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Estimating the Need for Pharmacist Manpower in 2032 Using Supply And Demand Analysis in Iran

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Abstract

Background: Pharmacists hold a distinctive position within the healthcare system. The education and training of pharmacists through higher education incur both direct and indirect costs for society. Moreover, there exists a disparity between the supply and demand of human resources. Therefore, this study aims to estimate pharmacists' supply and demand in 2032 in Iran.

Methods: The descriptive-analytical research was conducted using the library method, which involved surveying pharmacists in Iran's pharmacies. A researcher-made checklist was used to estimate consultation time. Current and past statistics concerning the number of pharmacy students and graduates and the migration and mortality rates of pharmacists were obtained from the Medical Council, the Ministry of Health, and the National Organization for Education Assessment of Iran to estimate the supply of pharmacists up to 2032. The demand for pharmacists in 2032 was estimated by examining four scenarios within the realm of professional roles and activities of pharmacists. After gathering data from 160 pharmacies, the collected data were analyzed. For sensitivity analysis and increasing accuracy, the results of Iran's population in 2032 were calculated in three scenarios: decreasing, stable, and increasing, and were used in demand calculations.

Results: The mean age of pharmacists was 37.57±10.74 years. The mean consultation time per patient was 114.21±58.81 seconds for prescription medicines and 90.51±45.23 seconds for over-the-counter medicines. The overall mean demand for pharmacists in 2032 was estimated to range between 26,888 (minimum) and 28,538 (maximum), while the total supply was projected to be 40,349. Therefore, it is predicted that by 2032, there will be an excess supply of between 11,811 and 13,461 pharmacists in Iran.

Conclusion: This study demonstrates that Iran will face an excess supply of pharmacists by 2032. This considerable surplus highlights an urgent need for strategic workforce planning to ensure that this growing pool of pharmacists is effectively integrated into the healthcare system. Policymakers should take these projections into account so that the education, training, and deployment of pharmacists are better aligned with the evolving healthcare needs of the population and can support more efficient use of pharmaceutical care services.

Keywords: Supply, Demand, Pharmacy, Human resource

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Introduction

Pharmacists are among the most crucial resources in the healthcare system and pharmaceutical industry (1-3). In Iran, a pharmacist is an individual who obtains a Doctor of Pharmacy (Pharm. D.) degree after completing a roughly 6-year pharmacy program. Pharmacists constitute one of the most important components of the healthcare chain (4). They can serve as a suitable reference point for controlling the prevalence, incidence, intensity of compli-

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↑What is "already known" in this topic:
Previous studies have highlighted the critical role pharmacists play in healthcare and the ongoing concerns regarding workforce supply and demand. However, there has been limited research specifically addressing the future supply and demand dynamics of pharmacists in Iran.

→What this article adds:
This study provides a comprehensive estimation of pharmacist supply and demand in Iran for 2032, revealing a projected surplus of between 11,811 and 13,461 pharmacists. These findings can inform educational policies, workforce planning, and healthcare strategies to optimize the pharmacist's role in the Iranian healthcare system.

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cations, and relapse of diseases. Effective pharmacist-patient communication can also foster a culture of optimal drug usage, leading to enhanced treatment outcomes (5, 6).

Such efforts may reduce costs associated with parallel treatments, decrease drug misuse, significantly lower the occurrence of side effects, and prevent hazardous drug interactions (7, 8). A study conducted in Brazil to estimate the pharmacist workforce in their healthcare system estimated the presence of at least one pharmacist for every 10,000 inhabitants in most regions of the country. The study also established that the greater the number of pharmacists present in a region, the better patients have access to pharmaceutical services (9).

The education and training of pharmacists through the higher education system incur both direct and indirect costs for society; moreover, it appears that within the field of pharmacy, there exists a disparity between supply and demand (10). The World Health Organization (WHO) has estimated a global shortage of approximately 7.2 million healthcare workers worldwide, and this figure is projected to rise to around 12.9 million by the year 2035 (11).

On average, people worldwide have been living longer in recent years, leading to an increasing need for medications and treatments (12). In 2015, the Ministry of Health of Iran estimated that around 23,078 pharmacists would be required by 2025(13). Farzadi et al. (2005) projected that the number of pharmacists needed to provide pharmaceutical services in hospitals would range from 775 to 1549 by 2013 in Iran. Furthermore, this study estimated that around 1,100 pharmacists would be needed for employment in the pharmaceutical industry, and 939 pharmacists would be required to provide pharmaceutical services in the Ministry of Health. Ultimately, the supply of pharmacists for 2015 was estimated to be around 12,900 individuals, while the calculated demand was approximately 15,684 pharmacists. Consequently, due to the shortage of pharmacists in 2015, the number of admitted students should increase from 665 in 2005-2006 to 770, representing a 15% increase(14).

