Labor Health Shortage and Future Prospects for the Medical Workforce in Morocco

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Abstract

This paper looks at the current situation of health deficits and shortages in Morocco with a focus on the roles of medical education and prospects for the health workforce for the period 2010-2030. The attained results from both trend description and simulations of patterns show major shortages relative to the needs. The existence of these trends appeals for further cooperation in the areas of health care through emphasis on medical education and research. These outcomes appear to be promising for the pursuit of satisfying the needs of a growing population and demand for health care.

Keywords: Morocco-Health Workforce-Simulations

Introduction

This paper is a follow-up to the characterization and estimation of the health workforce over the period 2010-2030 (Zouag and Driouchi, 2014) that is a chapter in the book by Driouchi (2014). The current paper starts with the characterization of the situation of health care in Morocco in terms of demand, supply with emphasis on the role of medical education in providing the

economy with health workforce. This is followed by simulations of the major stocks and flows with health professionals in relation to increasing the per year number of graduates from medical schools.

The fact that a shortage in the number of medical doctors exists is largely admitted and many countries tried projecting their needs in terms of physicians and finding solutions in order to achieve an increase in the number of doctors. The United States have a good forecasting model and there is evidence from a Spanish paper that Spain too tries to improve this process in order to simulate and forecast and, thus, control the increase of the number of doctors.

The present article is composed of four sections. The first one looks at the past contributions to the estimation of future needs in terms of medical doctors. The second part introduces a description of the Moroccan health system. The third section introduces the theoretical framework used in addition to the data mobilized. The last section focuses on the attained results with their discussion.

I.   Literature Review

Considering the Millennium development goals, it is agreed that the 2015 deadline is set to achieve the eight objectives. Under the sub-goals, there is a reference to the improvement of the country coverage in medical doctors. This is to confirm that there is a shortage in physicians. As a result, countries need to measure their shortage, correct it and find ways to prevent it in the future, through simulations that account for the number of needed physicians in a given future date. Scheffler, Liu, Kinfuc and Dal Poz (2008) used 158 countries' updated information, from the World Health Organization (WHO) databases, about the supply of medical doctors over a period of 20 years (1980-2001) to project the size of the future global need for, supply of and demand for physicians up to 2015, given that it is the target date for the MDG. They used an exogenous health

benchmark in order to decide on the sufficiency of number of medical doctors required to achieve the MDG where demand variables are based on the country's economic growth, that triggers an increase in worker salaries and thus increase their healthcare expenditures. Scheffler et al. (2008) used two approaches to modeling the requirements in medical doctors. The first one is a needs-based model that decides on the number of doctors per capita to cover up to 80% live births by skilled attendance. The second one is economic-based and it projects the number of physician per capita that will probably be demanded based on the country's economic growth. The authors compared the demand-based and need-based estimates with the forecasted supply of physicians which is inferred by projections based on historical trends. The results of this study identify serious shortages of medical doctors in the WHO African region by 2015. Among the policy implications suggested in this WHO study was increasing medical doctors' training or discouraging migration (Scheffler et al., 2008).

Barber and Lopez-Valcarcel (2010) also created an application to simulate Spain's supply and demand/ need in terms of medical doctors per medical specialty (43) using system dynamics and computed the supply and deficit/ surplus of physicians. The authors defined different scenarios whose parameters were variables controllable by health planners and included labor market, demographic and education variables in their models. Delphi method was also used to establish the specialists needed ratio per 1000 residents. The results of their simulation described a 2% increase in the deficit in terms of medical specialists by 2025 (Barber and Lopez-Valcarcel, 2010). Therefore, Barber and Lopez-Valcarcel (2010) suggested an increase in the number of students registered in medical schools, a redesign of training programs to allow for mobility among specialties and a rise in the immigration of doctors from the new European Union members and Latin America.

The USA efforts in this field are old based on the model provided by the Medical Education National Advisory Committee needs-based model (U.S. Congress) in 1980 and the study done by Greenberg and Cultice (1997) in forecasting the need for medical doctors. The Health Resources and Services Administration's Bureau of Health Professions (BHPr) established a model that projects the needs for physicians decades into the future, using data from the 1989 National Hospital Discharge Survey, the 1980 National Medical Care Utilization and Expenditure Survey and the 1985 National Nursing Home Survey and assumed that recent trends shall continue in the future. The model identified the requirements in terms of physicians by projecting demographic-utilization-determined conditions for physician specialties (18 specialties). In other terms, the BHPr physician requirements model operates in a world where there are three intervening factors that are the population, the physician specialty and the care setting context. The simulation, according to Greenberg and Cultice (1997), is more useful for monitoring trends and economic factors that are likely to affect the exploitation of medical specialist doctors than for providing policy implications. The simulation leads to the use of scenarios to simulate the need for physicians. These scenarios include (A) population growth plus demographic change with enrollment patterns being constant, (B) free-for-service extreme or (C) the managed care extreme. The ability to predict the need in terms of physicians and specialty is important in this model for two reasons: (1) when a specific specialty experiences a surplus of physicians, health costs increase, (2) a deficit in physicians is likely to keep underserved population (minorities mostly) lacking access to basic healthcare services (Greenberg and Cultice, 1997).

