Supply-and-demand projections for the health workforce at a provincial level from 2015 to 2025 in Ilam, Iran

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Abstract

Background: Human resources are the key component of health systems. It is critical to have the right number of human resources at anytime and anywhere in the health system. This article aims to help local health decision makers to identify potential gaps between the future supply and demand of human resources and to make necessary changes in medical training processes to fill the gap.

Methods: An eight-stage process was applied to project the supply and demand of health workers in Ilam province in 2025 for the following fields: public health, environmental health, general medicine, dentistry, pharmacy, nursing and midwifery. To estimate the demand for human resources, a mainly population-based model (manpower-to-population ratio) was applied. A modified version of the Australian dynamic stock and flow model was used to predict the supply of new recruits in 2025. The potential surplus or shortfall in the health workforce was calculated by comparing the supply and demand in 2025.

Results: The demand and supply projections for the chosen fields were estimated respectively as: general medicine 457,709; pharmacy 131,86; dentistry 86,251; nursing 949,1657; midwifery 24,247; public health 182,211; and environmental health 92,225.

Conclusions: The current trend of medical graduates will meet the need for human resources in 2025, and there is no need to increase medical student admission. The Education Deputy of Ilam Medical University should take into account the health needs of its catchment area in medical educational processes and training new health-care staff.

Keywords

Human resources, supply, demand, estimation, projection, prediction, health workforce

Introduction

Human resources are the key component of health systems in order to provide quality health-care services for the population. The importance of specialised health-care professionals in using other health-care technologies and applying medical knowledge makes them a vital and inseparable part of the health system.1,2 Health-care providers, in particular specialists, are the main factor affecting health-care expenditure, absorbing a major proportion of the health-care budget in most countries.3–6 Therefore, having a reliable health workforce management process is an issue which policymakers have always been concerned about. Health human resources management is defined as a process to ensure that the health...
system has ‘the right number of people, in the right place, at the right time, with the right skills, with the right motivation and attitudes, at the right cost, doing the right work, appropriate to the social context and economic conditions of the country’.7,8

Using precise approaches to project the supply and demand of the health workforce is therefore essential for having the right number of human resources at anytime and anywhere in the health system.9 Human shortfalls in healthcare can lead to underutilisation of healthcare services for those in extreme need, a reduction in the quality of healthcare services, an increase in waiting lists, uneven geographical distribution of the workforce and worsening of the general health situation and health inequities. A surplus of health staff is a waste of resources and can lead to unemployment, dissatisfaction among health workers and unnecessary growth in health-service provision.10–12

Human resources forecasting in the health system focuses on the number and mixture of health workers needed in the future which is not easy as many influencing factors affects the supply of and demand for human resources.13 These factors include sex, age and epidemiological features of the population; the prevalence and burden of diseases; current health-care facilities and expected developmental programmes in health infrastructures; the environmental situation; health behaviours and lifestyle; current and future trends in the utilisation of health-care services; waiting lists; the macro changes in social, cultural and economic trends in society; the inflows and outflows of the health workforce in the health system; health plans that policymakers introduce in the health system and so on.14–20

Therefore, globally, various models and methods have been devised by different scholars working in this area, with each model emphasising different factors with different assumptions, in order to make the projection of the health workforce more reliable and robust.10 Applying various models enables health policymakers to be ready to devise appropriate human-resources plans according to the projections estimated by the different models. Table 1 introduces the main models for health workforce management and their main features.10

Medical education system in Iran

Before and at the beginning of the Islamic Revolution of Iran in 1979, one of the main problems of the Iranian health system was the shortage of most kinds of health workers, especially in remote areas. There were only nine medical schools in the country at that time, and the annual number of students was just 1207, which was too low to meet the needs of the health system. For instance, in some provinces, the physician-to-population ratio was as low as 1:18,000. In a number of provinces, there were not even any practicing obstetricians, anaesthesiologists and so on.21