Given the significant role of pharmacists in the healthcare system and the pharmaceutical industry, along with the substantial time and cost investments required for pharmaceutical education, failure to accurately estimate this demand and supply could lead to substantial resource wastage.

Accordingly, the present study examines the supply and demand of pharmacists (the required workforce for the healthcare system and the pharmaceutical industry) in Iran up to 2032.

Methods

This descriptive-analytical study was conducted to assess the human resource demand for pharmacists and their supply in Iran using a supply and demand analysis model based on the service delivery system provided by pharmacists.

Part A

The pharmacist supply until 2032 was estimated through the following steps:

1- Determining the number of active graduate general pharmacists at the beginning of the study: In this step, the total number of active graduate general pharmacists in Iran was determined using statistics from the Ministry of Health and the Medical Council.

2- Determining the number of pharmacy students enrolled in the Doctor of Pharmacy program at pharmacy faculties across Iran: In this step, the pharmacy faculty determined the number of pharmacy students enrolled in the Doctor of Pharmacy program using statistics from the Ministry of Health. These projections were made considering the recent expansion in pharmacy school admission capacities and assuming a stable annual intake growth consistent with the observed average trend.

3- The annual mean number of pharmacy graduates who return to Iran after completing their education abroad and undergoing the process of document equivalence and accreditation was also obtained from the Ministry of Health.

4- Using the above statistics, the number of pharmacy students who will graduate by 2032 was estimated based on the current admission trends. Afterward, this number was added to the total number of current pharmacy graduates.

5- From the calculated total number of graduates until the end of 2032, deductions were made considering estimates for mortality and the number of graduates who will emigrate from Iran. Ultimately, the supply of the pharmacist workforce until 2032 was estimated based on these calculations.

Part B

Pharmacist demand until 2032: Four areas of work and activity for pharmacists were considered to estimate the pharmacist demand until 2032:

Working in Pharmacy

Initially, the ability of pharmacists to provide consultations per hour and the number of visits to pharmacies were estimated. To this end, a checklist was used to distinguish between prescription and non-prescription visits for both daily and 24-hour pharmacies. Since the objective was to measure consultation time and the tool used was an observational checklist rather than a questionnaire, conducting validity and reliability tests was not required. In the next step, the number of visits in 2032 and the required number of pharmacists based on their capacity to provide consultations for patients in pharmacies were estimated.

The consultation time provided by pharmacists and their activities in pharmacies across Tehran were assessed by determining the number of pharmacies using the following formula (15):

$$n = \frac{NZ^2S^2}{Nd^2+z^2s^2}$$

Where N is the number of pharmacies in Tehran (2090 pharmacies), Z is the confidence coefficient at a 95% level (1.96), S is the standard deviation (7.41), and d is the precision level (0.3).

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Approximately 37% of all registered pharmacists in Iran are based in Tehran, according to data from the Medical Council. Given that Tehran also hosts the largest number of pharmacies nationwide, data collection through checklists was conducted in this city. Furthermore, because the professional responsibilities of pharmacists and the operational functions of pharmacies do not substantially differ between urban and rural areas—and due to the absence of reliable reports detailing such differences—pharmacies located in Tehran were selected as the study sites.

The total sample size (i.e., the number of pharmacies studied) was determined to be 158 in Tehran. Finally, 160 checklists were prepared and distributed among pharmacies in various regions of Tehran, including central, northern, southern, western, and eastern areas, consisting of 32 checklists for each region. These 32 pharmacies were randomly selected in each area. The checklists were completed by the researcher.

The researcher-made checklist consisted of four sections:

A) Demographic questions, including the type of pharmacy, age, and gender of the technical supervisor

B) Observed consultation time for patients by the technical supervisor for prescription and over-the-counter (OTC) medications, as assessed by the researcher

C) The number of patient visits to the pharmacy within 24 hours to obtain prescription and OTC medications

D) A question directed to the technical pharmacy supervisor about their capacity to provide consultations to patients per hour.

In this study, "OTC medications" refer to medications that patients receive from the pharmacist without a prescription and receive consultation from the pharmacist upon obtaining them. Furthermore, the term "consultation time" for prescription medications refers to the time when the pharmacist provides consultation and explanations to the patient during the prescription delivery, excluding prescription preparation time.