The sixteenth report by the Council on Graduate Medical Education (COGME, 2005) also studies ways to make demand and supply of medical doctors converge in the USA. The report's recommendations include the yearly increase in the number of physicians entering residency

training from 24,000 in 2002 to 27,000 in 2015, the increase in total enrollment in US medical schools by 15% by 2015, the establishment of systems that track and re-assess the supply, demand, need and distribution of medical doctors and develop programs that would correct misdistribution of physicians, improve access to healthcare services for the underserved population, promote workforce diversity and appropriate specialty employment (COGME, 2005).

The RAND Europe report, in collaboration with the London School of Hygiene and Tropical Medicine, stresses the importance of healthcare planning that includes the long-term planning of the necessary number of medical doctors. The report develops and validates a structure that would assess and improve healthcare planning. The criteria of the structure include (1) vision, (2) governance and (3) intelligence (Fazekas, Ettelt, Newbould and Nolte, 2010). These assessment criteria do focus on planning as a process that involves several entities related to the health sector governance. The report is based on a literature that deals with planning in countries such as Germany, Austria, Canada and New Zealand. It is unrealistic to generalize the best practice over all countries' studies because of differences in the countries' health systems in terms of complexity and diversity. It was found that planning in healthcare is determined by a range of institutional, political and cultural factors and that its success is influenced by the support of an appropriate governance framework. Besides, planning in healthcare is also influenced by broader political goals (economic sustainability) as well as wider socio-economic context (Fazekas et al., 2010).

A study done to improve global health, by looking for successful health forecasting models and forecast health related variables for the next 50 years, shows that health outcomes are the result of influences from economic, demographic and education factors. The International Monetary Fund and the World Bank base their studied on the fact that national GDP per capita is one of the most important determinants of health. This has been proved through a study that attributed 50% of the

reductions in mortality to improved living standards Hughes, Kuhn, Peterson, Rothman and Jose (2011). Being a new activity, modeling and forecasting health outcomes seems to focus on the disease and patient side of the equation by dealing with life expectancy and age-specific mortality forecasting through the model (Hughes et al., 2011). However, it is suggested that more focused modeling is being considered that connects forecasting with policy analysis and thus allows more planning in terms of sufficient density of health personnel. Besides that, more modeling will include demographic, economic, environmental, sociopolitical and other systems (Hughes et al., 2011).

II.   Introduction to the Moroccan Health System

Health professions are regulated by a number of laws that are all listed on the Ministry of Health web site. Thus, there are regulations for doctors and auxiliary medical personnel such as nurses and other paramedical personnel. Therefore, exercising a medical profession is regulated by law 10-94 and its decrees of implementation, doctors' code of conduct reorganized by May 7th, 1949 decree, Dahir 1-84-44 related to the establishment and functioning of the national order of medical doctors and decree 2-84-780. The pharmacist profession, on the other hand, is regulated by Dahir 1-06-151 of 22 November 2006 bearing promulgation of law 17-04, bearing code of drug and pharmacy, pharmacists' code of conduct which was reorganized, approved and implemented by decree 2-63-486 of 26 December 1963, Dahir 1-06-151 of 22 November 2006 related to pharmacists order and decree 2-75-863, and the regulation of the pharmacy inspection (Ministry of Health, 2010). Concerning dental practice, it is regulated by the 1960 Dahir and implementation decrees, the national order of dental doctors and the code of conduct of the dental profession (Ministry of Health, 2010). As for the nurses' profession, it is regulated by decree 1-57-008 of 19

February 1960. The other paramedical professions are also regulated by decree such as the midwife occupation and herbalist profession that are regulated by decree 1-59-367 of 19 February 1960 (Ministry of Health, 2010).

