Iran J Public Health, Vol. 50, No.7, Jul 2021, pp.1463-1473

Original Article

Projection of Health Sector Workforce Requirement: Vision 2025

Gholamhossein Salehi Zalani [1], Azad Shokri [2], Elmira Mirbahaeddin [1], Tahereh Kashkalani [3], Roghayeh Khalilnezhad [3,4], *Mahboubeh Bayat [3]

1. *Telfer School of Management, University of Ottawa, Ontario, Canada*
2. *Social Determinants of Health Research Center, Research Institute for Health Development, Kurdistan University of Medical Sciences, Sanandaj, Iran*
3. *Center for Health Human Resources Research & Studies, Ministry of Health and Medical Education, Tehran, Iran*
4. *Health Management and Economics Research Center, Health Management Research Institute, Iran University of Medical Sciences, Tehran, Iran*

***Corresponding Author:** Email: h.bayat57@gmail.com

(Received 11 Mar 2020; accepted 15 Jul 2020)

Abstract

Background: This study was conducted with a long-term vision (2014-2025) targeted workforce requirement projection by occupational groups in Iran's health sector.

Methods: The "modified & combined model" used including Hall Model and Australian health workforce estimation model. It was a need-based approach with three components of estimation; requirements, supply with current growth and net required workforce. Requirement estimated by three assumptions: active workforce calculation; the growth of health service delivery resources and facilities; and daily individual working hours, created eight different scenarios. Economic feasibility of each scenario determined. To forecast the supply, used accurate numbers of the existing pool of practicing workforce in addition to inflows, minus losses from the profession. To calculate total recruits required, base year stock deducted from projected requirement and by adding Net flow, recruits required calculated.

Results: The health sector will need 781,887 workforces to realize service's needs. Workforce supply with the existing trend in the target year was 799,347. Therefore, workforce balance would be 17,460 surpluses. Moreover, to estimate required workforce and substitution number for the exited ones during the study periods till the target year, 547,136 individuals should be recruited mostly nurses and physicians.

Conclusion: Limiting the workforce required to economic feasibility challenge workforce accessibility in the future as it is sensed in present tense as well. Therefore, in addition augmenting GDP and health funds, it is necessary alternative policies such as increasing share of health sector from GDP, prioritization of workforce needs or moving towards other proper policies.

Keywords: Human resources for health; Projection; Requirement; Supply; Iran

Introduction

Health sector needs to train and appropriately distribute workforce in the whole range of spatial and temporal needs of communities concerning the extent of services and important goals such as

health for all and social justice (1, 2). Efficient workforce in a health system is a prominent asset for service provision and delivery since it is not feasible to use healthcare technology for service delivery and management when competent and proper human resources are absent (3). Several factors highlighted the significance of planning health workforce supply and demand such as increased demand for healthcare services, financing challenges, expand scope of globalization, scientific and technological attraction of developed countries, international healthcare markets, migration of health professionals, growing trend of retirement and thus withdrawal of active forces from organizations, etc.(4, 5). Therefore, workforce projections represent an important step in understanding the current and future workforce. Through this way current and projected supply and demand from 2014-25 is examined.

Initial studies indicate that health sectors have encountered numerous troubles in planning workforce supply and demand (6, 7). To name some of these complications; disproportionate composition of workers, accumulation of a large number of unskilled and semi-skilled employees, lack of coordination in training and supply of employees with real need (in terms of number and skill mix), geographic and gender maldistribution, and inflation of educated workforce in advantaged areas and their shortage in disadvantaged areas (7-9). Nonetheless, previous measures merely limited to changes in numbers of employees increasing year by year according to norms and standards. In fact, it was without specifying the real quantity and quality need and employment permits distributed among medical universities, mostly for newly established centers, according to a series of indicators such as workforce to bed ratio (6, 10). These projections were without considering health sectors' long-term plans, current and future education capacities and real health needs of the society. However, it appears highly likely that if this method of estimation continues, developmental plans face serious issues in the future (6, 11, 12).

To eliminate these difficulties, various models, methodologies and scenarios are used for workforce estimation at global level. Application of these models and scenarios by managers and planners has made it possible to evaluate different scenarios and possible futures to develop plans tailored to the situation (12-14). With this understanding, this study conducted with a long-term vision (2014-2025) considering changes in the method of health services delivery based on economic feasibility targeted workforce requirement projection by occupational groups in Iran's health sector.