In this study, a prescription was given to a regular patient, including four medications for the treatment of H. pylori infection: 20 mg omeprazole capsules, 500 mg amoxicillin capsules, 500 mg clarithromycin tablets, and bismuth subcitrate tablets.

This prescription was selected after consultation with clinical pharmacists. Because it represents a long-term treatment regimen that requires a high level of patient adherence. Consequently, comprehensive pharmacist counseling is essential to ensure treatment compliance. This particular prescription inherently demands a complete counseling model aimed at improving adherence, whereas most other treatment regimens typically require less detailed explanations. Therefore, this prescription was chosen to capture the maximum possible pharmacist consultation time.

The prescription was delivered to the pharmacy, and the consultation time provided by the pharmacist was observed and recorded at the time of prescription delivery. Afterward, the consultation time provided by the pharmacist for OTC medications was estimated by requesting a cough remedy from the pharmacist and asking the pharmacist to record the consultation time. It is worth mentioning that the studied pharmacies were those where the pharmacist carried out medication delivery, and they cooperated with the researcher as required. When calculating the consultation time, the pharmacist was not aware that consultation time was being calculated. This approach was adopted because if the pharmacist had been aware that consultation time was being measured, they might have allocated more time or behaved differently than usual, potentially introducing bias into the study results.

Working in hospitals

The required number of pharmacists per hospital bed was determined by reviewing the regulations for establishing and managing pharmacies in Iran. Also, the predicted number of hospital beds needed in the year 2032 was estimated accordingly by statistics from the Ministry of Health. Consequently, the number of pharmacists working in the hospitals was also calculated.

Working in the pharmaceutical industry

Given the lack of precise and scientifically validated data on the number of pharmacists working in Iran's pharmaceutical industry, a brief manual review of various international pharmaceutical industry reports was conducted to calculate the relative frequency of pharmacists employed in this sector across different regions of the world. Subsequently, using these statistics and expert opinions from industry professionals and policymakers regarding relative prevalence, the number of pharmacists required in the industrial sector up to the year 2032 was estimated.

Working in the academic-educational and research centers

Given the absence of precise and disaggregated data on faculty members or personnel working in educational and research centers with a pharmacy background—and considering that these centers primarily recruit individuals holding Ph.D. degrees, including some from non-pharmacy fields—an approximate estimation was made using scientometric databases of the Ministry of Health and medical universities. In addition, a brief manual review of international sources was conducted to calculate the relative frequency of pharmacists employed in educational and research centers across different regions of the world. Using these data, along with expert opinions from educational policy specialists, the number of pharmacists required in educational and research centers up to the year 2032 was estimated based on this relative prevalence.

Estimation of Iran's Population and Sensitivity Analysis

The population of Iran for the year 2032 was estimated using data from the Statistical Center of Iran and by referencing a similar study (16). To ensure an accurate estimation of the required number of pharmacists and to perform a sensitivity analysis under different population scenarios,

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three fertility assumptions were considered: decreasing, stable, and increasing. All calculations for population estimation were conducted under these three scenarios.

Data analysis

Data analysis was conducted using SPSS 16 software and Excel. Descriptive data analysis was performed using statistics such as frequency distribution tables, frequency percentages, and means. Based on these four areas of pharmacists' work and international studies, the demand for a pharmacist workforce until 2032 was estimated. Finally, the supply and demand of the pharmacist workforce in the year 2032 were compared and examined.

Results

According to Table 1, the mean age of the study participants was 37.57±10.74 years. The mean consultation time per patient by pharmacists was 114.21±58.81 seconds for prescription medicines and 90.51±45.23 seconds for over-the-counter (OTC) medicines. The results showed that female pharmacists allocated more time for consultation with patients for prescription and OTC medicines than male pharmacists ($P\leq0.05$). Besides, pharmacists' mean capacity for providing consultations to patients per hour was estimated to be 14.13±5.44 times per hour. There was no statistically significant difference in the mean capacity for providing consultations to patients per hour between male and female pharmacists in this study ($P>0.05$).

The results of the population estimation under the three scenarios are presented in Table 2. In the subsequent sections of the article, three corresponding demand models were projected based on these scenarios to enhance the accuracy of the results across differe nt population assumptions.

