and human resources requirement), in the Belgian Forecasting model;*
- *Forecasting of possible future changes in population health status by using data on epidemiological trends and experts guidance on socio-cultural development and unmet care needs, in the Dutch Forecasting excercise;*
- *Estimation of future changes in GDP and health expenditure growth considering future economic growth as one of the main pattern affecting the demand of the health services, in the forecasting model of England, Finland and Norway;*

(25) Physician supply forecast: better than peering in a crystal ball? - D Roberfroid, C Leonard, S Stordeur - Human Resources for Health, 2009, 7:10 - available at http://www.biomedcentral.com/content/pdf/1478-4491-7-10.pdf

- *Future changes in morbidity and epidemiology in the English forecasting exercises.*

Various statistical methods that might be used to forecast the future supply and demand (classical time series analysis, stochastic time series analysis, multiple regression analysis, etc.). The **quantitative methods** used are mainly classical time series analysis. However, in England and Spain they adopt a systems dynamic approach that permits to manage typical features of the complex systems, like internal feedback loops and time delays that affect the behaviour of the entire system.

The seven planning systems also adopt different **qualitative methods** and techniques in the health workforce forecasting both to set some future scenario and to feed the forecasting model with information collected with qualitative techniques (Delphi, Brainstorming, Market survey, elicitation methods, etc). The Delphi method is a prevalent mixed method-qualitative technique used in the seven planning systems[26]. In addition to Delphi, specific surveys are conducted to forecast specific indicators or trend. For example: development of a mathematical approach for calculating FTE for self-employed persons in Belgium, a hearing process involving relevant stakeholders to forecast future demand in Denmark, The Sheffield ELicitation Framework (SHELF) used in England[27] to involve experts in the forecasting excercise.

FORECASTING NEED METHODS	SUPPLY	DEMAND
BELGIUM	CLASSICAL TIME SERIES ANALYSIS; DELPHI FOR GENERAL PRACTITIONERS; MATHEMATICAL APPROACH FOR CALCULATING FTE FOR THE SELF EMPLOYED.	CLASSICAL TIME SERIES ANALYSIS; EXTRAPOLATING CURRENT OBSERVED HEALTH CARE DEMAND USING FORECASTED EVOLUTION OF SIZE AND COMPOSITION OF THE POPULATION.
DENMARK	CLASSICAL TIME SERIES ANALYSIS LOGISTIC REGRESSION ANALYSIS FOR CALCULATING RETIREMENT AGE AND MORTALITY.	CLASSICAL TIME SERIES ANALYSIS.
ENGLAND	SYSTEMS DYNAMICS APPROACH.	SYSTEMS DYNAMICS APPROACH; DELPHI ELICITATION.

(26) Fellows, J. and Edwards, M. (2014) User Guidelines on Qualitative Methods in Health Workforce Planning and Forecasting. www.euhwforce.eu and http://www.horizonscanning.org.uk/publications/eu-joint-action-user-guidelines-on-qualitative-methods-in-health-workforce-planning-and-forecasting/

(27) Elicitation methods: Applying elicitation methods to robust workforce planning - http://www.horizonscanning.org.uk/publications/elicitation-methods-applying-elicitation-methods-to-robust-workforce-planning/

Funded by
the Health Programme
of the European Union

FINLAND	YEARLY TIME SERIES; ANTICIPATING VOCATIONAL COMPETENCE AND SKILLS NEEDS (VOSE PROJECT).	YEARLY TIME SERIES.
NORWAY	CLASSIC TIME SERIES ANALYSIS.	CLASSIC TIME SERIES ANALYSIS.
SPAIN	SYSTEMS DYNAMICS APPROACH.	SYSTEMS DYNAMICS APPROACH.
THE NETHERLANDS	YEARLY TIME SERIES; DELPHI AND CONSUMER PANELS.	YEARLY TIME SERIES; DELPHI AND CONSUMER PANELS.

