Factors Affecting the Number of Medical Faculty Members Required in Iranian Medical Sciences Universities: An Exploratory Factor Analysis

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Abstract

Background: Because of an increased demand for clinical faculty members in medical departments and no comprehensive model, identifying the affecting factors could be effective in planning in this area. So in this study we aimed to identify the key variables (and their weight) influencing the number of medical faculty members required in Iranian medical sciences universities.
Methods: This study was an applied analytical descriptive one. It was a cross-sectional survey and done in Iran using the exploratory factor analysis. The main data collection instrument was a questionnaire and SPSS software version 20 was used for statistical analysis. We used expert opinions to assess the questionnaire's validity and Cronbach's coefficient alpha to confirm its reliability. The statistical population consisted of faculty members and directors of medical departments of Iranian medical sciences universities and experts of medical education. The sample size was determined to be 320.
Results: Exploratory factor analysis indicated that in an optimal system, nine factors (consisted of 40 variables) titled "research/scholarship services" (14.3%) ,"specialty training" (12.9%), "clinical services" (9.5%), "features of faculty members" (7.5%), "undergraduate training" (6.8%), "university development level" (6.1%), "other characteristics of the university or the region" (5.1%), "desertion rate among faculty members" (4.5%), and "the nature and scope of the specialty" (2.9%) could explain 69.623% of total variance of the rrequired number for medical faculty members.
Conclusion: Some of the factors like the volume of "research services" and "undergraduate training" should be considered in estimating the staffing requirements of medical faculty members.
Keywords: FACULTY, MEDICAL, REQUIRED WORKFORCE, IRAN, FACTOR ANALYSIS

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Introduction

Faculty members are the most vital source for academic departments and the pillar of excellence in a university (1, 2). Because of involvement in therapeutic procedures, medical faculty members, in addition to common roles and responsibilities (3), are increasingly considered as the most important capital of medical universities (4). Therefore, recruitment of faculty members for an academic health center is one of the critical duties of departments and faculties. So if it is properly done, this could be a wise and even vital investment (with high potential returns) (4).

As currently universities of medical sciences recruit faculty members and develop their

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training programs by relying on their own earnings (gained from hospitals) (5), it is difficult to decide on the recruitment of faculty members in academic centers. And quantification of academic activities has turned into one of the key issues (6-8).

Therefore, medical faculties should periodically measure the size of their departments in order to make sure that a sufficient number of faculty members are available to fulfill educational, research, and service goals (8, 9).

Nevertheless, there is no universal or systematic classification for the enhancement of faculty members' positions in relation to research and training functions (10). In other words, although the responsibilities assigned to faculty members are more than merely teaching issues and also involve research and executive services (6), educational services are the main bases for the evaluation of the duties of faculty members in most universities (11). So one of the most commonly used methods to estimate the number of required faculty members is the student/teacher ratio. Although such a is not adequate (9, 12), it is used as the indicator of human resources adequacy in the absence of other alternatives (12).

This subject has been dealt with in few studies on the estimation of the faculty members around the world. These studies have emphasized the necessity of examining the effect of various variables on the estimation of the workload and the number of required faculty members (8, 13, 14).

The review of studies on "clinical" faculty members in the world provided little information about the estimation of workload and the number of required faculty members. Halton's study in which pediatric oncology physician workforce was estimated with consideration of "clinical and academic workloads" (15), Bachir's study on urologists and related sub-specialties (16), Lightfoot's research on academic urologists compared with other urologists in which different workloads of academic specialists (not only treatment services) were addressed (17), Linzer's study on general internal medicine that used physician demographics and work patterns to determine physician staffing needs (18), Poehlman's research on a "family medicine" department that assessed workforce availability (instead of assuming faculty availability based on an average daily or monthly schedule) (7), Holloway's research in the field of "family medicine" in USA (19), and Clack and Jarrell's similar studies on general medicine, which calculated the required faculties on the basis of general medical students' rotations (curriculum volume) (20, 21)21 all are predominantly limited to a particular specialty and have focused on one or a few dimensions, and often do not have a comprehensive attitude.

In Iran [considering Iran's specific model in which medical education has been integrated in to health care services (22)] an increasing trend in the number of faculty members of medical sciences universities can be seen [55% growth since 2008 to 2015 and 26% during the last 5 years (4)]. Except our previous study that outlined the current situation regarding the determination of medical faculty members' staffing needs (qualitatively) (23), none of the others similar studies exist regarding the Iranian clinical field. Hence, the present study aimed to determine the effective factors in estimating the staffing requirements of medical faculty members and the extent of each factor's effect in Iran.