The participants of this research included 160 pharmacists from 160 pharmacies in different areas of Tehran. According to Table 3, the average number of visits in 24-hour pharmacies was significantly higher than in daily pharmacies for prescription and OTC medications ($P\leq0.05$). As shown in Table 4, 53.1% of the studied pharmacists were female, and 46.9% were male. Among the investigated pharmacies, 89.4% (143) were daily pharmacies, and 10.6% (17) were 24-hour pharmacies.

Estimation of Demand for Pharmacists by 2032:

A) Demand for working in the pharmacy

Currently, there are about 13,000 active pharmacies in Iran, with 10% of them operating as 24-hour pharmacies (1,300 pharmacies) and 90% operating as daily pharmacies (11,700 pharmacies) (17). In this research, the average working period for daily pharmacies was 290 days per year. According to the current population of Iran reported by the Statistical Center of Iran (84,000,000 people), the average number of visits to both daily and 24-hour pharmacies, the number of per capita visits of Iranians to pharmacies for prescription and OTC drugs were calculated to be 3.53 and 4.02 times per year, respectively. This value was obtained based on the findings presented in Table 3 and the number of pharmacies in this study (143 daily and 17 24-hour pharmacies) (Table 4). Accordingly, the total per capita visits of each Iranian person to pharmacies would be approximately 7.55 times per year (Table 5).

As shown in Table 3, the average visits to daily and 24-hour pharmacies for prescription drugs and OTC medications were 153.58 and 238.89 times per day, respectively. Also, 290 working days per year were considered for daily pharmacies and 365 working days per year for 24-hour pharmacies. Therefore, considering these explanations and the projected population of people in 2032, the following values are obtained (Table 6).

According to Table 5, the mean number of pharmacy

Table 1. Comparison of the mean age of pharmacists, consultation frequency per hour, and consultation time for prescription and OTC medications

Variable		$\overline{X}$	SD	P-Value
Pharmacist's age (year)	Male	38.08	8.35	
	Female	37.46	14.54	0.331
	Total	37.57	10.74	
Consultation frequency per hour (person)	Male	14.46	7.13	0.120
	Female	13.88	3.09	
	Total	14.13	5.44	
Actual consultation time for prescription medications (seconds)	Male	109.33	55.25	<0.001
	Female	118.08	34.60	
	Total	114.21	58.81	
Actual consultation time for OTC medications (seconds)	Male	86.08	23.75	0.021
	Female	95.14	88.38	
	Total	90.51	45.23	

Table 2. Estimated Population of Iran in 2032

Decreasing Scenario	Stable Scenario	Increasing Scenario
89,500,000	91,500,000	95,000,000

Table 3. Comparison of average visits to the studied pharmacies in a 24-hour period

Variable		$\overline{X}$	SD	*P*-Value
Number of visits for prescription medicines	24-hour pharmacy	108.02	18.72	0.001
	Daily pharmacy	72.26	26.27	
Number of visits for OTC medicines	24-hour pharmacy	130.87	44.04	0.000
	Daily pharmacy	81.32	31.12	

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visits per Iranian in 2022 was 7.55 visits per year. Assuming that the average number of pharmacy visits by Iranians in 2032 is the same as in 2022, the total number of pharmacy visits in 2032 will be between 675,725,000 (min) and 717,250,000 (max). Tables 5 and 6 show that a pharmacist can provide 29,390 consultations annually. Based on this value and considering the population of Iran in 2032, the total number of pharmacists required for activity in pharmacies in 2032 is calculated to range from 22,992 (min) to 24404 (max) pharmacists.

As shown in Table 1, a pharmacist can provide 14.13 consultations to patients in 1 hour. Considering a pharmacist's working hours per day (8 hours) and the average working days in a year (260 days), the required number of pharmacists for providing consultations in pharmacies in 2032 can be estimated as follows (Table 7).

B) Demand for working in the hospital in 2032

According to a report from the Iranian Ministry of Health in 2022, the number of hospital beds per 1000 people is 1.67 beds. Assuming that this hospital bed ratio remains the same in 2032 and considering the population size in 2032, there will be between 149,465 (min) and 158,650 (max) hospital beds in the country. Additionally, per the regulations for establishing pharmacies, one pharmacist is required for every 100 hospital beds. Accordingly, the required number of pharmacists in 2032 is as detailed in Table 8.

According to Table 8, the number of pharmacists working in the hospitals is estimated to range between 1495 (min) and 1586 (max) in 2032. The total number of pharmacists needed for pharmacies and hospitals in 2032 would be between 24487 (min) and 25990 (max).