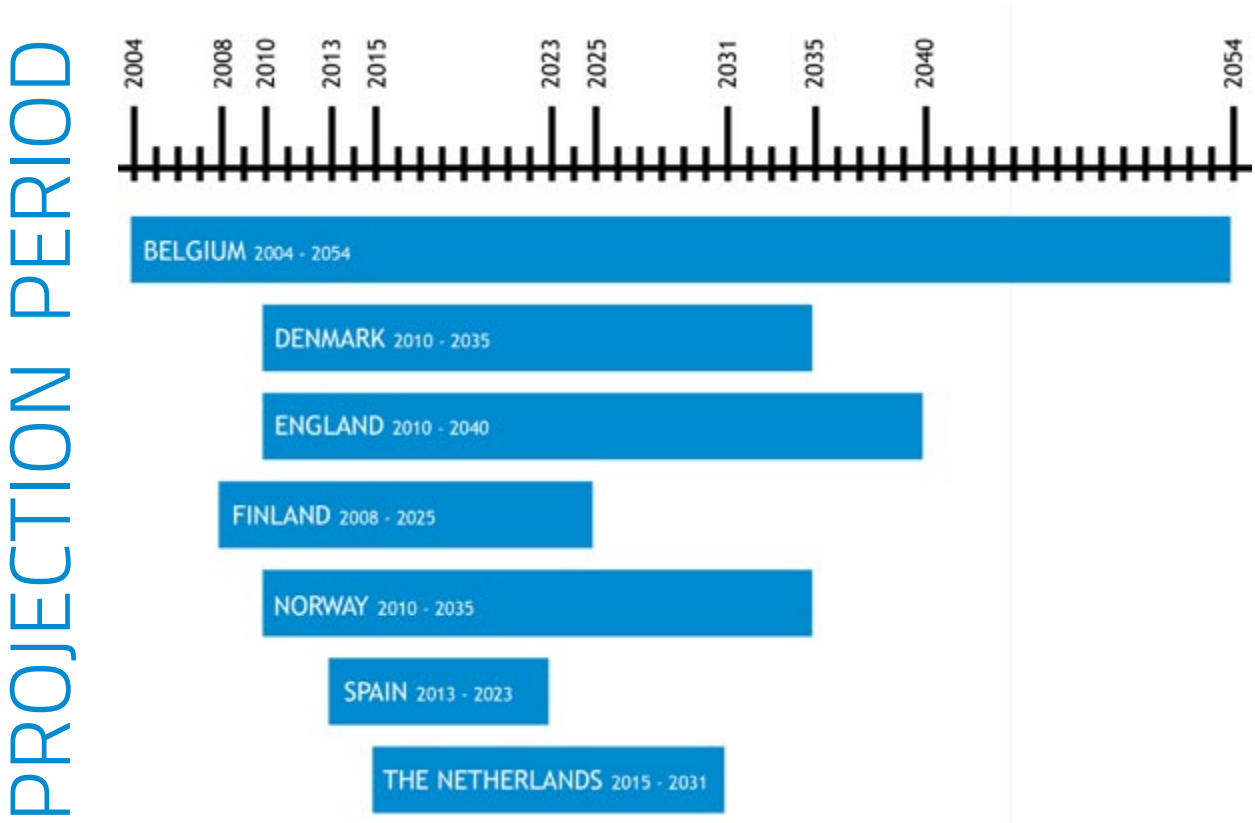
The result of the forecasting exercise is one or more scenarios showing the future situations. The HWF forecasting model may produce different scenarios also based on different patterns values (i.e. university training capacity, attrition rates, retirement patterns, migration flows). The scenario developed depends on the profession and on the purpose of forecasting exercise.

In most planning systems more than one scenarios is developed, a baseline scenario and one or more alternative scenarios. However, in some countries, such as Spain, only one scenario is explored.

The **projection period** might be different, depending on the parameters, professions considered, goals defined, etc. Indeed, the selected forecasting methodologies are distinguished by different projection period: 50 years in Belgium; up to 25 years in Denmark. In England, for medical doctors, it is 30 years, in Finland 15 years, in the Netherland almost 20 years, in Norway 25 years. In Spain, only for medical specialists, it is 10 years. Of course, the timeframe is related to the type of profession and also to the duration of education and training. For example, for medical doctors, the average duration of the basic training is 6 years. In average, 6 more years are necessary to entry in the labour market with a medical specialization; so, the minimum projection period for medical doctors is, more or less, 15 years, while for nurses 5 years could be sufficient. But there are also other reasons for this variability. For example, in The Netherlands there are subintervals with intermediate targets: the recommendations 2013 are thougt to be implemented by the field for the first time in 2015. Starting in 2015, the first target to reach the equilibrium between supply and demand is fixed in 2025 (the postgraduate training takes 6 years, so there are only 4 years remaining to adjust the equilibrium by a different inflow of medical graduates). The second “chance” to reach