Methods

This study was conducted in 2015 aiming to estimate health workforce requirements for 2025 in Iran. The applied model was a "modified & combined model" including Hall Model which is location-based (15) and the Australian health workforce estimation model (16). This model was a need-based approach with three components of requirements (need) estimation, supply estimation with current growth and estimation of net required workforce (Fig. 1). Considering the number of occupations and service delivery locations, implementation of the modified model required provision of some grounds such as grouping the occupations and service delivery locations. Hence, the occupations grouped into 13 categories and health SDLs classified as inpatient and outpatient service delivery locations by private and public.

A) Requirements (need) estimation

Considering the uncertainty of projections, three groups of assumptions used in eight scenarios. Firstly, the scenario related to active workforce calculation which has two categories; using 100% work capacity of medical group students and using 60% work capacity of medical group students. Secondly, the growth of health service delivery resources and facilities assumed to physical and financial resources.

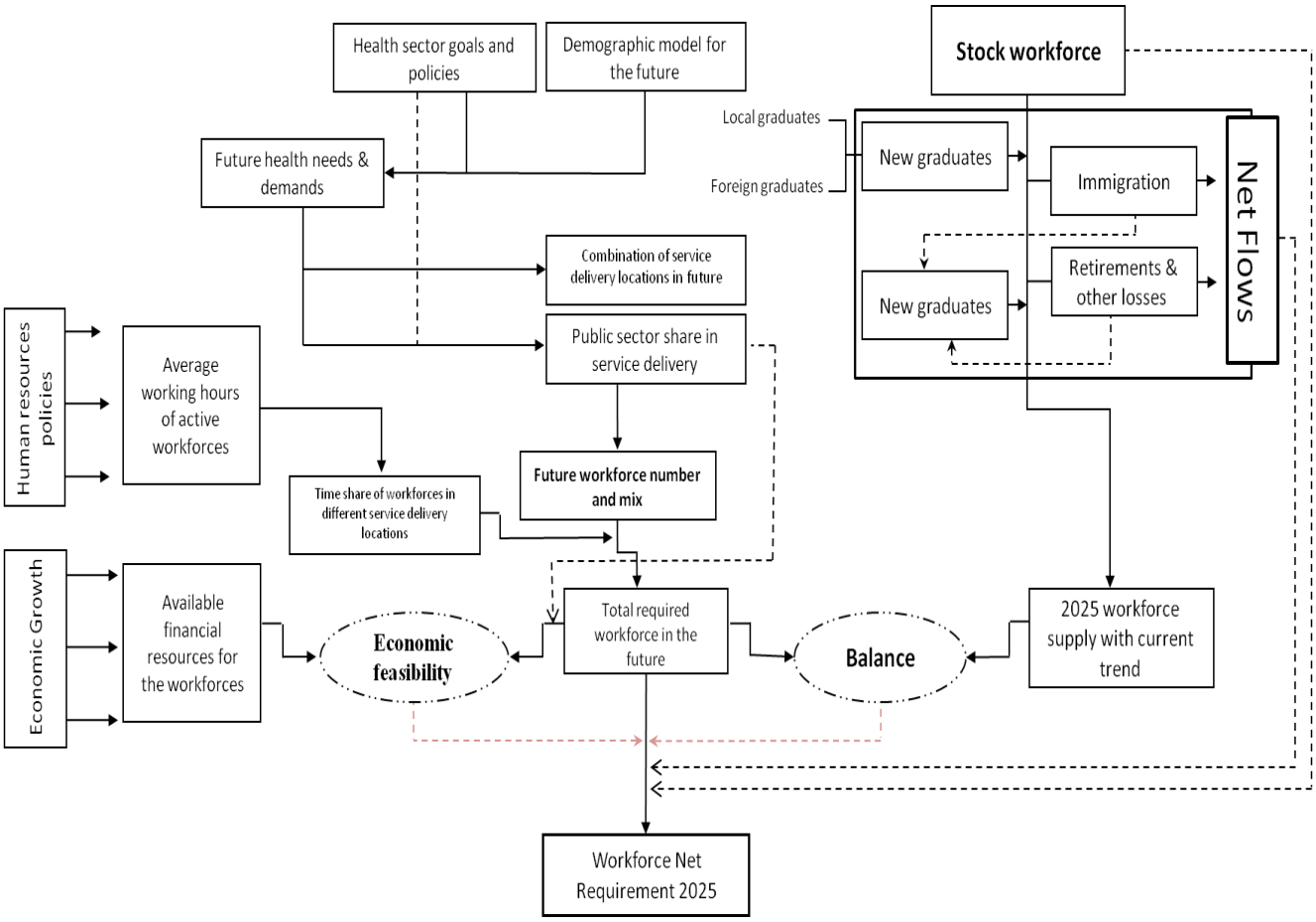

Fig. 1: Adjusted framework for health sector workforce planning

The growth was based on two variations either as "resources growth based on national policy documents" or "resources growth based on benchmarking and optimization". Finally, the third assumption was based on daily individual working hours. There are two categories in the third assumption; maintaining existing hours and relative decline in working hours considering the maximum acceptable FTE. As figure 2 shows, putting the assumptions in opposite directions creates 8 different scenarios for decision making.

To make projection scenarios, the health needs filtered by demographic characteristics (17) and basic assumptions of the health sector according to national documents, status of health service delivery facilities in the next 10 years forecasted and converted into required workforce using different workforce norms including workforce to bed ratio, workforce to population ratio, other jobs to physicians ratio and distribution of workforces in different health system delivery facilities. Finally, for each scenario, the estimated number of workforce for each location in the target year calculated. Economic feasibility of each workforce scenario determined by calculation of "anticipated cost of human recourses in public sector in the target year" divided by "anticipated funds for human resources of public sector in the target year". Based on this ratio, scenarios with economic feasibility scoring close to 100 were acceptable in economic terms.