C) Demand for working in the industry and academic-research sectors

The required number of pharmacists in Iran's industry and academic-research sectors in 2032 was estimated by examining the current number and per capita of pharmacists working in these sectors worldwide. Globally, approximately 7.09% and 1.84% of pharmacists are engaged in the industry and academic-research sectors, respectively.

The following equations were used to calculate the projected number of pharmacists needed for the industry and academic-research sectors:

$$A+X+Y=Z$$

A= total required number of pharmacists for working in pharmacies and hospitals in 2023

X=(αZ)= required number of pharmacists for working in the industry sector

α=7.09%

$Y=(\beta Z)$=required number of pharmacists for the academic-research sector

β=1.84%

Z=total required number of pharmacists for working in pharmacies, hospitals, industry, and the academic-research sector

X=0.0709 Z

Y=0.0184Z

Table 4. Gender distribution frequency of pharmacy supervisors and the type of pharmacy

Variable		Frequency	Relative frequency (%)	Total
Gender	Female	85	53.1	160
	Male	75	46.9	
Type of pharmacy	Daily	143	89.4	160
	24-hour	17	10.6	

Table 5. Estimated per capita visits of Iranians to pharmacies for prescription and OTC medicines

Row	Variable	Number (persons)
1	Number of visits by Iranians to daily pharmacies per year for prescription drugs (average daily visits = 72.26 times)	11700 × 72.26 × 290 = 245178180
2	Number of visits by Iranians to daily pharmacies per year for OTC drugs (average daily visits = 81.32times)	11700 × 81.32 × 290 = 27518760
3	Number of visits by Iranians to 24-hour pharmacies per year for prescription drugs	1300 × 108.02 × 365 = 51255490
4	Number of visits by Iranians to 24-hour pharmacies per year for OTC drugs	1300 × 130.87 × 365 = 62097815
5	Per capita visits by Iranians in the year 2022 for prescription drugs	(245178180+51255490) ÷84000000 = 3.53
6	Per capita visits by Iranians in the year 2022 for OTC drugs	(62097815+275918760) ÷84000000 = 4.02
7	Number of visits in 2022	(634450245÷84000000) = 7.55

Table 6. Estimated number of pharmacy visits in 2032

Row	Variable	Number (persons)
1	Total number of pharmacy visits in the year 2032 (Decreasing Scenario)	7.55×89500000=675,725,000
2	Total number of pharmacy visits in the year 2032 (Stable Scenario)	7.55×91500000=690,825,000
3	Total number of pharmacy visits in the year 2032 (Increasing Scenario)	7.55×95000000=717,250,000

Table 7. Estimated number of pharmacists required for pharmacy consultations in 2032

Row	Variable	Number (persons)
1	The ability of a pharmacist to provide consultations to patients in one year	14.13×260×8=29390.4
2	Number of pharmacists required for consultations in pharmacies in 2032 (Decreasing Scenario)	(675,725,000÷29390.4) =22991.5
3	Number of pharmacists required for consultations in pharmacies in 2032 (Stable Scenario)	(690,825,000÷29390.4) =23505.1
4	Number of pharmacists required for consultations in pharmacies in 2032 (Increasing Scenario)	(717,250,000÷29390.4) =24404.2

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Table 8. Estimated number of pharmacists required to work in the hospital in 2032

Row	Variable	Number in (Decreasing Scenario)	Number in (Stable Scenario)	Number in (Increasing Scenario)
1	Required number of hospital beds in 2032	149,465	152,805	158,650
2	Required number of pharmacists per hospital bed in 2032	1494.65	1528.05	1585.50
3	Total number of pharmacists required for pharmacies and hospitals in 2032	24,487	25,033	25,990

Table 9. Estimated number of pharmacists required in 2032 and the relative distribution of pharmacists

Row	Variable	Number in (Decreasing Scenario)	Number in (Stable Scenario)	Number in (Increasing Scenario)	Relative distribution (%)
1	Number of pharmacists required to work in pharmacies	22992	23505	24404	85.51
2	Number of pharmacists required to work in hospitals	1495	1528	1586	5.56
3	Number of pharmacists required to work in the pharmaceutical industry	1906	1949	2023	7.09
4	Number of pharmacists required to work in academic-research sector	495	506	525	1.84
5	Total	26888	27488	28538	100

*(COI: 95%)

Therefore, it is estimated that between 1906 (min) and 2155 (max) pharmacists would be required for the industry sector and between 495 (min) and 559 (max) individuals for the education-research sector in 2032. According to the above calculations, the estimated number of pharmacists in 2032 ranges between 26,888 (min) and 28538 (max) (Table 9). Also, 85.51% of pharmacists will be active in daily and 24-hour pharmacies.