Methods

Study Design

This study was an applied analytical descriptive one. It was a cross-sectional survey, which was in Iran in 2017. A quantitative approach (using the exploratory factor analysis) was used generally, but qualitative methods were also used as needed.

Data Collection

A researcher-made questionnaire was the main instrument to identify and finalize the factors affecting the estimation of required medical

faculty members.

First a literature review was done to extract the variables from different sources without any restriction in time (based on hand searching and also "Ulrich Web" that showed there are good studies before 2000) or type of study (because of the lack of studies), but just in English and Persian languages. After so much hand searching, these words were selected to search: Clinician Faculty/ Medical Faculty/ Attending Faculty/ Academic Physician/ Physician Faculty/ Specialty Faculty/ Medical Teacher/ Medical Instructor/ Clinician Educator/ Attending Physician/ Hospitalist Educator, Staffing Needs/ Requirement/ Required Number Full Time Equivalent (FTE), Required Faculty/ Faculty Labor Needs, Faculty Requirement Modeling, Faculty Forecasting/ Projection/ Prediction Models, Calculate Faculty Needs, Faculty Supply and Demand, Faculty Staffing Formula/ Plan, School/Department Teaching Manpower Requirement/ School's Need to Faculty, Formulas Used to Determine/ Allocating Number of Faculty Positions, Right Size Number of Faculty Quantitative Standards, Calculate Workload and Time Required To Accomplish Faculty Tasks.

The below sources were determined to search:

1. Search engines: not only Google Scholar but also other specialized search engines like Duck Duck Go, Microsoft Academic Search, Refseek Academic Search, and Online Journals Search Engine (OJESE.com).

2. Data bases: Iran Medex, Mag Iran, SID, and Iran Doc were searched for studies in Persian language and Scopus, PubMed, Cochrane, and Education Resources Information Center (ERIC) were searched for English language studies. Meanwhile some considerable publishers like Elsevier, Emerald, Springer, Willey, and ProQuest were considered, too.

3. Thesis and gray literature: For Persian language thesis, Iran Doc and libraries of medical sciences universities were considered as needed. For international ones, Google Scholar, ProQuest, and websites of medical sciences universities or medical schools were searched as needed.

4. Related journals: The most important journals that were searched were Academic Medicine, Medical Education, and Medical Teacher.

In order to consider all aspects of the activities of a faculty member and prevent the probable ignorance of a group of variables, the contents of all existing administrative regulations and other upstream documents regarding faculty members and also the registration system of faculty members' activities of Iranian medical universities (SHOA system) were studied deeply and analyzed using qualitative content analysis.

Then, extracted themes were finalized through a focused group discussion with stakeholders (the participants of the focused group discussion (FGD) consisted of scientific and executive experts on issues related to faculty members in Iranian medical universities and the headquarters of the Iranian Ministry of Health and Medical Education. They were selected due to their various roles in approving the relevant laws, defining job descriptions and definitions, determining the number of organizational positions, or the number of faculty member recruitment license, etc. Finally, nine of them were selected for the group discussion session. In FGD, three general questions were considered:

- In your opinion which tasks that are defined in the upper documents for faculty members are applicable for clinical faculty members?
- Which of these tasks can be related to determining the need for faculty members?
- What are the examples or representations of each tasks of the faculty?

Based on the in-depth review of previous studies and the result of group discussion, the initial draft of variables was developed in a 75-item questionnaire. The questionnaire was sent to various groups of experts to assess its validity (face and content). After eliciting experts' opinion, based on the overlap of some variables or the unfeasibility of their

extraction, finally 44 items were extracted.
In order to assess the questionnaire reliability, 20 questionnaires were distributed among the study population. Since Cronbach's alpha was obtained 94.3%, the reliability of the questionnaire was evaluated as good.
The questionnaire consisted of seven-point Likert-type scale, with 0 representing completely uninfluenced to 6 as completely influenced for each item.
The questionnaires were distributed among the participants in person (by research team) or via email and were then collected after one or two weeks. The data collection phase was accomplished in over 2 months.

Population

To identify the variables (aiming at incorporation of policymaking and execution levels), the population consisted of:
- Faculty members of Iranian medical universities
- Directors of medical departments in faculties of medicine (in all medical sciences universities)
- Experts of medical education (individuals with a background or related studies in this area).