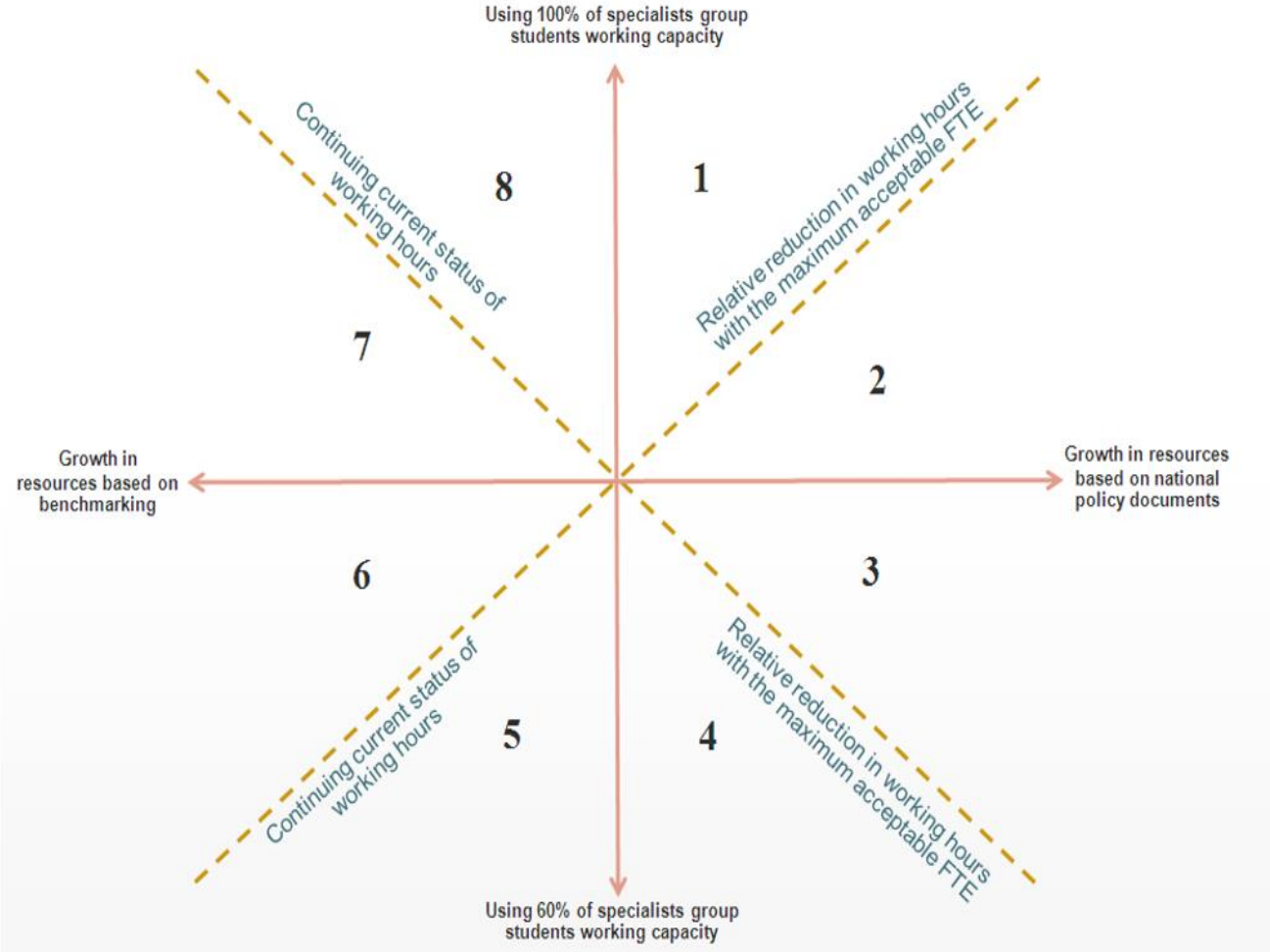

Fig. 2: Decision-making atmosphere for the estimation of health sector workforces

B) Supply Estimation with Current Growth

According to the model in this study, we used accurate numbers of the existing pool of practicing (stock) workforce (a) to forecast the supply in addition to (b) inflows (new graduates and those returned from migration), minus (c) losses from the profession because of death, retirement and leaving clinical practice. Each of the aforementioned items was in form of FTE by calculating individuals working hours through surveys about some occupational groups, and for some others group discussion and qualitative studies were applied.

Stock

It was agreed to use active data banks to determine the active workforce in non-medical groups. To calculate active workforce in the medical groups, three sources capture-recapture method used due to dispersion of databanks for active workforce, and lack of up-to-date and comprehensive databases (18). Moreover, considering integration of medical education with health services delivery in Iran since 1985, medical students in some courses of study have a direct role in service delivery and they are responsible for a major part of the services. Therefore, similar to the Australian model (16), two assumptions of

using 60% and 100% of students' work value applied in the workforce estimation.

New Graduates

In Iran, there is a minimal inflow hence only domestic graduates considered. This study estimated the graduates for the target year using the numbers from previous years and their trends.

Migration

Due to limitations in access to precise and comprehensive information about migration of active and graduated workforce, limited existing studies used as a basis (19-22). After extracting migration information, Iran's workforce migration rate in different occupation categories estimated through group discussions with experts for the next 10 years.

Informed loss rate (other losses)

Considering lack of access to information, other losses (retirement, death, dismissal, resignations, etc.) calculated based on the modified model as the below formula shows.

$$\text{Informed loss rate} = \frac{100}{\text{Average years of occupation}} + 0.2^{*}$$