Estimation of pharmacist supply by 2032

The supply of pharmacists in 2032 was estimated using data from the Ministry of Health of Iran and statistics on the number of pharmacy student admissions from the National Organization for Educational Assessment from the beginning of 2017 to 2022. The obtained results (Table 10) indicate that the mortality rate in the country, as reported by the Statistical Center of Iran, is 5 per 1000 people per year. Therefore, a calculated number of 579 pharmacists passed away during 2017-2022. According to the Ministry of Health, the average annual emigration of pharmacists from Iran is 112 individuals. Resulting in an estimated number of 560 pharmacists having emigrated from 2017 to 2022. Therefore, there were 22,025 pharmacists in Iran at the beginning of 2022. Table 11 represents the calculations for the number of supplied pharmacists by 2032. The number of pharmacists supplied in 2032 was estimated, assuming that the capacity for admitting pharmacists until 2032 will be similar to the current trend in recent years (1596 individuals per year).

According to the statistics of the Ministry of Health, the number of students currently studying in the field of pharmacy is 11,863. These students will graduate at the beginning of 2028. Other assumptions for the calculations include an annual emigration of 112 individuals, an annu-

Table 10. Estimation of the number of pharmacists at the beginning of 2022

Row	Variable	Number (persons)
1	Number of pharmacists present at the beginning of 2017, according to the Medical Council number	19351
2	Number of pharmacists present at the beginning of 2022, according to the Medical Council number	26629
3	Number of pharmacists added to the pharmacist workforce from 2017 to 2022 (according to the Medical Council number)	26629-19351=7278
4	Actual number of pharmacists at the beginning of 2017, based on MOH data	15886
5	Actual number of pharmacists at the beginning of 2022, according to statistics	15886+7278=23164
6	Actual number of pharmacists at the beginning of 2022, after accounting for a mortality rate of 0.5% between 2017 and 2025	23164-(23164×5(0.5%))=22585
7	Number of pharmacists at the beginning of 2022, after subtracting the migration rate (average migration of 112 individuals per year)	22585-(5×112) =22025

*(COI: 95%)

Table 11. Estimation of the number of pharmacists in 2032

Row	Variable	Number (persons)
1	Number of pharmacists present in 2022	22025
2	Number of Pharmacy students who will graduate within 6 years (2022-2028)	11863
3	Number of Pharmacy students who will graduate from 2028 to 2032	4×1596=6384
4	number of pharmacists in 2032	22025+11863+6384=40272
5	number of pharmacists in 2032, by adding the number of graduated pharmacists returning to Iran from other countries	40272+(10×338) =43652
6	The actual number of pharmacists at the beginning of 2032, after accounting for a mortality rate of 0.5% between 2022 and 2032	43652-(43652×10(0.5%))=41469
7	Number of pharmacists at the beginning of 2032, after subtracting the migration rate (average migration of 112 individuals per year)	41469-(10×112) =40349

*(COI: 95%)

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al mortality rate of 5 per 1000 pharmacists, and an annual return of graduated pharmacists to Iran, estimated at 338 pharmacists per year. With the current admission rate (1596 individuals per year) and the existing number of students, the number of pharmacists at the beginning of 2032, without accounting for mortality and emigration, will be approximately 40,272 pharmacists. Considering the estimated number of graduated pharmacists returning to Iran from other countries (338 pharmacists per year), this number will reach 43,652 pharmacists. By subtracting this value from the annual mortality rate (5 per 1000 individuals per year) and the annual emigration rate (112 individuals per year), the supply of pharmacists until the beginning of the year 2032 is estimated to be 40,349 individuals (Table 11).

Based on the findings of this study, it is estimated that the total demand for pharmacists will be 26,888, and the total supply of pharmacists will be 40,349 in 2032. Therefore, it is predicted that we will have an excess supply of pharmacists by 13,461 individuals in Iran in 2032, leading to potential unemployment in the pharmacy workforce. In other words, about 33% of pharmacists will be surplus to the demand in 2032.