Concerning basic health statistics, Morocco's performance is still weak in comparison to other countries of the MENA region. It was ranked 18 over 22 MENA countries in terms of life expectancy, child mortality, overweight, malnutrition, HIV/AIDS, expenses, hospital accreditations, doctors and hospital beds (Kjeilen, 2008). The Moroccan health system is defined by geographic differences, management of expenses and revenues and capacity. There are major differences in quality between the rural and urban sides of Morocco. The public services dominate the Moroccan health sector but private and semi-public services also exist. By 2008, the Moroccan medical system included 122 hospitals, 2400 health centers and four university hospitals just before the inclusion of the 5th university hospital of Oujda (Teach Mideast, 2008). Numbers from 2009 WHO report showed that 83% of the population has improved access to drinking-water sources and 72% can access improved sanitation (WHO, 2009). A study that took place in Morocco concluded that a project to improve access to water has yielded direct health benefits to the younger population by significantly reducing the prevalence of diarrheal diseases among children aged less than five years. It also led to longer-term benefits by improving school registration and retention rates for girls (Martin, 2008).

The mortality rate caused by tuberculosis among HIV-negative people is 8 per 100000 people and among HIV-positive people is 0.1 per 100,000 in 2007 (WHO, 2009). Around 95 adults over 15 years old per 100,000 of the Moroccan population are infected with HIV/AIDS and the infant mortality rate continues to drop, to 36 deaths per 1,000 births according to the 2009 WHO report, which is still high compared to other countries of the MENA region (Kjeilen, 2008; Teach Mideast,

2008). According to the 2009 WHO report, the number of physicians per 100,00 people is 5, the number of nursing and midwifery personnel per 10,000 people is 8 and the density of dentistry personnel is 1 per 10,000 people during 2000-2007.

The progress observed in different health services indicators shows that the supply of health assistance reflects an increasing demand in terms of patients' increase through the growth of the Moroccan population in need of medical services especially the youngest and the over 60 years old people. It also reflects an increase in the urbanization rate meaning the number of people living in urban areas, the increase in life and health expectancy at birth, the evolution of the human development index (HDI) and the increase in income per capita (Table 1).

Table 1: Indicators of the Moroccan demand for health services

	Years	Indicator
	1990	65
Life expectancy at birth (years)	2000	70
	2007	72
	2010	71.8
Healthy life expectancy at birth (years)	2007	62
Neonatal mortality rate (per 1000 live births)	2004	24
Total population ('000s)	2007	31224
% population under 15	2007	29
% population over 60	2007	8
Population annual growth rate (%)	1987-1997	1.7
Population annual growth rate (%)	1997-2007	1.2
	1990	48
Population living in Urban areas (%)	2000	55
	2007	56
Gross National Income ($ per capita)	2005	1060
Gross National Income per Capita (PPP 2008 $)	2008	4628
Human Development Index (HDI)	2003	0.63
Human Development Index (HDI)	2010	0.56

Source: WHO, 2006; HDR 2005, 2010; NationMaster.com (Morocco, 2005)

The supply of health services concerns the development of medical hospitals, health centers in rural areas, equipment and new technologies. The Moroccan health system includes the public sector (health ministry and health services of royal armed forces), the semi-public sector (mutual insurance companies and entities of the CNSS) and the private sector comprises medical doctors, dentists, pharmacists and medical auxiliaries. An informal sector also exists and is based on traditional treatments. The national health system involves a network of structures that are rural dispensaries, communal health centers; communal health centers with childbirth module, local hospital, urban health centers, reference centers for family planning, diagnostic centers specialized in tuberculosis and laboratory of epidemiology and environment hygiene (Saidi, 2009). The health coverage entities in Morocco (Saidi, 2009) are known as the (1) National Social Security Fund (CNSS) that covers healthcare costs for active and retired employees of the private sector and their rightful dependents, the (2) National Fund for Social Welfare Works (CNOPS) that covers healthcare costs for active and retired employees of the public sector and their rightful dependents and the (3) National Agency of Medical Insurance (ANAM) that is responsible for regularizing the Compulsory Medical Insurance (AMO) and for managing the Medical Assistance Regime (RAMED).

In an assessment of the advancement towards the realization of the millennium development goals (MDGs), the 2010 fact sheet of the WHO (2010) gives the to-day achieved results generally including Morocco. This includes the decrease in the number of children dying (MDG4), the decrease in the number of underweight children (MDG1), the increase in the number of women being attended by skilled health professionals while giving birth (MDG5), the decrease in the number of people contracting HIV (MDG6), the increased success in tuberculosis treatment

(MDG6) and the improvement in drinking-water access (MDG7). With the deadline on reaching the MDGs set for 2015, it seems that Morocco's progress is still slow.