Inclusion criteria for the third group of participants were having academic or executive experience as well as essential knowledge in the domain of faculty members' affairs. And inclusion criteria for other participants were being in one of the mentioned positions. Exclusion criterion was a participants' refusal to participate in the study.

Sample Size and Sampling Methods

According to a number of statistics experts quoted by Williams, Brown, and Onsman (24), the appropriate sample size for doing factor analysis should be at least 3 times the items in the questionnaire. So the sample size (considering the possible low return rate of questionnaires) was determined to be 320 (7 times the items). After collecting the questionnaires, data adequacy was measured using Kaiser-Meyer-Olkin (KMO) test.
Since there were various groups of stakeholders, sampling was performed in several methods. Simple random sampling was used for the first group. Due to different universities' share of medical departments, stratified random sampling was used for the second group based on the weight ratio of the number of departments in each university to the total medical departments in all medical universities. Finally, due to the low number of samples, total enumeration was used for the third group. All information about sampling is provided in table 1.

Data Analysis

Data were entered into SPSS software version 20 for statistical analysis. After measuring the data adequacy, the factors affecting the number of medical faculty members required and their eigenvalue and variables of each factor were extracted after a varimax rotation.

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. Also, the questionnaires were handed out to the participants with a clear introduction at the beginning, and the information was gathered voluntarily, anonymously, and confidentially.

Results

Following at least two phone or email follow-ups, the return rate of questionnaires was equal to 98%. More precisely, 314 out of 320 distributed questionnaires were answered and returned. The profile of samples is shown in table 2.
Table 2 indicates that most of the respondents to the questionnaire (83%) were medical faculty members, the majority of whom (45%) were directors of medical departments with over 15 years of experience in medical education

Table 1: The sample size and sampling methods

Study population	Population size	Weight ratio (to the whole samples)	Sampling method	Sample size
Medical faculty members	6848	35%	Simple random sampling	110
Directors of medical departments	389	50%*	Stratified random sampling	160
Expert opinion	About 50	15%	Total enumeration	50

*It is noteworthy that since directors of clinical departments play the most important role in determining the number of required faculty members, the largest number of samples was selected from this group

Table 2: Sociodemographic characteristics of the participants

Participants' characteristics	Subtitle	Frequency	
		Number	Percent
Type of organizational relationship	Medical faculty member	261	83.1
	Non-medical faculty member	26	8.3
	Non faculty	21	6.7
	Indeterminate	6	1.9
Academic rank	Assistant professor	180	57.3
	Associate professor	81	25.8
	Full professor	27	8.6
	Non faculty or indeterminate	26	8.3
Years of service in medical education	Up to 5 years	51	16.2
	5 to 10 years	98	31.2
	10 to 15 years	60	19.1
	More than 15 years	99	31.5
	Indeterminate	6	1.9
Field of study	Surgical specialties	100	31.8
	Internal medicine specialties	118	37.6
	Diagnostic specialties (i.e. radiology & pathology)	33	10.5
	Other specialties	62	19.7
	Indeterminate	1	0.3
Position	Director of department	142	45.2
	Medical faculty member	101	32.1
	Non-medical faculty member or non-faculty	47	14.9
	Indeterminate	24	7.6
Total samples		314	

(32%). In addition, most participants were assistant professors (57%).

The result of KMO test indicated that the sample size was enough for factor analysis (0.906). Moreover, the Bartlett test and its corresponding level of significance showed that the data matrix was not uniform and there were significant relationships between data (X^2=9799.033, df=946, Sig=0.0001).

After the exploratory factor analysis, it was observed that nine factors had an eigenvalue greater than 1. Therefore, it can be stated that variables can be reduced to nine factors with specific concepts. After a varimax rotation, these nine factors could explain 69.623% of total variance of concluding factor.

Table 3 shows the total variance explained by the 44 variables in nine explored factors and Figure 1 depicts the relevant Scree plot.