The Ministry of Higher Education was responsible for medical education and was unable to increase the number of medical students.21 To solve the problem, it was decided to integrate medical education with health-care services. Therefore, all health-related schools and institutions were seceded from the Ministry of Higher Education and were transferred to the Ministry of Health in 1985, resulting in the formation of the Ministry of Health and Medical Education (MoHME).22 Soon after, at least one university of medical sciences was established in each province across the country.21 Currently, there are 67 public medical universities and faculties of medical sciences (some with medical schools), plus 14 medical schools affiliated with the army and the semi-private Islamic Azad University (IAU). Ilam University of Medical Sciences (IUMS) is the university in Ilam province responsible for training medical students. It was established in 1995 and currently has five faculties (medicine, allied medicine sciences, nursing and midwifery, health and dentistry). Ilam Province is one of the 31 provinces of Iran. It is located in the western part of the country, sharing 425 km of border with Iraq. The population of the province in 2016 was approximately 580,000 people.

Medical education initiatives in Iran in 2015

As the fourth stage of the Iran Health Transformation Plan, reform in medical education was introduced by the Minister of Health in May 2015.23 As a result, to improve the medical education system in Iran, 11 new innovative educational packages were approved by the MoHME to be implemented across the country, and all medical universities became responsible for following them and putting them into practice. Accordingly, 11 committees were formed by the Education Deputy in each medical university. As one of the 11 committees, the Committee of Spatial Planning, Missionary, Decentralization and Empowering the Medical Universities was assigned to estimate demand for the health workforce in the future and accordingly to enable educational officials in IUMS to make necessary modifications to educational courses to meet health human needs. This article therefore aims to estimate the supply and demand of human resources in health system in Ilam province over the 10-year period from 2015 to 2025. This can be useful in identifying potential gaps between the number of health workers required in 2025 and the number of graduates that would be supplied and ready to work during the same period of time. The identification of potential gaps between supply and demand can help health officials, including educational authorities in IUMS, to develop and implement plans to close the gaps.

Methods

This study was conducted in Ilam in 2015. As there are more than 80 job titles in health care and 400 educational field courses, making the process of health human resources management more difficult. As a result, we focused on the main job titles with the highest number of health workers working actively in the health system. In the next stage, based on the current academic courses in IUMS and the recommendations of educational authorities of IUMS, the following job titles were selected for the purpose of the study: public health, environmental health, general medicine, dentistry, pharmacy, nursing and midwifery.
Table 1. Main models for health workforce projections.

| Estimation approach | Model                                      | Method                                                                 | Method                                                                 |
|---------------------|--------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------|
| Population-based    | Manpower-to-population ratio               | This is a simple method to forecast future requirements for health manpower by calculating the number of staff needed to serve the future population in the way they are currently being served. This ratio is often identified by governmental policymakers, professionals in expert panels or technical agencies such as the World Health Organization. There are three main assumptions regarding this approach: the current number, skill mixture and distribution of manpower are adequate; the productivity, age and sex of manpower will stay unchanged in the future; the number and demographic specification of manpower alters according to current observed trends over time. | Derived from international standardised rates                                |
|                     | Benchmarking model                         | Using provider population rates derived from a comparable country or region with the best health indicators af all health needs of the population is a cost-effective approach regardless of other needs existing in different sectors of the country, and methods of dealing with needs are clarified and can be recognised without facing any difficulty; and health-care resources are always employed in reference to actual amount of need. | Using provider population rates derived from a comparable country or region with the best health indicators |
|                     | Health service volume approach             | Needs-based model (epidemiologic approach)                             | Selecting a health-care facility which serves its catchment area well and estimating the health workforce according to it |
|                     | Health system model                        | Health system needs-based model (service target approach)              | Estimating the required health workforce according to the prevalence and incidence of diseases in the society |
|                     |                                             | The service target approach links manpower provision to specific health-care services that are mentioned as an objective to be produced for a specific number of population or for a defined region | Projections based on using the health facilities regardless of being able to afford to use them |
|                     |                                             | Health system developmental goals–based model                         | Projections based on the amount of health-care services utilised by people |
|                     |                                             | Hall model                                                             | Using the vacancies in the health system for projection |
|                     |                                             | Mixed model                                                            | Using proposed developments in the health-system infrastructure for projection |
|                     |                                             | Mixed models are introduced to be useful in estimating health human manpower in a most effective way. In this approach, an efficient amount of required manpower is determined by integrating several factors of human-resource conceptual approaches and creating a single comprehensive model. In reality, however, mixed (combined) models are used in projections. | Applying complex mathematics model using various factors |