Discussion

The present study predicted that the required number of pharmacists would be between 26,888 and 28,538 individuals in 2032. This projection was made considering the population growth, the number of pharmacy visits, the pharmacists' capability to provide consultation for patients, and their involvement in hospitals, industry, and educational and research centers. Considering the mortality, migration, and return rate of foreign-educated pharmacists, the estimated supply of pharmacists would be 40,349 individuals in 2032. Therefore, in 2032, Iran would face an excess supply of between 11,811 and 13,461 pharmacists. Similar to studies conducted in other countries, such as the United States and Japan (18, 19), it is anticipated that Iran (like other countries) will experience a surplus supply of pharmacists in the future. Previous studies in Iran showed that this country was facing a shortage of pharmacists at the time of those studies. However, with the ongoing trend of accepting pharmacy students, it would likely experience an excess supply of pharmacists. For instance, a study conducted by the Ministry of Health in collaboration with the country's medical universities in 2015 reported that about 23,077 pharmacists would be needed by 2022 (24,693 to 21,462 individuals) (20, 21). This study implemented a benchmarking-based model and a service delivery system-based model to estimate the required workforce for the healthcare sector in Iran by 2025 under the framework of an Iranian medical documentary. In another similar study, "Estimate of physician and pharmacist needed in Iran (2005)", Farzadi et al. estimated the supply and demand of general pharmacists until 2015. The results showed that each pharmacist could provide services to approximately 8,500 individuals seeking pharmaceutical services. Therefore, considering the estimated population of the country in 2005 (68 million individuals), the required number of pharmacists to respond to the community's healthcare needs for pharmaceutical services was estimated to be 8,055 pharmacists. In this respect, the need would amount to 12,096 pharmacists, assuming a 50% increase in the demand for pharmaceutical services. The required number of pharmacists for pharmaceutical services in hospitals in 2013 was estimated to be between 775 and 1,549 pharmacists.

Additionally, the required number of pharmacists for the pharmaceutical industry was estimated at 1,100 individuals, and the required number of pharmacists for providing pharmaceutical services in the Ministry of Health and Medical Sciences universities was estimated to be 939. Ultimately, the projected supply of pharmacists in 2015 was calculated to be 12,900 pharmacists, while the estimated demand for pharmacists was 15,684 individuals. Therefore, it was suggested that due to the shortage of pharmacists in 2015, the annual student intake should increase from 665 individuals in 2005 to 770 individuals in 2015, reflecting a 15% increase (13). Meanwhile, the nominal capacity for accepting pharmacy students has reached 1,300 individuals, and the practical acceptance capacity for pharmacy students has reached 1,600 per year in recent years.

Similar to the present study, a study was conducted by the United States Human Resources and Services Administration in 2016 to predict the required number of pharmacists for the year 2030. Two scenarios were considered for this purpose. In the first scenario, population changes, health system population targets, insurance plans, and hospital access were not considered. In this case, it was estimated that the required number of pharmacists in 2030 would be 359,770 individuals (a 19% increase compared to 2016). In the second scenario, considering population growth, achieving healthcare system population targets, increased care and insurance plans, and hospital and primary care access, the estimated required number of pharmacists for 2030 was 391,850 individuals (a 29% increase compared to 2016). In this study, the supply of pharmacists in 2030 was also estimated to be 410,490 individuals (19).

In a study conducted by Yoshiro et al. (2015) in Japan, it was predicted that the demand for pharmacists in 2025 and 2040 would increase by 11.1% and 98.0% respectively, compared to 2015. It was also projected that the supply of pharmacists would increase by 24.1% and 56.1% in 2025 and 2040, respectively, compared to 2015 (18). The results of this study are consistent with those of the present study, indicating that countries like the United States, Japan, and Iran will face an excess supply of pharmacists in the future.

In the present study, the average consultation time for prescription and OTC drugs was 114.21±58.81 and 90.51±45.23 seconds, respectively. These values are similar to those reported by Zargarzadeh et al. (2013) (14). In this study, the professional performance of pharmacists in prescribing OTC drugs for individuals seeking pharmaceutical advice for cough, diarrhea, and obesity was investigated. The average consultation time by female technical supervisors was 130.2±86.1 seconds. Similar to the

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results of the present study, this was significantly longer than that of male supervisors (98.6±72.6 seconds) (P=0.01) (14).