The study of commonality rate of each item with the linear combination of other items showed that since the cumulative percentage of total variance explained by extracted factors was equal to 70%, there was no need

Table 3: The contribution of each factor to the explanation of total variance

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.913	31.622	31.622	13.913	31.622	31.622	6.289	14.293	14.293
2	4.762	10.823	42.445	4.762	10.823	42.445	5.661	12.866	27.160
3	2.928	6.654	49.099	2.928	6.654	49.099	4.177	9.494	36.654
4	2.168	4.927	54.026	2.168	4.927	54.026	3.318	7.541	44.195
5	1.805	4.101	58.127	1.805	4.101	58.127	2.993	6.802	50.997
6	1.675	3.806	61.933	1.675	3.806	61.933	2.685	6.102	57.099
7	1.309	2.974	64.908	1.309	2.974	64.908	2.266	5.149	62.248
8	1.059	2.407	67.314	1.059	2.407	67.314	1.970	4.477	66.725
9	1.016	2.308	69.623	1.016	2.308	69.623	1.275	2.898	69.623

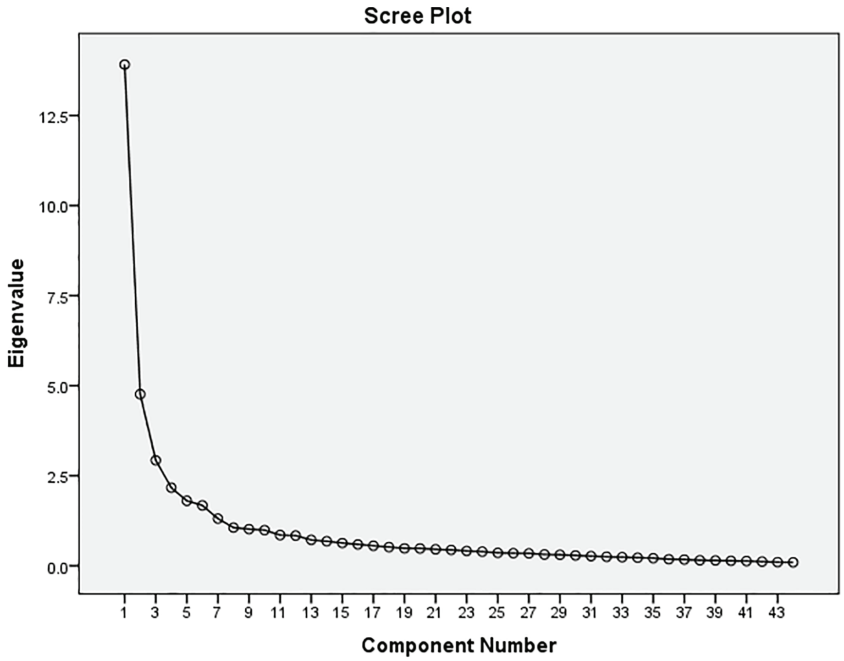

Figure 1: Scree plot of the eigenvalues and number of factors

to eliminate the items with low correlation in factor analysis.

After the optimal number of factors was determined, the items were classified under extracted factors based on the factor load values after a varimax rotation. Although it was possible to focus on variables with a factor load greater than 0.4, factors with a factor load greater than 0.5 were selected in order to increase the applicability of the model and help the relevant policymaking. Accordingly, four variables "gender of faculty members", "lack of a non-teaching hospital in the city and the need for faculty members to cover medical demands of people", "being the head of other universities in a region", and "types of skills taught in various specialties" were eliminated.

Finally based on the content of the variables, the identified factors were classified under one of the following titles: "research/ scholarship services", "specialty training", "clinical services", "features of faculty members", "undergraduate training", "university development level", "other characteristics of the university or the region", "desertion rate among faculty members", and "the nature and scope of the field (specialty)". Figure 2 shows the relationship between variables and the factors. The findings are presented in figure 2.