Proceedings of Singapore Healthcare 2011
The following eight strategies were followed to manage the process of health workforce planning in Ilam province in 2025:

1. Establishing a system to gather, preserve and analyse the profile of the health workforce
2. Analysing the status quo of the health workforce
3. Predicting health workforce demand
4. Predicting health workforce supply
5. Comparing and analysing the likely inconsistency and the gap between supply-and-demand flows
6. Planning to train and provide the required health workers
7. Planning to maintain the current health workers and reduce leavers
8. Appropriate and timely decisions about the allocation of human resources

Stages 1 and 2: Analysing the status quo of the health workforce

At this stage, the number of available health workers working in Ilam province in 2016 was determined, including those working in the public health sector (provided by the Human Resources Information System of IUMS), private health sector and other organisations such as the Social Security Organization, army health facilities, charitable and public non-governmental institutions (provided by Licensing Department of IUMS), regardless of their employment status or origin of living place.

Stage 3: Projecting demand for the health workforce in 2025

For the purpose of estimating the demand for the health workforce, we used the Iran Health Road Map 2025. This map uses benchmarking for the estimation of demand for the health workforce. The required health workers were estimated per 100,000 of the population. For benchmarking, manpower-to-population ratios were extracted from the international literature for countries with comparable demographic and economic conditions, including Turkey, Egypt, Saudi Arabia, Poland, Argentina, Colombia, Malaysia, Spain, South Africa, Thailand and Mexico. By analysing the ratios of these countries, holding expert panels and surveying a wide range of key experts in the health system, including chancellors and treatment affairs deputies of medical universities and the key health policymakers in the country, the manpower-to-population ratios were finalised for Iran.

Based on the health provider-to-population ratios and also expected population growth in Ilam in the coming years, the required health workforce was projected for 2025. It should be mentioned that the number of human resources needed in 2025 were adjusted based on the full-time equivalent (FTE). One FTE is equal to one full-time employee who works eight hours a day, five days a week for 52 weeks a year. This common criterion is used for the calculation of workload and the number of employees needed to do it. Studies show that FTE in Iran for midwifery, general medicine and nursing were all >1 (1.2, 1.28 and 1.39, respectively). In this study, to predict the demand for the health workforce in 2026, the FTE was therefore considered as 1.2 for these three job titles. For pharmacy and dentistry, the FTE was considered as 1.

Stage 4: Projecting health workforce supply in 2025

The Australian dynamic stock and flow model was used for projecting the supply of the health workforce in 2025 (Figure 1). This model has been devised based on the stock and inflows and outflows of the workforce to the health system. This model uses the current inventory, health human inputs and outputs, and the factors influencing the available and dynamic flows of human resources into the health system to estimate the supply of the health workforce in 2025. For the purpose of the study, the Australian model was localised based on the data available at the provincial level (Figure 2).

One of the main sources of new recruits into the health system in Ilam is the number of students graduating from medical universities. As the estimations were done for usage at the provincial level, we focused just on Ilamian medical students. Four main sources were identified as the supplier of new graduates at
the provincial level: (a) IUMS, (b) other public medical universities in Iran, (c) Islamic Azad universities (IAU) and (d) Ilamian students studying in foreign countries (Figure 2).

The number of graduates and students studying in IUMS was obtained from the IUMS Information Technology Department. For more reliable estimation, we emphasised two objectives. First, we separated students into two groups: Ilamian and non-Ilamian students. For the purpose of the study, we assumed that Ilamian students would work in Ilam province. So, we just focused on the Ilamian students for projections. Second, we analysed the trends of student admissions in IUMS for each field in the previous four years in order to predict student admissions for the coming years. Moreover, we interviewed the high education authorities in IUMS to obtain more reliable information regarding the policies of the Education Deputy about the admission rates for medical students in IUMS in the coming years.