To achieve progress in the health sector in Morocco, many factors and actors should be taken into consideration such as education of doctors in Morocco, research, emigration patterns, medical cooperation and the health needs of Morocco.

Medical education is among the longest higher education in Morocco. The medical studies include three parts and take place in one of the five universities that have a medical and pharmaceutical college associated with one of the five university hospitals (Table 2). The total duration of studies varies between 8 (general medical studies) and 13 years (specialty studies).

Table 2: Medical Public Universities in Morocco (FMP, 2010)

Medical University	Settlement Date	Related University	CHU
Faculté de Médecine et de Pharmacie de Rabat	16 October 1962	Université Mohammed V - Souissi	CHU Ibn Sina
Faculté de Médecine et de Pharmacie de Casablanca	September 1975	Université Hassan II - Ain Chok	CHU Ibn Rochd
Faculté de Médecine et de Pharmacie de Marrakech	October 1999	Université Cadi Ayyad	CHU Mohammed VI
Faculté de Médecine et de Pharmacie de Fès	20 October 1999	Université Sidi Mohamed Benabdellah	CHU Hassan II
Faculté de Médecine et de Pharmacie d'Oujda	13 October 2008	Université Mohamed Ier	CHU Oujda

These studies include a first cycle of pre-clinical sciences (first and second year), a second cycle of clinical sciences (third to fifth year), a sixth year full-time external practice with the University Hospital Center (CHU), a seventh year training as intern in peripheral hospital and an eighth year for preparation and defending the doctoral thesis.

The 2010-2011 seats for the five medical universities are identified in a note from the ministry of national education, management training and scientific research (MNEMTSR, 2010). Table 3 shows the needs in terms of potential students.

Table 3: Number of Seats in Medical Public Universities for 2010-2011 (MNEMTSR, 2010)

University	Total	Civil	Military
Medical and Pharmacy Studies			
Rabat	500	412	88
Casablanca	450	450	
Marrakech	275	275	
Fès	275	275	
Oujda	200	200	
Dental Studies			
Rabat	130	110	20
Casablanca	130	130	

A new school of medicine will soon open its doors to young and future doctors in Casablanca. The new medical school will collaborate with the already existing School of Medicine of Casablanca and will be part of the International University of Casablanca. The new school is built in the neighborhood of the newly inaugurated Sheikh Khalifa B. Zayed private hospital. This will allow the new school's third year to pursue for internships at the hospital.

Another private medical school is also planned within the International University Averroès of Settat. The school will also have a medical center.

These developments are taking place within an environment where public policies are aiming at pushing the privatization process in medical care through allowing investors participate to the creation of new hospitals and clinics.

In Morocco, the national union of the doctors of the private sector (Syndicat National des Médecins du Secteur Libéral, SNMSL) stated the problems arising from the private practice of medical services. The problems are both internal and external. The internal ones include (1) disordered competition between colleagues of the same sector (absence of dialogue about fees while some call upon commission agents), (2) establishment of illegal conventions with social work organisms

of different delegations, (3) opening of private structures to academic people and (4) disregard of regulations governing the practice of private medical services (SNMSL, 2003).

The external problems include (1) unfair competition from state establishments, institutions of benevolence (Moroccan Red Cross), hospital settlements of the ONE, ONEP, medical services of certain administrations, local government agencies…etc., hospital settlements of the CNSS and private hospitals without membership. These latter do not pay taxes, they can get the land for a duration of 99 years against a symbolic price, personnel is paid by the government and their practice does not necessitate official authorization. The second problem concerns (2) the lack of guidance framework of private sector investments, supported by the population needs and damping possibilities by the deadlines set by the finance law. Then, (3) the government does not encourage private sector participation in the general health policy as it is the case for the other sectors. The other problems deal with (4) taxation and failures, (5) delivery of drugs by dispensaries without prescription, (6) the fight against the illegal medical practice is not efficient in spite of repeated complaints and (7) the informal privatization of the public sector puts the private sector in a bad competing position in terms of medical acts' costs applied in each sector (SNMSL, 2003).