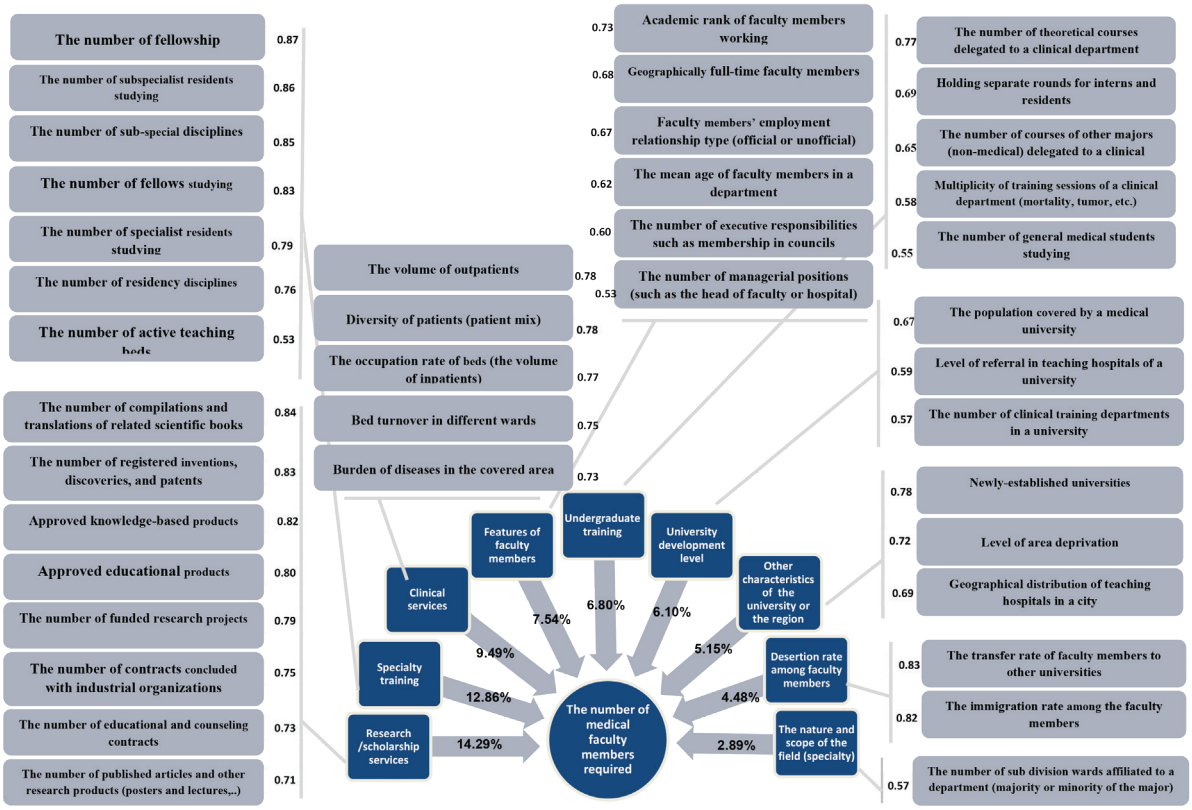

Figure 2: Factors and variables (and their factor loads) affecting the number of medical faculty members required in Iranian medical sciences universities

Discussion

In the study of variables affecting the number of faculty members required for medical universities of Iran (in an optimal model, not current situation), 40 variables were extracted and classified under nine factors with specific concepts. Considering the research objective and results, it can be stated that various factors should be involved in determining the number of required faculty members, some of which have a substantial weight because of the integration of the medical education system into the health care system in Iran. In addition, some of the factors that are considering now have no place in an optimal system and should be replaced by more effective factors.

One of the considerable results of this study was that the research/scholarship function of faculty members explained the highest variance in the estimation of required faculty members, whereas all participants of our previous study agreed that "research" and similar activities has no impact on the staffing needs of faculty members in Iran (23). Although the use of data related to research activities seems to be problematic because research activity cannot be broken into separate elements and standards of the Education Accreditation Council have not specified a quantitative minimum for such activities per institution or per faculty member (9), the volume of research/scholarship activities of faculty members is seriously taken into account in determining the required faculty members in western countries (8, 17, 19, 25, 26). In fact, this problem has been greatly solved by classifying the positions and roles of faculty members in medical universities under the three titles of "educational", "research", and "clinical" (19).

The second highest variance was related to the volume of specialty training, which was also extracted in studying the "current" status of Iran (23). Similar to previous studies, "the number of residents" was one of the most important effective variables identified in the

present study (10, 27-30).

"Clinical" function of the faculty members explained the third highest variance. This factor is currently regarded as one of the main criteria in Iran (23); however, variables of this factor are more comprehensive in the model proposed in this study. In other words, experts believed that, in an optimal model, "variety of patients", "burden of diseases in the covered area", and "bed turnover in different wards" should be taken into account, in addition to the "number" of inpatients and outpatients. The volume of clinical services as a variable in determining the required faculty members has been emphasized in many previous studies (15, 17, 31, 32). Roshetsky reported that there was no significant relationship between the workload of medical faculty members and the real volume of patients (14). In fact, some of the clinical faculty members believe that efficiency in serving patients is the enemy of medical education (33).