We obtained the number of Ilamian medical students studying at governmental medical universities other than IUMS from the National Organization of Educational Testing (NOET). These data were limited to the years 2011–2016. Predicting the number of student admissions at other governmental medical universities in the coming years was decided based on the trends of previous data taken from NOET. We also interviewed high education officials in IUMS to endorse our estimation. As the supply-and-demand projections for the health workforce were for the planning horizon in 2025, we predicted the admission rate in the coming years (2017–2021) based on the academic duration for each job title. For instance, as academic course for general medicine in Iran takes seven years to complete, we predicted the admission rate until 2018, as general medicine students entering university in 2018 would graduate in 2025. The same policy was followed for other academic courses as well. In Iran, the study years required for dentistry and pharmacy students is six years, and for nursing, midwifery, public health and environmental health students, four study years are required.

The branch of IAU in Ilam province has no academic courses in medial fields. To obtain data about the number of Ilamian students studying in selected job titles in Azad universities in other provinces outside of Ilam, we requested this from the National Organization for IAU, but no data were presented. To fill this gap, based on the number of Ilamian students in other medical universities and the share of medical students studying in medical universities and IAU at a national level (Table 2), we estimated the number of Ilamian medical students studying in IAU.

The number of Ilamian students studying in foreign countries was derived from Ministry of Health and Medical Education.

Factors influencing the number of graduates. Some students may drop out of university during their studies, change their field of study or continue their studies at higher levels. This reduces the number of graduates for the health system as new recruits. In this study, according to the estimation of the Information Technology Department and consultation of the research team members, we estimated that 5% of students would fall into this category.

Human resources attrition. In addition to migration, several other factors affect the human resources attrition, including retirement, death, fire, resignations and so on. To determine the attrition rate in the coming years, previous data can be used. In the Iran Health Road Map 2025, the annual attrition

Table 2. Share of different medial students trained in different kinds of universities in Iran.

| Job title  | Medical universities affiliated with MoHME | Islamic Azad universities | Other universities |
|------------|-------------------------------------------|---------------------------|--------------------|
| General medicine (%) | 87 | 11.8 | 1.4 |
| Dentistry (%) | 89 | 9.6 | 1.9 |
| Pharmacy (%) | 91 | 9.1 | - |
| Nursing (%) | 60 | 37.9 | 2 |
| Midwifery (%) | 52 | 48.2 | 0.3 |
| Health (%) | 79 | 19.2 | 1.4 |

MoHME: Ministry of Health and Medical Education.
rate for health personnel and general physicians were 3% and 5%, respectively. The attrition rate for general physicians was more of an estimate because every year more than 3000 general physicians start studying specialty courses. For this study, these rates were used. One of the factors affecting the inputs and outputs of the health workforce is immigration of Ilamian health workers to other provinces and emigration of health personnel from other parts of the country into Ilam province. As there were no exact and up-to-date data available regarding this concern, we assumed the inflows and outflows to be equal and did not take them into account. As health workers transferring between the private and public sectors within Ilam province does not affecting the whole supply of health human resources, this factor was not included in any calculations.

Stage 5–8: analysing the gap between supply and demand and devising measures to close the gap

The main focus in these stages was to propose necessary short- and midterm modifications in academic courses held in IUMS in order to fill the potential gap between supply and demand for the health workforce within Ilam province in 2025.

Results

Stages 1 and 2

According to the Information Technology Department of IUMS, the existing health workforce for the selected job titles in Ilam province in 2015 were as following: general medicine 176, pharmacy 64, dentistry 123, midwifery 291, nursing 733, public health 197 and environmental health 87.

Stage 3: Predicting health workforce demand

According to the manpower-to-population ratios in the selected countries and the result of the expert panel, the ratio of required manpower per 100,000 of the population for Iran was estimated as shown in Table 3. The number of health workers required each year in the 10-year period from 2015 to 2025 is presented in Table 4. The number of health workers needed in Ilam province in 2025 is presented in Table 5.

As there was no manpower-to-population ratio for public health and environmental health, we used the service target approach (using the vacancies in the health system) for projection. According to the Deputy of Resources Development of IUMS, there were 350 and 126 approved organisational posts for public health and environmental health, respectively, and it was planning to establish an additional seven new health posts and 15 health facilities in urban areas by 2025 (Table 6). According to the current standards in health documents at the Health Network Development Centre, one public health person and one environmental health person are required for each of these new health centres.