Some of these reasons and others led to the pattern of emigration of medical doctors from Morocco to the European Union and the United States that experience an important lack in medical doctors. However, there is also the reverse movement of medical doctors from developed countries to Morocco which explains the existence of foreign doctors in the country. In 2005, the number of foreign medical doctors and pharmacists was 619 foreigners (Khachani, 2010). This market opening is due to free trade agreements with the European Union and the United States. However, Moroccan doctors complain that they were not consulted and they fear the expected competition especially given the predicted draconian conditions of the health sector (B.A., 2009). Among the

factors leading to the emigration of medical doctors is the promise of brain gain enjoyed by both sending and receiving countries. Driouchi and Kadiri (2010) state that the countries under lower gains such as Morocco can enhance their capacity of education of medical doctors as a way to improve their overall benefits.

Research in the domain of medical services is very important and can improve the status of health in Morocco. According to the ministry of health the position of researcher/ professor is filled by 1191 specialist doctors that are distributed in the regions where the first four hospital universities exist (Ministry of Health, 2009). New developments are also expected in relation to the new medical schools and new hospital systems.

III. Empirical Method Used and Data

In Morocco, the number of physicians per 10,000 people was less than 6 in 2007 as shown in Table II.1 (WHO/EMRO, 2009). The World Health Report of 2006 also focused on the human resources needed to improve health and thus to help achieve the Millennium Development Goals (MDG) by 2015. Therefore, in 57 countries, it was estimated that there is a shortage of around 2.3 million medical doctors, nurses and midwives (Table 4).

Therefore, many countries including Morocco do have shortage in the number of physicians and need to measure their deficiency and model their future needs in terms of the medical personnel.

Table 4: The Density of Human Resources for Health per 10,000 people

Human Resources for Health category	Number	Density per 10000 population	Year
Physicians	**18269**	**5.92**	**2007**
Generalists	10006	3.24	2007
Specialists	8263	2.68	2007
Nurses	**22250**	**7.44**	**2004**
Registered nurses	11520	3.85	2004
Enrolled nurses	10730	3.59	2004
Midwives	**2078**	**0.7**	**2004**

Dentists	**3091**	**1.03**	**2004**
Pharmaceutical personnel	**7366**	**2.46**	**2004**
Pharmacists	7212	2.41	2004
Pharmacy technicians	154	0.05	2004
Physiotherapist	**377**	**0.13**	**2004**
Medical assistants	**356**	**0.12**	**2004**
Laboratory technologists	**827**	**0.28**	**2004**
Radiographer	**643**	**0.22**	**2004**
Environmental and public health officers	**737**	**0.25**	**2004**
Administrative and support staff	**9500**	**3.18**	**2004**
Skilled administrative staff	3200	1.07	2004
Other support staff	6300	2.11	2004

Source: Human Resources for Health Mapping, Eastern Mediterranean Region Observatory (EMRO, 2009)

The number of medical doctors in important in terms of preventing complications during birth and immunization programs (WHO, 2006).

Besides this, medical schools are very selective in Morocco and thus the number of medical graduates is not up to the general social and economic needs in Morocco. There are many factors that impact the availability of enough physicians per population number. This can include the unavailability of doctors willing to work in faraway regions or in rural areas, the case of doctors who retire, leave or emigrate. The following diagram shows the links and outcomes of such an approach.

Stock of medical doctors at a given time
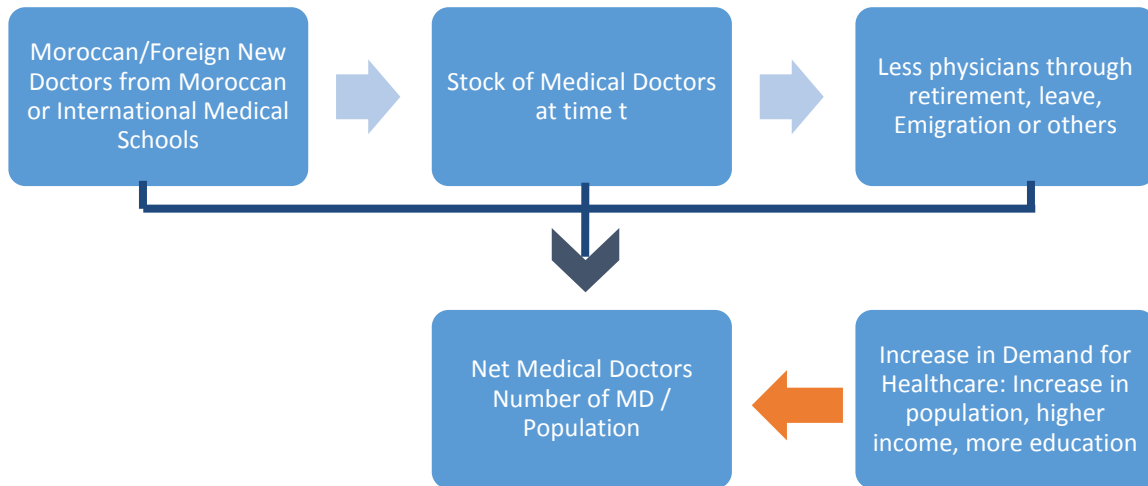
Scheffler et al. (2010) model can be a good start for the development of a Moroccan simulation projecting the number of medical doctors in 2015 or later. The model is based on the assumption that there is only one specialty which is being a medical doctor, setting aside all the specialties. The data is based on WHO Moroccan databases and the Moroccan Ministry of Health regional health-related data. Data about economic growth, demographics, household income and regional (urban/ rural) development is also needed. The data used in the simulation covers the period of 1995-2009. It has to be noted that the method used here is not that different from the one that is clearly developed in a recent book about the African labor market for health workers (Soucat, Scheffler and Ghebreyeus, 2013). It starts with the assessment of needs through incorporating contextual factors specific to each country for the determination of the supply of health workers. From the figure above, it is observed that the stock of medical doctors in a given year depends on the inflows and outflows of physicians that happen that same year such as:

$$S_t = \int_0^t \left(Inflows - Outflows \right) ds + S_{t_0} \text{ or}$$

$$\frac{dS}{dt} = Inflows(t) - Outflows(t)$$

Where S_t is the stock of medical doctors at time t.

After determining the net of medical doctors, the projected developments in term of demand for health care should be taking into consideration to measure its impact on physicians' need. The Moroccan minister of health explained that the number of medical, paramedical and administrative staff increased by 20.6% from 2007 to 2009 and announced the creation of 2,000 new positions under the current finance bill. In addition, the ministry started a new health care plan to train 3,300 doctors by 2020 (Magharebia, 2010).

In order to achieve the planned number of medical doctors by 2015 (MDGs), 2020 or later, it is necessary to define the trends of the most important variables influencing the results. The number of medical doctors in Morocco in a yearly basis is needed. The Moroccan Ministry of Health "Santé en chiffres 2009" provides the number of medical doctors (specialists and generalists) in 2009. The values of this variable during 1999-2007 are provided by the Global Health Workforce Alliance (2010) from the Ministry of Health (GHWA, 2010). The stock of medical doctor migrants is also needed in a yearly basis. It is retrieved from the Docquier and Bhargava (2006) database about medical brain drain from 1999 to 2004. The rate of retirement is assumed to be a yearly average of 2.5% and is computed directly from the number of medical doctors. In 2005, the number of retiring medical doctors has increased by 371 (Boudarham, 2005) because of the voluntary leave campaign that took place that year when 236 specialists and 135 generalists voluntarily retired (Boudarham, 2005). Therefore, the yearly addition to the number of medical doctors can be computed as the new number minus the actual number of medical doctors plus the number of retired doctors and migrant doctors (Table 5). The value of total population is also needed in a yearly basis. The values were retrieved from the World Bank (WB) data bank (2010) for the period 1999-2009 and from the Human development Report for 2010 value and projection values of 2015 and 2020 (HDR, 2010).

It is then possible to compute the number of medical doctors per 10,000 people on a yearly basis. There is also the distribution of the population over the Moroccan land that can be needed when assessing the distribution of medical doctors over the rural and urban areas of Morocco. It is computed yearly given the Moroccan area of 446,300 square Km of land (WB, 2010) and the total population each year.

The other set of variables includes economic, health education and growth data that would be used as inflows into the model (Table 5). The values of GDP (US$) and GDP per Capita (US$) are retrieved from the World Data Bank of the WB. The values of the Gross National Income per Capita are also retrieved from the World Data Bank on a yearly basis from 1999 to 2009. In addition, data about the urban population values as percentage of total population is also retrieved on a yearly basis from the World data bank (WB, 2010). Health expenditures per Capita (PPP US$) values are taken on a yearly basis from the Human Development Reports of 2006, 2005, 2004, 2003 and 2002 for the period 2000-2004. Then, the number of graduates in health is also taken from the World data bank (WB) for the years 2001 and 2005-2009 and includes all human resources for health.

IV.   Results and Discussion

The idea is to define the trends of the different variables that are either inflow of outflows that influence the rate of physicians per population. After doing the back-casting, the trends allow the forecasting of future values until 2030. The trends are defined for key variables in Table 5 by conducting some linear regressions on the yearly data where X represents a yearly index.

Table 5: Trends of key variables

Variable	Equation	R^2	Obs.

