Iranian Journal of Pharmaceutical Sciences
2024: 20 (2): 143- 152
https://journals.sbmu.ac.ir/IJPS

Original Article

Scientific Authority in Iranian Pharmaceutical Sciences Research Centers: The Results of a Decade Research Evaluation

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Abstract

The scientific authority refers to social power of scientific knowledge, in different sciences. The aim of this study is to present the role of Iranian pharmaceutical research centers in scientific authority based on research evaluation for a decade. Iranian pharmaceutical research centers with more than one year of activity from 2013 to 2022 were assessed based on the intervention model of evaluation system. Three domains including stewardship, knowledge production and research impact with 20 indicators have been used in this process. 36 pharmaceutical sciences research centers (PhRCs) related to 23 universities of Medical Sciences (UMSs) were evaluated for a decade. The mean and standard deviation (SD) of age of the research activities in PhRCs was 12.2 ± 8.60. The ratio of faculty member to research center was 10.5. The total number of published articles was 20166 and 70% of which were indexed in ISI –WOS.34.2% and 21.7% of them were published in the first quantile journals and with international collaboration respectively. Based on research ranking, the first three centers were Tabriz Applied Pharmaceutical Science Research Center, Mashhad Pharmaceutical Sciences Research Center and Tabriz Pharmaceutical Nanotechnology research center. Mission oriented research activities in Iranian pharmaceutical research centers may lead them in achieving scientific authority.

Keywords: Scientific authority; Pharmacy; Research center; Evaluation; Healthcare research.

1. Introduction

Based on definition, the scientific authority refers to social power of scientific knowledge, in different sciences [1]. Pharmacy is one of the related branches of science that is closely related to medical sciences. Today, medicinal chemistry and pharmacognosy play an important role in the treatment of diseases and its prevention [2]. Herbal medicines are used in primary health care by about 80% of the world's population, mostly in developing countries [3]. In fact, drug production is one of the major inputs of health system in all countries and

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Cite this article as: Eftekhari MB, Falahat K, Ashouri S. *Scientific Authority in Iranian Pharmaceutical Sciences Research Centers: The Results of a Decade Research Evaluation*, Iran. J. Pharm. Sci., 2024, 20 (2): 143- 152 .

DOI: https://doi.org/10.22037/ijps.v20i2.44546

many resources have been allocated to it [4]. Pharmaceutical costs account for about 30% of total health care costs in many developing countries [5].

In the field of pharmaceutical science, researchers are constantly looking for new molecules and ideal drugs with special properties [6]. Increasing demand for pharmaceutical research and evidence-based medicine to provide the best performance in the field of treatment is one of the main reasons for knowledge production improvement in the pharmaceutical field [7]. Knowledge production in this field needs to pay more attention to main areas concluding knowledge translation and end-users' benefit or impact. One of the criticisms of this knowledge is that it is deeply embedded in the individual and his professional culture in a way that makes it difficult to knowledge transfer. It is clear that pharmacists have a responsibility to use their knowledge both when communicating with other healthcare professionals and directly with community [8]. Increasing demand for conducting applied research in the field requires cooperation with different disciplines. One of the necessary context for cooperation and inter-sectoral partnerships to knowledge generation is academic research centers and institutes. Research centers are creating a great revolution in the method of science is done in such a way that the goals and effects of science also appear. Academic research centers are changing the infra-structure and content of the research university, whose interdisciplinary cooperation and combination of research and education has provided a new paradigm for science implementation [9].

Based on Tash Study in 2003, there were 26000 research centers in the world which half of them were in the United States [10]. In Iran, until 2023, more than 900 research centers have been established of which 5.5% is in the field of pharmaceutical sciences [11]. In recent years, the consortia or large research centers have multiple projects to solve part of complex puzzles of pharmaceutical problems. To answer these questions, which research centers perform better? How well are they doing with making innovation and discoveries?

The evaluation model based on intervention [12] is able to evaluate all stages of research from input, process, output, outcome and impact using quantitative and accurate indicators and this is a program that has been carried out for more than two decades in the Islamic Republic of Iran [13].

The aim of this study is to present the role of Iranian pharmaceutical research centers in scientific authority based on research evaluation for a decade. It is hoped that the results of this study will help policymakers in adopting appropriate policies to design and implement appropriate interventions to resolve the challenges in this valuable field.

2. Materials and Methods

2.1. Setting

This study was done in 2023 in Iran. Research and technology in medical sciences are carried out by 69 universities of medical sciences (UMS) and 885 research centers (RC) in clinical, biomedical and health promotion fields. All research centers with more than one year of activity have evaluated based on research and technology indicators. The

number of research centers in clinical, biomedical and health promotion fields is 428, 259 and 198, respectively. By 2021, all of RCs were divided into two groups based on budget line assigned (independent, dependent).