Stage 4: Predicting health workforce supply

The number of student admissions in the selected job titles for each year who study in IUMS is shown in Table 7. The total number of Ilamian students for the selected job titles who will graduate from other public medical universities in Iran, Islamic Azad Universities and foreign countries during the period 2016–2025 and the number of Ilamian students available as new recruits in 2025 for each job title is presented in Table 8. Table 9 shows the cumulative number of medical students that would be ready to work in the health system in 2025.

Stages 5–8

Stages 5–8 consisted of analysing the gap between supply-and-demand estimation of the health workforce and planning for recruiting the required human resources or downsizing. Table 10 shows the gap between the supply-and-demand projections of the health workforce in Ilam province in 2025. According to Table 10, for all job titles except pharmacy, there is a surplus, and it seems to be high.

Discussion

In this study, we tried to estimate the supply and demand for the main health workforce in the local region of Ilam province. We believe that the main strength of the study was localising

Table 3. Number of health workforces required per 100,000 populations.

| Job title       | Number of health workers required per 100,000 of the population |
|-----------------|---------------------------------------------------------------|
| General medicine| 90                                                            |
| Dentistry       | 30                                                            |
| Pharmacy        | 32                                                            |
| Nursing         | 270                                                           |
| Midwifery       | 45                                                            |

Table 4. Number of required health workers in each year during the 10-year period from 2015 to 2025.

| Year   | 2016  | 2017  | 2018  | 2019  | 2020  | 2021  | 2022  | 2023  | 2024  | 2025  |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| General medicine | 571,988 | 574,883 | 577,819 | 580,786 | 583,780 | 586,797 | 592,301 | 597,858 | 603,467 | 609,128 |
| Dentistry     | 204    | 233    | 261    | 289    | 317    | 346    | 374    | 402    | 430    | 459    |
| Pharmacy      | 127    | 131    | 135    | 139    | 142    | 146    | 150    | 154    | 158    | 162    |
| Nursing       | 73     | 83     | 92     | 102    | 111    | 121    | 130    | 140    | 149    | 159    |
| Midwifery     | 285    | 279    | 273    | 266    | 260    | 254    | 248    | 242    | 236    | 230    |
the major factors influencing the supply and demand for health workers. The methodology used in this study can be applicable and useful for those who want to obtain the same projections for a local area.

The main approach used in this article for demand projections was using population size. Although in this approach the age and sex of the population matter to estimate the need for health-care services and in turn the number of health workers, in this study, only the size of the population was considered.

Estimations show that graduates from IUMS can provide the major part of the need for health workers in 2025. For instance, the current graduation trend for dentistry, midwifery and environmental health from IUMS will cover the need for

Table 5. Demand for health workforces in Ilam province in 2025 adjusted by FTE.

| Job title       | Existing health workers in base year (2015) | Predicting health workforce demand in 2025 | Predicting health workforce demand in 2025 based on FTE 1.2a | Range of need for health workforce in 2025 | Gap over the 10-year period |
|-----------------|--------------------------------------------|--------------------------------------------|-------------------------------------------------------------|---------------------------------------------|-----------------------------|
|                 | Number (A) Ratio | Number (B) Ratio | Number (C) Ratio | Minimum demandd | Maximum demande | Number of workers who should be replaced (D)f | Demand for workers (taking into account the replacements) (E): E=(C–A)+D |
| General Medicine | 176 31 | 550 90 | 459 75 | 426 | 491 | 174 | 457 |
| Pharmacy        | 64 11 | 190 31 | 159 26 | 148 | 179 | 37 | 131 |
| Dentistry       | 123 22 | 194 32 | 162 27 | 151 | 173 | 47 | 86 |
| Nursing         | 733 129 | 1608 264 | 1340 220 | 1246 | 1434 | 342 | 949 |
| Midwifery       | 291 51 | 275 45 | 230 38 | 213 | 246 | 86 | 24 |

aPredicting health workforce demand in 2025 was based on a FTE of 1.2 for general medicine, nursing and midwifery. A FTE of 1 was applied to dentistry and pharmacy.
bThe number of workers was provided by Ilam University of Medical Sciences’ Information Technology Unit.
cNumber of workers per 100,000 of the population.
dThe minimum number was determined based on 7% less than the health workforce demand projection.
eThe maximum number was determined based on 7% more than the health workforce demand projection.
fThis number was calculated by assuming 3% and 5% outflows of the health workforce and general physicians due to retirement, death, migration, etc.
FTE: full-time equivalent.