Medical Doctor Number	$MDNumber = 12898.52 + 684.69(X)$ $\quad\quad\quad\quad\quad\quad (231.178)\quad\quad (41.93)$	0.9672	10
Medical Doctor Migrants	$MDMigrants = 1844.76 + 73(X)$ $\quad\quad\quad\quad\quad\quad (175.26)\quad\; (20.999)$	0.9888	6
Total Population	$TotalPOP = 27.6 + 0.3859(X)$ $\quad\quad\quad\quad\quad (88.98)\quad (15.388)$	0.9402	16
Urban Population (% of Total)	$UrbanPOP = 51.2974 + 0.5916(X)$ $\quad\quad\quad\quad\quad (81.54)\quad\quad (11.63)$	0.8995	16
Health Expenditures per Capita (PPP $)	$HealthExpend = 174.4 + 13.9(X)$ $\quad\quad\quad\quad\quad\quad (19.58)\quad (3.8225)$	0.7729	5
GDP per Capita (Current US $)	$GDPperCapita = 938.09 + 159.5036(X)$ $\quad\quad\quad\quad\quad\quad (10.65)\quad\quad (11.7564)$	0.9258	12
GNI per Capita (PPP int. $)	$GNIperCapita = 2310 + 205.64(X)$ $\quad\quad\quad\quad\quad\quad (51.43)\quad\quad (27.08)$	0.9865	11
Health Graduates (000s)	$HealthGraduates = 64.55 + 38.795(X)$ $\quad\quad\quad\quad\quad\quad\quad (1.03)\quad\quad (4.61)$	0.8018	6

The observed past trends are then projected into the next 30 years approximately to provide an idea about the outcomes of health given the movement of some variables such as migration and retirement of physicians. The forecasted number of additional medical doctors for the year 2015 is 4,204 that is greater than the wished for number of 3,300. However, this is just a projection of past trends where other variables, such as the retirement rate, were assumed to not change over the years.

Other results accounting for retirement could be attained to show that more medical doctors are needed. Furthermore, when considering the densities of medical doctors in relation to different territories with the inclusion of income increase, health and social security coverage and the new medical needs of the population in the coming years, the projected numbers of medical doctors are expected to be higher.

This means that the baseline scenario shows already important deficits in medical doctors in Morocco for the coming years. This can only increase under the current emigration flows and the retirement rates. Also, these are global figures where increases can further be obtained when looking at series of medical specialties that are now poorly populated or absent (Tables 6 and 7).

Table 6: Projections of the first set of variables

Years	MD Retirement	MD Migration	MD Number	Period MD Addition	Total POP (Millions)	POP density / sq. Km of land	Physician / 10,000 people
1999	316	1842	12647		28.5	63.8	4.4
2000	326	1905	13045	2556	28.8	64.6	4.5
2001	358	1998	14314	3501	29.2	65.4	4.9
2002	374	2085	14970	3012	29.5	66.1	5.1
2003	408	2137	16307	3796	29.8	66.8	5.5
2004	419	2197	16775	3012	30.2	67.6	5.6
2005	801	2283	17188	3029	30.5	68.3	5.6
2006	443	2356	17716	3611	30.9	69.1	5.7
2007	457	2429	18269	3352	31.2	70.0	5.9
2008	477	2502	19061	3677	31.6	70.8	6.0
2009	481	2575	19250	3168	32.0	71.7	6.0
2010	511	2648	20430	4236	32.4	72.6	6.3
2011	528	2721	21115	3843	32.6	73.1	6.5
2012	545	2794	21800	3933	33.0	73.9	6.6
2013	562	2867	22484	4023	33.4	74.8	6.7
2014	579	2940	23169	4114	33.8	75.7	6.9
2015	596	3013	23854	4204	34.3	76.9	7.0
2016	613	3086	24538	4294	34.5	77.4	7.1
2017	631	3159	25223	4384	34.9	78.3	7.2
2018	648	3232	25908	4474	35.3	79.1	7.3
2019	665	3305	26592	4564	35.7	80.0	7.4
2020	682	3378	27277	4654	36.2	81.1	7.5
2021	699	3451	27962	4744	36.5	81.7	7.7
2022	716	3524	28646	4835	36.9	82.6	7.8
2023	733	3597	29331	4925	37.2	83.5	7.9
2024	750	3670	30016	5015	37.6	84.3	8.0
2025	768	3743	30700	5105	38.0	85.2	8.1
2026	785	3816	31385	5195	38.4	86.1	8.2
2027	802	3889	32070	5285	38.8	86.9	8.3
2028	819	3962	32755	5375	39.2	87.8	8.4
2029	836	4035	33439	5465	39.6	88.6	8.5
2030	853	4108	34124	5555	40.0	89.5	8.5