Funded by
the Health Programme
of the European Union

the equilibrium is in 2031. In Belgium, the 50 years timeframe (2004-2054) permits to "follow" the cohort of students of 2004 until their retirement 45 years later. While in England they generally look 20 to 30 years ahead to consider the medium to long term, especially considering the typical timescales of healthcare education and training timeframes. England also considers longer timeframes, however beyond 30 years the level of uncertainty generally increases and the projections become less robust for example the future student intakes to medical and dental schools are looking forward, in the current study to 2040.



The frequency of the **updating** of the forecasting exercise is important in order to take into consideration changing circumstances, new data, new policies and programs.

That's why all analyzed models foresee a recurrent updating of projection. The frequency of updating can vary from one (in England) to a maximum of four years (in Finland). It depends on the organisation of the workflow in the planning process and if there are changes to be taken into account in the models assumptions. The majority of the Member States update the forecasting exercise every two or three years.

Despite the fact that the estimation of the migration flows is an ambitious challenge,

Funded by
the Health Programme
of the European Union

international mobility is nearly always included (directly or indirectly) in the forecasting models. With the exception of the Finnish and the Norwegian models, the other ones include migration flows as input variables in the forecasting model.

The estimation of migration flows is primarily based on historical data analysis, but it's also clear the need to combine the analysis of the past trends with the estimation and the insights of the experts because the international migration is strongly fluctuating with the labour market conditions in other countries and with the economic situation.

INTERNATIONAL MOBILITY - FORECASTING MODEL

COUNTRY	VARIABLES CONSIDERED IN THE FORECASTING MODEL	METHOD OF ESTIMATION
BELGIUM	MIGRATION INFLOW MIGRATION OUTFLOW (BUT VALUE SET TO ZERO)	HISTORICAL TIME SERIES ANALYSIS THE ESTIMATION IS ALSO BASED ON THE INSIGHTS OF THE CONSULTED EXPERTS
DENMARK	MIGRATION INFLOW MIGRATION OUTFLOW	HISTORICAL TIME SERIES ANALYSIS POSSIBLE ADJUSTMENTS AFTER DISCUSSION IN THE PLANNING AND FORECASTING COMMITTEES SUBCOMMITTEE
ENGLAND	MIGRATION INFLOW MIGRATION OUTFLOW MIGRATION FLOWS CONCERN BOTH THE INTAKES IN EDUCATION SYSTEM (STUDENTS AND TRAINEES) AND THE WORKFORCE	'- HISTORICAL DATA ANALYSIS - ESTIMATION BASED ON QUALITATIVE METHODS
FINLAND	VATTAGE (THE FINNISH GENERAL ECONOMIC MODEL) AS SUCH DOES NOT TAKE INTO ACCOUNT THE MIGRATION FLOWS	ANYWAY MIGRATION ARE CONSIDERED AS QUALITATIVE VARIABLE FOR DETERMINING THE FINAL INTAKES FOR INSTITUTES AND UNIVERSITIES
NORWAY	MIGRATED HEALTH PERSONNEL WITH FOREIGN CITIZENSHIP IS INCLUDED IN THE STOCK POPULATIONS, BUT THERE ARE NO SPECIFIC VARIABLE ON FUTURE MIGRATION PATTERNS	N.A.
SPAIN	MIGRATION INFLOW MIGRATION OUTFLOW	HISTORICAL DATA ANALYSIS

Funded by
the Health Programme
of the European Union

THE NETHERLANDS	MIGRATION INFLOW: 1) ANNUAL IMMIGRATION 2) GENDER FREQUENCIES IMMIGRATION 3) YIELD IMMIGRATION	ESTIMATION BY EXPERT GROUPS ON THE FUTURE NUMBER OF FOREIGN TRAINED HEALTH PROFESSIONALS HISTORICAL DATA ANALYSIS

Often specific assumptions on mobility trends are required to run the forecasting tool in order to make up for data not available.

There is a common meaning of immigration that is define as the number of foreign educated professionals estimate by the number of recognized qualifications. Different data sources are used in each Country including first of all the Authorization Register. Otherwise, there is a lack of information on emigration of professionals and this is why this variable is not included in some forecasting models.