*This number considered as workforce dismissed, retired or dead or etc.

Returning from migration

To estimate level of return from migration, a limited number of existing studies used.

Total recruits required

It shows new recruitment needs including the number of required workforce to estimate service needs and required number of substitution workforce for the ones who exited during the study period. The below equation is used:

$$f(x) = \sum_{i=1}^{13} (Requirement_i - Stock_i + \text{Netflow}_i)$$

Therefore, to calculate total recruits required, base year stock in each occupational group (i) deducted from projected requirement in target year for group (i) and by adding Net flow of occupation group (i) in the base year till target year level of recruits required calculated in each occupational group. Finally, recruitments for 13 groups were obtained.

Ethics approval and consent to participate

The Center for Health Human Resources Research and Studies in MOHME ethically assessed and approved the study methodology and ethical considerations to the confidential data from specialists' records.

Results

Feasibility scores in each scenario showed that there was still a long way towards score 100 even with 8% growth of GDP which is one of very optimistic scenarios based on national policy documents. Noting the current health sector funds, it was possible to select a scenario as the practical one which required less GDP growth and on the aspect of economic feasibility, it was acceptably close to score of 100. Therefore, based on economic terms and the context of decision-making for health workforce estimation, scenario number 8 appeared feasible due to lower growth of GDP (Table 1).

Table 2 shows workforce balance considering 2025 supply with the existing trend in the selected scenario (scenario 8). Health workforce supply in the target year was 799,347. According to the elected scenario assuming that the existing working hours continue to 2025, there would be 17,460 surpluses of workforce.

As Table 3 shows, to estimate required workforce and substitution number for the exited ones during the study periods till the target year, 547,136 individuals should be recruited from which were mostly nurses and physicians.