Table 7: Projections of the second set of variables

Years	Urban POP (% of total pop)	Health Expend./ Capita (PPP $)	GDP per Capita (Current US $)	GNI / capita (PPP int. $)	Graduates in Health (000s)
1999	55.3	160.5	1380.9	2460.0	65
2000	53.3	174.0	1270.3	2510.0	103
2001	53.6	199.0	1278.7	2730.0	181
2002	54.0	186.0	1353.6	2840.0	181
2003	54.3	218.0	1649.2	3060.0	220
2004	54.7	234.0	1863.0	3270.0	259
2005	55.0	243.9	1924.1	3450.0	251
2006	55.3	257.8	2096.1	3790.0	263
2007	55.7	271.7	2372.8	3980.0	407
2008	56.0	285.6	2768.7	4230.0	444
2009	56.4	299.5	2795.2	4400.0	471
2010	58.2	313.4	2852.1	4572.0	491
2011	59.0	327.3	3011.6	4777.6	530
2012	59.6	341.2	3171.1	4983.3	569
2013	60.2	355.1	3330.6	5188.9	608
2014	60.8	369.0	3490.1	5394.5	646
2015	61.4	382.9	3649.6	5600.2	685
2016	61.9	396.8	3809.2	5805.8	724
2017	62.5	410.7	3968.7	6011.5	763
2018	63.1	424.6	4128.2	6217.1	802
2019	63.7	438.5	4287.7	6422.7	840
2020	64.3	452.4	4447.2	6628.4	879
2021	64.9	466.3	4606.7	6834.0	918
2022	65.5	480.2	4766.2	7039.6	957
2023	66.1	494.1	4925.7	7245.3	996
2024	66.7	508.0	5085.2	7450.9	1034
2025	67.3	521.9	5244.7	7656.5	1073
2026	67.9	535.8	5404.2	7862.2	1112
2027	68.5	549.7	5563.7	8067.8	1151
2028	69.0	563.6	5723.2	8273.5	1190
2029	69.6	577.5	5882.7	8479.1	1228
2030	70.2	591.4	6042.2	8684.7	1267

To complete the picture, the trends in key variables are introduced in table 8.

Table 8: Regression outcomes for Trends in Key Variables

Variable	Trend	Intercept	R²	observations
Urban Population (as % of Total)	0.5916 (11.63)	51.29 (81.54)	0.8995	16
Health Expenditures per Capita (PPP $)	174.4 (19.579)	13.9 (3.8225)	0.7729	5
GDP per Capita (Current $)	159.5036 (11.7564)	938.0879 (10.6479)	0.9258	12
GNI per Capita (PPP int. $)	205.6364 (27.0843)	2310 (51.4275)	0.9865	11
Health Graduates (000s)	38.795 (4.6076)	64.5517 (1.0276)	0.8018	6

The above results show how the forecasting of medical doctors in relation to the needs while accounting for migration and retirement could benefit from simple methods developed elsewhere. This simple exercise could be repeated each time there are new needs and supplies. While the new medical schools and the new hospitals are not included in the above simulations, they can easily be introduced as far as new data is available.

When looking closely to a specific country (Morocco) of the MENA region, it appears that local needs of healthcare are increasing. Furthermore, enhancements in the quality of health services are also expected to play an important role. This is happening under the effects of demographic changes, income enhancement, urbanization and regionalization but also with the promotion of social health programs. While the factors related to the demand side do have increasing impacts on progressive increases in supplies in the future, this is also showing the need for diversifying the means of providing better services. In this process, while medical research needs to be emphasized further, the deficit in medical doctors is considered to be increasing. Medical education and research are then becoming central parts for satisfying the pressure from increased health demand. This is expected to be happening even under the current increase of the capacity of medical schools and the development of new schools.

Conclusion

The current paper focused on the forecasting of health workforce under the pressure of the increasing needs for health services. When accounting for the emigration of medical doctors, the pressure of demand becomes even more important. Away from health technologies that need continuous updating, human resources and especially medical doctors and human expertise appears to be crucial. The cooperative frameworks with other countries and mainly with the EU and the countries composing it can be an important source for satisfying both the needs of the EU and those of Morocco. In this process, research and education in the medical area can be the core for the acceleration of bilateral and multilateral exchanges in health services.

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