INTERNATIONAL MOBILITY - DEFINITION, ASSUMPTIONS AND DATA SOURCES

COUNTRY	DEFINITION AND ASSUMPTION	DATA SOURCES
BELGIUM	FOR MIGRATION INFLOW: RECOGNITION OF FOREIGN QUALIFICATIONS FOR MIGRATION OUTFLOW: ASSUMED TO BE ZERO	FOR MIGRATION INFLOW: FPS PUBLIC HEALTH, PRIMARY HEALTH CARE & CRISIS MANAGEMENT (DG2) - DATA ARE AVAILABLE ANNUALLY AND ARE INTEGRATED IN THE BELGIAN CADASTER OF PRACTICING HEALTH PROFESSIONS FOR MIGRATION OUTFLOW: CURRENTLY NO RELIABLE DATA IS AVAILABLE
DENMARK	FOR MIGRATION INFLOW: FOREIGN EDUCATED DOCTORS BEGINS A SPECIALIST EDUCATION IN DENMARK AND FOREIGN EDUCATED DOCTORS THAT RECEIVE A SPECIALIST DEGREE ON THE BASIS OF A SPECIALIST EDUCATION COMPLETED IN DENMARK. MIGRATION OUTFLOW: DOCTORS EDUCATED IN DENMARK LEAVING DENMARK AFTER COMPLETION OF THEIR UNIVERSITY DEGREE	REGIONAL COUNCILS OF POSTGRADUATE MEDICAL EDUCATION (INFLOW) AUTHORIZATION REGISTER (INFLOW AND OUTFLOW)
ENGLAND	SPECIFIC ASSUMPTIONS FOR THE DIFFERENT FLOWS CONSIDERED	DIFFERENT DATA SOURCES

Funded by
the Health Programme
of the European Union

FILNLAND	DATA ON MIGRATION INFLOW AND OUTFLOW IS NOT USED AS ANY DIRECT INPUT TO THE VATTAGE MODEL	NATIONAL INSTITUTE FOR HEALTH AND WELFARE (THL) ON DATA FROM: - OFFICIAL STATISTICS OF FINLAND, EMPLOYMENT STATISTICS, STATISTICS FINLAND; - CENTRAL REGISTER OF HEALTH CARE PROFESSIONALS MAINTAINED BY THE NATIONAL SUPERVISORY AUTHORITY FOR WELFARE AND HEALTH (VALVIRA).
NORWAY	N.A.	N.A.
SPAIN	MIGRATION INFLOW: % SPECIALISTS' TITLE RECOGNITION BASED ON THE PAST TREND DOWN: ANNUAL REDUCTION 8%	MIGRATION INFLOW: - PAYROLL DATA OF REGIONS; - ECONOMICALLY ACTIVE POPULATION SURVEY (EAPS); - NATIONAL IMMIGRANT SURVEY (NIS) 2007 - SOCIAL AND DEMOGRAPHIC CHARACTERISTICS OF PERSONS BORN ABROAD; MIGRATION OUTFLOW: - 2010 NATIONAL STATISTICS INSTITUTE (INE) DATA (NON-SPECIFIC FOR DOCTORS)
THE NETHERLANDS	MIGRATION INFLOW: NUMBER OF FOREIGN TRAINED HEALTH PROFESSIONALS MIGRATION OUTFLOW HAS NOT BEEN MONITORED UNTIL 2014 BECAUSE IT WAS NOT CONSIDERED TO BE OF ANY SIGNIFICANCE BY ALL STAKEHOLDERS	- MEDICAL REGISTRATION COMMITTEE (RGS) FOR HISTORICAL INFORMATION ON THE ALLEDGED IMMIGRATION OF MEDICAL SPECIALISTS; - BIG REGISTER FOR HISTORICAL INFORMATION ON IMMIGRATION OF MEDICAL GRADUATES AND DENTISTS; - EXPERT ESTIMATIONS FOR FUTURE MIGRATION.

The forecasting model might produce different estimations along different service delivery settings or sectors of employment (**segmentations** of the forecasting). From this point of view, the seven forecasting models analyzed consider the health workforce differently. Most of them forecast the single profession (medical doctors, specialized medical doctors, nurses, dentists). But Finland and England look also at the whole system including public health and social care. Finally, in Belgium they develop projections on five sectors concerning nurses: hospital sector, nursing home sector, home care sector, other health care sector and non-health sector (including welfare and education).