Table 1: Economic feasibility of required workforce estimation scenarios in health sector

Occupational Groups	*100% work value*		*60% work value*		*100% work value*		*60% work value*	
	Maintain the status quo Working Hours	Relative decline in working hours, considering the maximum acceptable FTE	Maintain the status quo Working Hours	Relative decline in working hours, considering the maximum acceptable FTE	Maintain the status quo Working Hours	Relative decline in working hours, considering the maximum acceptable FTE	Maintain the status quo Working Hours	Relative decline in working hours, considering the maximum acceptable FTE
General physicians	60,696	60,696	60,696	60,696	62,134	62,134	62,134	62,134
Medical Specialists	52,113	58,015	55,678	61,984	66,061	70,407	69,537	77,413
Dentists	24,882	24,882	24,882	24,882	25,878	25,878	25,878	25,878
Pharmacists	27,872	27,872	27,872	27,872	30,124	30,124	30,124	30,124
Nursing Professionals	149,792	155,066	149,792	155,066	200,395	207,450	207,450	207,450
Midwifery Professionals	40,356	40,356	40,356	40,356	45,127	45,127	45,127	45,127
Clinical Medical Assistant	68,306	68,306	68,306	68,306	83,435	83,435	83,435	83,435
Nurse aid assistant	73,614	75,285	73,614	75,285	97,550	99,775	99,775	99,775
Behvarz	44,907	44,907	44,907	44,907	44,907	44,907	44,907	44,907
Diagnostic Medical Assistant	71,350	71,350	71,350	71,350	86,386	86,386	86,386	86,386
Non-Clinical health related Professionals	20,237	20,237	20,237	20,237	22,276	22,276	22,276	22,276
Public health professionals	81,974	81,974	81,974	81,974	82,584	82,584	82,584	82,584
Other paramedicals	65,789	65,836	65,789	65,836	78,304	78,371	78,304	78,371
Others	182,034	182,034	182,034	182,034	227,028	227,028	227,028	227,028
Total	963,921	976,814	967,486	980,783	1,152,188	1,165,880	1,164,945	1,172,887
Economic feasibility	116%	118%	116%	119%	138%	140%	140%	141%
Expected GDP growth	5.9%	6.2%	5.9%	6.1%	7.6%	7.7%	7.7%	7.8%

*The required workforces means the total necessary workforces to deliver health services. This number includes the existing workforces as well

Table 2: Workforce balance based on the selected scenarios

Occupational Groups	*Supply 1404*	*Maintain the status quo Working Hours*	
		Demand	*Shortage & Surplus*
General physicians	59,412	60,696	-1,284
Medical Specialists	54,103	52,113	1,990
Dentists	28,101	24,882	3,219
Pharmacists	30,486	27,872	2,614
Nursing Professionals	181,174	149,792	31,382
Midwifery Professionals	44,692	40,356	4,336
Clinical Medical Assistant	54,165	68,306	-14,141
Nurse aid assistant	60,988	73,614	-12,626
Behvarz	31,283	44,907	-13,623
Diagnostic Medical Assistant	106,184	71,350	34,834
Non-Clinical health related Professionals	5,771	20,237	-14,467
Public health professionals	87,601	81,974	5,628
Other paramedicals	55,387	65,789	-10,402
Total	799,347	781,887	17,460

Table 3: Projected Net Requirements for New Recruits

OCCUPATIONS	*Supply in 2014*	*Population per worker*	*Total HRH Flows 2025*		*Total Projection Requirement 2025*		*Net Requirement for Recruits*	*POPULATION / HEALTH WORKER*			*Distribution by occupation*	
			Outflow (b)	Inflow (c)	Total Projection (d)	Population per worker		Base supply	Target supply	Target requirement	2014	2025
General physicians	41,316	1,884	46,419	64,779	60,696	1,477	65,799	1,884	1,502	1,477	9%	8%
Medical Specialists	35,113	2,217	9,773	28,763	52,113	1,720	26,773	2,217	1,141	1,720	8%	7%
Dentists	17,574	4,430	10,741	21,268	24,882	3,603	18,049	4,430	2,701	3,603	4%	3%
Pharmacists	15,717	4,954	9,516	24,285	27,872	3,216	21,671	4,954	4,420	3,216	3%	4%
Nursing Professionals	114,681	679	42,948	101,854	149,792	598	78,059	679	561	598	25 %	19 %
Midwifery Professionals	36,211	2,491	11,695	25,329	40,356	2,221	20,800	2,491	1,316	2,221	7%	5%
Clinical Medical Assistant	30,082	2,588	34,247	58,330	68,306	1,312	72,470	2,588	1,310	1,312	6%	9%
Nurse aid assistant	35,396	2,200	20,718	46,310	73,614	1,218	58,936	2,200	1,470	1,218	8%	9%
Behvarz	35,000	2,224	11,835	8,118	44,907	1,996	21,741	2,224	2,866	1,996	8%	6%
Diagnostic Medical Assistant	42,774	1,820	19,096	82,507	71,350	1,256	47,673	1,820	844	1,256	9%	9%
Non-Medical health related Professionals	2,547	30,569	357	3,581	20,237	4,430	18,048	30,569	15,534	4,430	1%	3%
Public health professionals	31,431	2,477	5,273	61,443	81,974	1,094	55,816	2,477	1,023	1,094	7%	10 %
Other paramedicals	33,495	2,324	9,009	30,900	65,789	1,363	41,302	2,324	1,619	1,363	7%	8%
Total	471,338	167	231,627	557,467	781,887	115	547,136	167	107	115	100 %	100 %