Table 6. Demand for public and environmental health workforces in Ilam province in 2025.

| Job title        | Number of additional posts proposed to be developed (B) | Total demand in 2025 (C) | Number of current employees in 2015 (D) | Total attrition in 2025 due to retirement (E) | Demand for workers (taking into account the replacements) (F): F=(C–D)+E |
|------------------|----------------------------------------------------------|--------------------------|------------------------------------------|---------------------------------------------|-------------------------------------------------------------------|
| Public health    | 350a                                                      | 372                      | 197                                      | 7                                           | 182                                                               |
| Environmental Health | 126                                                      | 148                      | 87                                       | 31                                          | 92                                                                |

aThis number includes two posts in the organisational structure of the health network in Iran: ‘family health’ and ‘fighting diseases’. These two posts are occupied by public health graduates.

Table 7. Number of medical student admissions in the selected job titles for each year studying in IUMS.

| Job title             | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | Total |
|-----------------------|------|------|------|------|------|------|------|------|------|------|------|-------|
| General Medicine      | 29   | 29   | 24   | 41   | 40   | 51   | 100  | 80   | –    | –    | –    | 394   |
| Pharmacy              | –    | –    | –    | –    | –    | –    | –    | –    | –    | –    | –    | –     |
| Dentistry             | –    | 17   | 15   | 15   | 9    | 19   | 14   | 15   | 15   | –    | –    | 119   |
| Nursing               | –    | –    | 60   | 28   | 49   | 59   | 61   | 60   | 60   | 60   | 497   |
| Midwifery             | –    | –    | 26   | 16   | 14   | 12   | 23   | 17   | 17   | 17   | 17   | 159   |
| Public Health         | –    | –    | 14   | 16   | 14   | 11   | 17   | 15   | 15   | 15   | 15   | 132   |
| Environmental Health  | –    | –    | 12   | 8    | 12   | 11   | 16   | 15   | 15   | 15   | 15   | 119   |

Table 8. Ilamian medical graduates during the period of 2016-2025 from other public medical universities, Islamic Azad Universities and foreign countries.

| Job title             | Other public medical universities | Islamic Azad universities | Foreign countries |
|-----------------------|-----------------------------------|---------------------------|-------------------|
| General medicine      | 284                               | 39                        | 29                |
| Pharmacy              | 67                                 | 6                         | 17                |
| Dentistry             | 55                                 | 7                         | 83                |
| Nursing               | 771                                | 476                       | –                 |
| Midwifery             | 53                                 | 48                        | –                 |
| Public health         | 72                                 | 18                        | –                 |
| Environmental Health  | 96                                 | 22                        | –                 |
health workers. According to the projections, 949 nurses are required in 2025 to cover health services for the population in Ilam province. Only half will be trained by IUMS (about 497 nurses), and the rest should be provided by other medical universities. IUMS can train more nurses needed in 2025 by increasing capacity and increasing the number of nurse admissions. Although in the study by Shokri et al. the share of general practitioners per 1000 of the population in Ilam in 2015 was among the lowest ratios compared to other provinces in Iran, the misdistribution of health workers within Ilam province. It should be mentioned that this study does not consider the misdistribution of health workers within Ilam province. In the study by Sefiddashti regarding inequality in the distribution of human resources in Tehran province, they found that the highest value of the Gini coefficient (GC) was related to nurses (GC=0.291) in 2007. They indicated that inequalities in the distribution of human resources in the health sector have increased over time, partially due to the developing of the private health sector. It also should be considered that demand projections in 2025 do not mean IUMS would have enough financial resources to employ and recruit all health workers required, at least in the public health sector.