"Faculty members' characteristics" was the fourth factor identified in the present study. Similar to this study, Abdul Rahim (34) extracted "academic rank" as an affecting factor. The effect of "geographically full-time" (working at least 54 hours per week) against "full-time" faculty members (working about 40 hours per week) is consistent with the findings of Linzer (18) and also Stuart and colleagues (5). In the present study, "gender" was not identified as an effective factor in determining the number of required faculty members. This is consistent with the results of Howell (35) and Crespo (36). In fact, they showed that there was no significant difference between male and female faculty members in terms of workload, and gender was not an effective factor in desertion. By contrast, studies of Linzer (18), Bunton (25), and Nassar (37) indicated that gender was an influential factor in this regard.

"Type of employment relationship" of faculty members has not been directly mentioned in similar studies. This may be attributed to the low number of faculty members with permanent relationships in western countries (10). Since having an permanent position (official recruitment relationship) plays a major role in the allocation of time to education (35) (because of the feeling of job security and less concern for earning income), it can be taken into account in determining the number of required faculty members.

Another result of this study was the effectiveness of the volume of "managerial and executive activities" of faculty members, which is consistent with the findings of Arenson (28), Poehlman (7) and Holloway (19). In other words, if a number of faculty members of a department have managerial positions, the hours they are available for educational and clinical affairs should be reduced and considered in determining the number of required faculty members. "Managerial positions" are currently considered in determining required faculty members in Iranian universities, but "executive activities", such as membership in a council, committee, scientific journal, and national or international editorial boards, are taken into account in none of the universities (23). The effectiveness of a special "managerial" position in roles of medical faculty members is in contrast with the findings of Sherbino (32).

The fifth identified factor, was "volume of undergraduate training", which its variables are consistent with Clack (20) and Jarrell's studies (21) who have researched in order to provide the human resources of a medical school for "general medicine" education.

"University development level" and "other characteristics of the university or the region" were other factors identified in this study, whereas they have not been mentioned in studies conducted elsewhere. A part of the importance of the variables related to the location and space of service delivery in Iran can be attributed to the integration of medical education into the health care system and the university's requirement to cover the medical treatment demands of the people due to the ownership of teaching hospitals with national and regional referrals (23).

The possibility of desertion was identified in the present study and most previous studies (17, 18). The nature and scope of field or major, with the lowest variance, was another extracted factor. Robertson also stated that all academic institutions and independent departments have their own underlying factors and priorities that determine the way their academic activities allocation should be planned and modeled (38). Howell also believes that expectations from faculty members have greatly changed because of the specialty, discipline, and departmental needs (35). In fact, the needs of different departments for faculty members vary because of the different nature of the diseases covered, diversity and the number of affiliated wards, bed turnover, and length of stay (23).

Considering what mentioned above and authors' searches, it can be claimed that the present study is the first national one that deals with the identification of factors affecting the staffing needs of faculty members and their weight. Concentration on multiple specialties, involving all of the medical sciences universities (who have faculty of medicine) in the country, diversity of samples (different level of policymaking, execution, and target community) and appropriate sample size are some of the positive points of the present study. However, some of the extracted variables are specific to Iran because of the integration of medical education into the health care system and may not be generalized to other countries.

Conclusion

Since the clinical faculty members use a high percentage of the costs of the health sector and medical education, it is very essential to use the factors affecting the estimation of required faculty members in an organized manner. The variance of various factors suggests that some dimensions specially the volume of "research/ scholarship services" and "undergraduate training" which have no place in current status should be involved in the estimation of medical faculty members.

Given that one of the effective variables is the number of students (in general, specialized, and higher levels), one of the prerequisites for the estimation of needed medical faculty members is to develop a national and provincial document of demand and supply for medical human resources. Then, the above-mentioned documents should be approved by the decision-making authorities to be regarded as a long-term guide and also in annual plans. While the capacity of general practitioner acceptance in a university may sometimes increase by 50% from one year to the next, it is not possible to plan for determining the number required for faculty members.

To involve research affairs in the estimation of required faculty members, faculty member positions cannot be differentiated (with an emphasis on merely one role in each position and even designing a separate performance evaluation system for each type of position). Otherwise the volume of research activities can be considered as an allowance (which is usually used to calculate the workload) for all faculty members (because research activities are a part of self-development programs and are common among all faculty members).

However, it is obvious that future strategies of the health and medical education system like prevention and provision of outpatient services, expansion of communications with the industry, and attraction of grant for increasing research efforts should also be taken into account in estimation of required faculty members.

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