Discussion

Choosing a projection approach or forecasting method requires deliberate consideration since the type of used model can have a significant effect on the outcomes and recommendations (12). In Canada, two main approaches of need-based or harness-based have been presented which estimated different numbers for required nurses (23). The applied model makes the projections based on current status, future health system capacities and feasibility assessments so that the implementation could be feasible as well (24). The present study used a model introduced by WHO which was a location-based model focused on the point that health services delivered. It has been one of the best scenario-based models for workforce projections considering uncertainties and probabilities (15, 25) as such some countries have made the workforce estimations according to scenarios. In Australia, five scenarios used to

estimate medical specialists; specialists working hours, length of educational degrees, migration and workforce retention (16). In Mexico, physicians' productivity and retirement rate used in form of two scenarios of productivity improvement and workforce maintenance (24).

Workforce forecasts of this study showed that to reach the required workforce norms, one individual per 115 populations is required in the target year. In Turkey, this number was 79 in their target year (26). This difference was justifiable considering different population patterns and different rates for population density in addition to different health priorities and more focus of that country on specialists. Moreover, considering medical truism and referral patients from other countries, there are more health workforces estimates in Turkey (27). Present findings showed that if the current trend of training workforce continues until 2025, the highest net requirement for recruits would be in nursing, medical physicians and similar groups. Most of this requirement relates to Health Transformation Plans (HTPs) (28).

Calculations for workforce projection of the target year showed that nursing group owned the most share of workforce mix to be recruited (19%). Comparison of rates for nurses per 10,000 population in Iran (14.7) with turkey (17.0) showed a relatively high shortage of this group in Iran. Considering significant role of nurses in improvement of health indicators and the issue of their shortage compared to international standards, especially similar countries such as Turkey, the ratio of nurses will have significant change in the target year (improves from 14.7 to 16.7 per 10000 population) (26).

Apart from nurses, physicians had the most share of workforce mix (15%) including both general and specialist physicians. Need for this occupation group has increased, on the one hand, due to clinical and preventive needs and on the other hand because of their unbalanced distribution. However, their ratio is still showing a wide gap with developed countries. Specialists in Iran had a ratio of 6 per 10,000 population while this ratio for Australia (29), USA (30) and even Turkey (26), as a developing country, were 29, 15, and 21.5, respectively. Iran's ratio in target year showed a significant difference compared to Australia (16) in 2008 (21 specialists), the USA (31) in 2010 (16 specialists) and Turkey (26) in 2008 (11 specialists). However, part of this difference was due to differences in regional characteristics. In America, there has been high demand for specialists due to private nature of services and high capacity of private sector absorbing specialists and increased need for specialty services owing to population aging (16). Similarly in Canada, it was 10 (32), and in Denmark, Finland and Norway, it was 23.2, 21.8 and 23.4, respectively (33).

Regarding the general practitioners, studies showed that most developed courtiers such as the USA and Australia have had a significant shortage, even though realizing their essential role in primary care. In the target year, this ratio in Iran (7 General Practitioners (GPs)) will be highly less than the base year of developed countries; Canada (1.14), Australia 1.15, and France (1.39). In some developed countries, especially Europeans the ratio of GPs to population was equal or even less than Iran due to training the specialty of family physicians which is equal to GPs in Iran (34), for example, in Nordic countries; Scotland, Greenland, Finland, Norway this ratio was 8. 4, 9. 3, 9. 7, 9. 2 and other developed countries such as Germany and Sweden and 0.51, 0.61 (35). EMRO and WPRO regions, of WHO which have been similar to Iran in terms of development level and diseases, pattern showed same status as Iran comparing a total number of physicians as their total ratios were 12.7 and 15.5 in order. And compared to less developed regions, AFRO and SEARO regions showed ratios of 2.7 and 5.9 physicians per 1000 population (36).