A new trend which has formed and intensified over the last few years is the rising number of students who go to other countries – mainly Russia and other European countries – to study in medical fields. The high unemployment rates amongst university graduates and the poor economic situation in Iran due to international economic sanctions over recent years have encouraged people to shift towards medical fields, as there is more chance of finding a job. There is tough competition for these courses, students have to pass a national exam called Konkor in order to enter medical universities and choose those medical fields with a higher chance of employment such as medicine, dentistry, pharmacy and nursing. Those students who go abroad to study these fields by paying with their own money are usually those students who failed Konkor. So, those from rich families have the chance to go abroad to study in these medical fields by paying, which can jeopardise equity in education. This trend has been exacerbated as these students were allowed to come back to Iran to continue their studies, as the cost of living and studying abroad increased as the economic situation worsened and the value of Iran currency decreased over the last few years. Many critics in Iran opposed it, as they believed it is against equity in access to high education, and these students bypassed Konkor just because they are from rich families.

Although one the main objectives of establishing the MoHME was to address the shortage in human health resources in the country by increasing the capacity to train more students in different medical fields, the findings of this study show that the number of graduates in most of the selected medical fields was more than what is needed for the health system in Ilam province.
Strengths and limitations

Unlike other similar studies done at a national level, this study is one of the studies targeting supply and demand of the human health workforce conducted at a provincial level. This study also tried to address the demand for health workers in 2025 by addressing academic courses, the rate of medical student admission and educational processes at medical universities. We made several assumptions especially for projecting the supply side of human resources which can be used by other researchers working in this field within a local region. These include: focusing on just Ilamian students (we excluded non-Ilamian students from calculations), considering all Ilamian students studying in different universities as new graduates to work in Ilam province, and also taking into account inflows of non-Ilamian workers into Ilam province and outflows of Ilamians from Ilam province. One the limitations that we faced in conducting this study was that there was no reliable and up-to-date health human information system in Iran in general and in Ilam in particular to collect, store, analyse and provide a reliable and accurate health human profile for evidence-informed policymaking regarding health workforce planning. For exact and precise supply and demand projections, there was no neat profile, even at the provincial level. So, we had to follow reliable assumptions for predictions instead. Projections of the supply and demand of the health workforce are influenced by many factors, and it is difficult to take all of them into account.13 The current model uses different assumptions for these projections, which may affect precise predictions. Assuming equal inflows and outflows of migration into and out of Ilam province, and assuming that 5% of students continue their studies or withdrawn from study, were some of the assumptions we used in this study. A 3% attrition rate for health workers was assumed due to death, retirement and so on. According to this assumption, the number of nurses leaving the heath sector was estimated to be 342, which may be more than the actual number who may leave the health sector in reality. We could not obtain the precise number of Ilamian students studying in Islamic Azad Universities. So, we estimated the numbers based on the Table 2, which might have led to higher estimates than the real figures. It should be mentioned that we did not consider the current employment status of employees in the health sector for demand projections and those who may leave the health sector. A majority of health workers working in Ilam province are recruited as graduates who are obliged to work for about two years based on law in deprived regions. After this two-year period, they are usually replaced by other graduates on waiting lists, and these leavers have to wait for occasionally job opportunities in the future or have to shift to the private health sector to work. The turnover and variation in these kinds of workers is high, and no reliable trend for inflows and outflows was found in Ilam province. So, we decided not to consider these fluctuations and followed the 3% attrition rate. Another limitation of the study was that we did not take into account the number of unemployed graduates in Ilam in 2015, as there were no data available in this regard. The current unemployment rate and the number of unemployed graduates should be taken into account as a source of new recruits.

Conclusions

As one of the main objectives in creating the MoHME in Iran was to reach self-sufficiency in meeting demand for the health workforce in the country, accordingly each medical university in Iran as the representative of MoHME in its province should make a long-term human resources plan for its own territory and represent the health needs of its catchment area in medical educational processes. That means medical universities should provide necessary health workers for its population and try to avoid training more medical students than what is needed.

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Authors’ contributions

M.B. participated in designing the study, gathering data, analysing and interpreting data and writing the manuscript. All authors made substantial contributions to the design and analysing of all phases of the main study and also the conception and design of the paper. All authors read and approved the manuscript.

Availability of data and materials

All raw data and also the file of this study have been prepared in Persian (not English). But the corresponding author will gladly provide any supporting materials upon request.

Ethical approval

This study has been approved by the ethics committee of Ilam University of Medical Sciences (code number: IR.MEDILAM.REC.1399.089).

Informed consent

Not applicable.

Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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