In this regard, Zolfaghari et al. (2008) showed that 82% of pharmacists spend less than 1 minute, 12% spend between 1 and 2 minutes, and 6% spend more than 2 minutes on counseling patients on the use of herbal medicines when they visit the pharmacy (9). However, the World Health Organization (WHO) has recommended that a minimum of 3 minutes be allocated for each patient for pharmaceutical counseling by pharmacists. Despite this recommendation, the consultation time is shorter than 3 minutes in some developing countries like Iran. For instance, the average counseling time in pharmacies is 149 seconds in Cyprus, 53.9 seconds in Brazil, 21.8 seconds in Sudan, 86.1 seconds in Nepal, 12.5 seconds in Nigeria, and 23 seconds in Bangladesh (22)

The findings of this study showed that the average number of visits per Iranian to the pharmacy for prescription and OTC drugs was 3.53 and 4.02 times a year, respectively (with a total of 7.55 times a year). In this regard, Pouragha et al. (2012) conducted a study on the insured individuals of the Social Security Organization. They found that each insured person's total average visits to direct and indirect healthcare pharmacies decreased from 3.40 times a year in 1998 to 4.25 times a year in 2009 (23). Considering that this study covered all individuals with various insurance types and uninsured individuals and also considered visits for OTC drugs, the estimated number of visits (7.55 times a year) can be regarded as accurate.

A pharmacist's ability to counsel patients was estimated to be 29,390.4 times per year. Based on this estimate and considering Iran's population in 2032, the total number of pharmacists needed to work in pharmacies in 2032 is estimated to be 22,992. Besides, given the per capita visits by each Iranian (7.55 times a year), it can be calculated that each pharmacist can handle consultations for pharmaceutical services for 3,893 individuals in pharmacies. Meanwhile, Farzadi et al. (2005) predicted the supply and demand of general practitioners and pharmacists by 2015 in a study entitled "Estimate of physician and pharmacist needed in Iran" (13). The results of this study indicated that each pharmacist could handle consultations for pharmaceutical services for 8,500 individuals.

This study did not calculate the demand for pharmacists to work in government organizations and agencies. Additionally, the annual migration rate of pharmacists was considered to be 112 individuals, while this number can vary in different years and depending on economic, social, political, and other conditions. The study also accounted for the annual return of pharmacy graduates from foreign universities to Iran, estimated at 338 individuals. However, these figures can also change based on various factors, which are among the important limitations of our study.

It should be noted that this study was conducted assuming that the Iranian pharmaceutical market remains constant (in dollars), and if the pharmaceutical market becomes larger, it can be expected that a greater number of pharmacists will be needed than what was calculated in this study.

Limitations

This study does not include changes in immigration conditions or career changes due to economic issues because it was not the direct aim of this study, and there is no accurate data on changes over the years. Especially due to the different policies adopted in recent years despite the economic crises, these numbers are very variable and unpredictable. As mentioned in the text, due to the high concentration of pharmacies in Tehran, the checklist was filled out in Tehran. It should be noted that the duties of pharmacists in urban and rural pharmacies are largely the same, and like medics, there is no significant difference between urban and rural areas. However, there was no accurate data on the difference in capacity and consultation time, and if this difference is identified and included in the studies, it can increase the accuracy of the results. There is no accurate data on the employment status of pharmacists in different parts of the Iranian health system, and as mentioned in the text, this prevalence was calculated from global studies along with expert opinions.

Conclusion

The findings of this study indicate that there will be an excess of pharmacists in Iran in 2032. Training pharmacists requires a significant investment from society. Therefore, to prevent the waste of public resources, it is recommended that the trend of admitting pharmacy students be reduced or, at the very least, the increase in student admissions and the establishment of new pharmacy faculties be halted. Otherwise, new job opportunities must be created for pharmacists.

For this purpose, pharmacist education requires a shift from a focus on training for pharmacy practice, aiming at training for clinical care and prescription reading to training for more active involvement in patient care in pharmacies and hospitals. Moreover, education must be adjusted toward a more dynamic role and innovation in the pharmaceutical industry.

Furthermore, policymakers in the healthcare sector should provide the necessary infrastructure to enhance the role of pharmacists in the community. Additionally, pharmacy services should be included in the healthcare service tariffs. Since the annual admission of 1600 pharmacy students will lead to an excess of between 11,811 and 13,461 pharmacists, it is recommended to reduce the university admission capacity by at least 10% annually for the next 5 years.

Authors' Contributions

Conception and design: MM Data Collection: SG Analysis and interpretation of data: MM, MT Drafting the article & revising it: MM, SG Final approval of the version to be published: MM.

Ethical Considerations

This study was a part of the Pharm. D thesis (code: REC.IR. IUMS.1400.135) that was approved by Iran Uni-

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Conflict of Interests

The authors declare that they have no competing interests.

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