Conclusion

The present study attempted to improve its reliability by decreasing the limitations including the lack of access to information and the lack of var-

ious studies. Therefore, using need-based approaches in different locations and also benchmarks and surveys to decreasing the limitations, projections for the coming years in Iran showed, the health sector will need 781,887 workforces to realize health service's needs. It should also consider recruiting 547,136 workforce because of losses due to retirement, death, etc. during these years. According to the selected scenario, Iran needs 6% GDP growth considering a wide gap with developed countries in terms of workforce to population ratio. However, limiting the workforce required to economic feasibility can challenge workforce accessibility in the future, as it is sensed in present tense as well. Therefore, in addition to augmenting GDP and health funds, it is necessary to have other alternative policies such as increasing share of health sector from GDP, increasing the share of workforce expenditure from total health expenditures or prioritization of workforce needs and improving norms of service delivery occupations such as general practitioners, specialists, nurses and clinical assistants instead of all norms. In response to the workforce demand and the losses, some of the most important substitution policies, which are less expensive in long term, are moving towards policies such as decreasing workforce loss and returning specialized and technical workforce to the health sector and reduce the need for workforce replacement recruitment.

Availability of data and material

The data of this study are available from Iran Ministry of Health and Medical Education (MOHME), but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Center for Health Human Resources Research and Studies (CHHRRS).

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Funding

This study received no funding.

Acknowledgements

We are sincerely grateful of the managers and expert staffs in Iran's Ministry of Health and Medical Education headquarter for their support and guidance, and colleagues in medical universities for their assistance through our discussions and for sharing their valuable opinions.

Conflict of interest

The authors declare that there is no conflict of interest.

References

1. de Andrade L. O. M, Pellegrini Filho A, Solar O, et al (2015). Social determinants of health, universal health coverage, and sustainable development: case studies from Latin American countries. *Lancet*, 385(9975):1343-1351.
2. Gore D, Kothari A (2012). Social determinants of health in Canada: Are healthy living initiatives there yet? A policy analysis. *Int J Equity Health*, 11:41.
3. Framework A, & Dilonardo J (2011). Workforce Issues Related to: Physical and Behavioral Healthcare Integration. Available from: https://www.thenationalcouncil.org/wp-content/uploads/2021/04/ONDCP_Framework_Paper.pdf
4. Diallo K (2004). Data on the migration of health-care workers: sources, uses, and