The forecasting model might take into consideration possible **integration** between (vertical substitution) and/or within (horizontal substitution) **professional groups**. It is important to take into consideration various professional mixtures in the future: starting from the assumption that health care services may be provided from association of professionals different from those actual, but also from the consideration of the

Funded by
the Health Programme
of the European Union

increasing role of patients and service users, hypothesis that create different scenarios in terms of quantitative useful resources are advanced. In this sense one of the themes presently very debated is the horizontal substitution within doctors and nursing professions. In most of the forecasting models the mathematical tool is built separately for every profession. Just in England, in Netherlands and partially in Norway (vertical substitution only) the integration between and within professional groups are modelled. Considering the importance that the theme of skills mix and tasks shifting has for HWF future, at least following the literature in the field, the lack of such a parameter in many forecasting models maybe shows difficult to forecast future scenarios in which the organisation of work should be different from the present one.

COUNTRY	INTEGRATION BETWEEN PROFESSIONS	DESCRIPTION
BELGIUM	NO	
DENMARK	NO	
ENGLAND	YES	ROLE SUBSTITUTION AND SKILL MIX
FINLAND	YES	DIFFERENT OCCUPATIONAL CATEGORIES
NORWAY	NO	

Funded by
the Health Programme
of the European Union

SPAIN	NO	
THE NETHERLANDS	YES	VERTICAL INTEGRATION (FROM MEDICAL PROFESSIONS TO NURSES AND FROM DENTISTS TO ORAL HYGIENISTS) AND HORIZONTAL INTEGRATION (FROM MEDICAL SPECIALISTS TO EACH OTHER AND TO GENERAL PRACTITIONERS)

A forecasting model might take into account interaction between demand and supply and estimates specific effects such as a **supply-induced demand** (feedback effects[28]). But, at current time, except for the English model, no one of the selected forecasting model considers at present this interaction. To mention the Belgian case, for which the effect of the supply-induced demand is one of the initial hypothesis of the planning system, that's why a parameter 'supply-induced demand' is available but not currently activated in planning scenarios.

Human resources inside a health system represent the central element both for the direct relation with the quality and quantity of cures supplied by the system (and so system coverage and cures level) and for the costs represented by these resources. So the health workforce projections might be put in **relationship with others health system goals** such as access to care, quality of care and costs containment. But most of the models analysed do not report projections taken from the model with other goals with a few exceptions: in England, for example, the health workforce projections are looked in relation to outcomes, cost-effectiveness and affordability, while in The Netherlands the projections are put in relationship with the goal concerning the access to care.

Finally, the **assessment of the forecasting model** is very important. The calculation of the goodness of fit and of the forecast accuracy are necessary to make an objective evaluation of the results. But the assessment of the forecasting model and of its results seems to be a challenge for some of the planning system considered that don't have any kind of evaluation process. Tests on historical data seem to be the most common technique used for evaluation. But in some cases sensitivity tests also are made in order to assess the forecasting model (for example in the Dutch system).

(28) See http://www.systemdynamics.org/DL-IntroSysDyn/feed.htm for some examples and definitions.

Funded by
the Health Programme
of the European Union

COUNTRY	ASSESSMENT OF THE FORECASTING OUTPUTS	DESCRIPTION
BELGIUM	YES	FOLLOW-UP COMPARISON
DENMARK	NO	
ENGLAND	YES	COMPARING THE RESULTS WITH PREVIOUS SIMULATIONS; BACKCASTING; SHARING RESULTS WITH RELEVANT STAKEHOLDERS; ASSESSING THE SENSITIVITY OF THE MODEL OUTPUTS TO THE INPUT DATA.
FINLAND	YES	PEER REVIEW PROCESS
NORWAY	NO	
SPAIN	NO	
THE NETHERLANDS	YES	TESTS ON THE HISTORICAL DATA; TESTS ON THE RELIABILITY OF THE MODEL; SENSITIVITY TESTS.

FOR FURTHER DETAILS:

- *Focus on --> Details of the seven planning systems --> Forecasting model*

Funded by
the Health Programme
of the European Union