challenges. *Bull World Health Organ*, 82(8):601-7.
5. Cometto G, Tulenko K, Muula A. S, Krech R (2013). Health workforce brain drain: from denouncing the challenge to solving the problem. *PLoS Med*, 10(9): e1001514.
6. Ehsani Chimeh E, Akhavan Behbahani A (2017). Factors affecting the service delivery locations of newly graduated Iranian general practitioners. *Iran Red Crescent Med J*, 19(2):e40032.
7. Jahani S, Abedi H, Elahi N, Fallahi-Khoshknab M (2016). Iranian entrepreneur nurses' perceived barriers to entrepreneurship: A qualitative study. *Iran J Nurs Midwifery Res*, 21(1):45-53.
8. Qidwai W, Ashfaq T, Khoja T A, Rawaf S (2012). Access to Person-Centered Care: A Perspective on Status, Barriers, Opportunities and Challenges from the Eastern Mediterranean Region. *Middle East Journal of Family Medicine*, 10(6):4-13.
9. Simforoosh N, Ziaee S. A. M (2014). Growth Trends in Physician Specialists Supply in Iran; 1979-2013. *Arch Iran Med*, 17(11):771-775.
10. Fereshteh A, Tabibi S. J, Maleki M. R, Nasiripour A. A, Eshlagi A. T (2015). A prediction of the geriatric specialists for the elderly in Iran: a dynamic system. *WALIA Journal*, 31(S2):132-8.
11. George G, Quinlan T, Reardon C (2009). Human resources for health: A needs and gaps analysis of HRH in South Africa. Health Economics and HIV&AIDS Research Division (HEARD). University of Kwa-Zulu Natal: Durban, South Africa.
12. World Health Organization (2010). Models and tools for health workforce planning and projections. https://apps.who.int/iris/bitstream/handle/10665/44263/9789244599013_rus.pdf
13. World Health Organization (1992). Methodology for planning of human resources for health: report of a consultation, Bangkok, Thailand, 23-27 March 1992 (No. HRH/92.9. Unpublished). Available from: https://apps.who.int/iris/handle/10665/59873
14. Tjoa A, Kapihya M, Libetwa M, et al (2010). Meeting human resources for health staffing goals by 2018: a quantitative analysis of policy options in Zambia. *Hum Resour Health*, 8:15.
15. Hall T (2001). Human Resources for Health: Models for projecting workforce supply and requirements. World Health Organization, San Francisco.
16. Health Workforce Australia (2012). Health Workforce 2025: Medical specialties. Canberra: HWA; https://apo.org.au/sites/default/files/resource-files/2012-01/apo-nid154456.pdf
17. Statistical Centre of Iran (2017). Indicators of population in Iran 2015. https://www.amar.org.ir/english
18. Bayat M, Harirchi I, Zalani GS, et al (2017). Estimation of Oncologists' Active Supply in Iran: Three Sources Capture-Recapture Method. *Iran Red Crescent Med J*, 19(7): e56126.
19. Ronaghy H. A, Shajari A (2013). The Islamic Revolution of Iran and migration of physicians to the United States. *Arch Iran Med*, 16(10):590-3.
20. Lankarani K. B (2015). A closer look at Iranian migration to the United States. *Arch Iran Med*, 18(3): 205.
21. World Bank (2011). Migration and Remittances Factbook 2011. Washington DC. Available from: http://siteresources.worldbank.org/INTLAC/Resources/Factbook2011- Ebook.pdf
22. Alaeddini F, Fatemi R, Ranjbaran H, et al (2005). The inclination to immigration and the related factors among Iranian physicians. *Hakim Research Journal*, 8(3):9-15.
23. Birch S, Kephart G, Tomblin-Murphy G, et al (2007). Human resources planning and the production of health: a needs-based analytical framework. *Canadian Public Policy*, 33(S1):1-16.
24. Nigenda G, Muños JA (2015). Projections of specialist physicians in Mexico: a key element in planning human resources for health. *Hum Resour Health*, 13:79.
25. Roberfroid D, Stordeur S, Camberlin C, et al (2008). Physician workforce supply in Belgium: current situation and challenges. http://dspace.itg.be/bitstream/handle/10390/2588/2008phys0150.pdf?sequence=1
26. Turkish Ministry of Health (2011). Turkish health sector human resources for health vision 2023. Ankara: Turkish Ministry of Health.

https://www.sesric.org/imgs/news/Image/729-doc-5.pdf
27. Altunisik MB (2011). Turkish Foreign Policy and its Regional Implications. *ECSSR* (Abu Dhabi) Emirates Lecture Series. (87):0-1.
28. Iran Ministry of Health and Medical Education (2013). Health Sector Evolution Plan 2014.
29. O'Sullivan BG, McGrail MR, Stoelwinder JU (2017). Reasons why specialist doctors undertake rural outreach services: an Australian cross-sectional study. *Hum Resour Health*, 15(1):3.
30. Staiger DO, Auerbach DI, Buerhaus PI (2009). Comparison of physician workforce estimates and supply projections. *JAMA*, 302(15):1674-80.
31. National Center for Health Workforce Analysis (2014). Projecting the Supply of Non-Primary Care Specialty and Subspecialty Clinicians: 2010–2025. https://bhw.hrsa.gov/sites/default/files/bureau-health-workforce/data-research/clinicalspecialties.pdf
32. Canadian Medical Association (2011). Number of physicians by province/territory and specialty, Canada. Retrieved July. 2011;3:2012. https://www.cma.ca/sites/default/files/2019-11/2019-01-spec-prov_1.pdf
33. Ozcelik H, Fadiloglu C, Karabulut B, Uyar M (2010). Palliative care activity in the field of oncology in Turkey. *J Palliat Care*, 26(4):305-10.
34. Canadian Institute for Health Information (2005). Supply, Distribution and Migration of Canadian Physicians, 1986-2004. In: Scott's Medical Database CIfHI, Editor. 2005-2015.
35. Marcussen J (2015). Health Statistics for the Nordic Countries. p. 40-209. http://nowbase.org/publications/health-statistics-nordic-countries
36. World Health Organization (2015). Geographic distribution Data by country. http://apps.who.int/gho/data/view.main.92500