2.2. Study design

This was a cross-sectional study. All pharmaceutical science research centers (PhRC) have been evaluated for one decade (2013-2022). All research centers related to pharmaceutical sciences, pharmacology, medicinal plants, pharmaceutical nanotechnology, pharmaceutical biotechnology, pharmaceutical chemistry, pharmaceutical quality, drug economics, and food and drug laboratories that are licensed by the Council for the Development of Medical Sciences Universities until 2012 have been included to the study. In this study, the intervention model of evaluation system (**Fig. 1**) has been used.

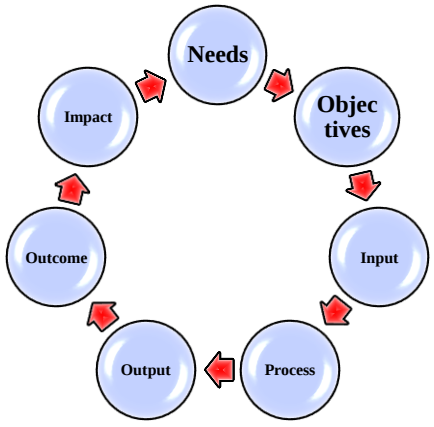

Figure 1. Intervention model of evaluation system.

2.3. Executive steps

The steps of evaluation process were:

i) Forming the expert panel: The members of this panel include three representatives from universities of medical sciences, three representatives from pharmaceutical science research centers, as well as two scientometric experts and research team.

Duties of the expert panel:

- Defining areas, axes and evaluation indicators
- Determining of scoring system (**Table 1**)
- Holding training workshops for research centers
- Supervising the evaluation process

ii) Development of comprehensive evaluation system platform: Development of comprehensive platform for data extracting, uploading the scientific documents and judging

iii) Ranking of research and technology activities of pharmaceutical science research centers

2.4. Research domains and indicators

Three domains including stewardship, knowledge production and research impact with 20 indicators have been used to evaluate the pharmaceutical research centers since 2013 to 2022 as follow:

- Stewardship: This area includes four indicators as follow:
  - Designing and monitoring the five-year strategic planning of research center with stakeholder cooperation.
  - Determining five-year research priorities with annual updates
  - Attracting domestic grants to conduct research from financial sources within the country
  - Attracting foreign grants to conduct research from abroad

This domain has been added to the evaluation system since 2021.

Table 1. Scoring system in Pharmaceutical Research Centers (PRCs) evaluation.

Domain	Indicator	Score of indicator	Maximum weight (MW)	Calculation method
Stewardship*	Strategic Plan	Without score	Mandatory	Qualitative evaluation
	Research Priorities			
	Grant recruitment	1.0 for every 100 million Rials	100	Indicator×Score=Total Score (TS) Max (TS) = Maximum weight & for (n-1) =Adjusted (TS)
Knowledge production	Published article indexed in ISI- WoS	2.0	250	
	Published article indexed in PubMed	1.5		
	Published article indexed in Scopus	1.0		
	Published books indexed in Scopus	2.0		
	Conference paper/meeting abstract	0.5		
	Published article with international cooperation (since 2015)	1.0	150	
	Published articles in the first quartile journals (since 2015)	1.0	250	
	Total citation to five past years published articles (since 2015)	1.0	400	
	Average h-index	1.0	100	
	Domestic patent	2.0	100	
	Foreign patent	4.0		
Research Impact*	Research projects whose effects lead to changes in decision making	Three levels: U=5 P=20 N=100	500	Σ (Indicator×Score of each level) = total scores of all levels Max (TS of all levels) = Maximum weight & for (n-1) =Adjusted (TS)
	Research projects whose effects lead to changes in health status			
	Research projects whose effects lead to changes in service providing			
	Research projects whose effects lead to changes in the economy			
	Research projects whose effects lead to changes the social determinants of health			

*: data related to these domains from 2021 have been evaluated, U: university, P: Provincial, N: National

- Knowledge Production: This domain includes eleven indicators consist of:
  - o Publication of articles with research center affiliation indexed in ISI-WOS
  - o Publication of articles with research center affiliation indexed in PubMed
  - o Publication of articles with research center affiliation indexed in Scopus
  - o Paper presentation at the conference (domestic / foreign)
  - o Book publication with research center affiliation
  - o Publication of articles with research center affiliation in the top 25% of journals
  - o Publication of articles with international cooperation
  - o Number of citations to articles with research center affiliation of the last five years
  - o Five-year h index of research center
  - o Domestic patents
  - o Foreign patents
- Research impact: this domain includes five indicators as follow:
  - o The number of research projects that lead to a change in decision-making
  - o The number of research projects that lead to a change in health status
  - o The number of research projects that lead to changes in service delivery
  - o The number of research projects that lead to a change in social determinants of health
  - o The number of research projects that lead to a change in the economy.

This domain has been added to the evaluation system since 2021.

All of data were analyzed using SPSS software (version 22.0, SPSS Inc., Chicago, IL, USA) and the significance level (P values) was considered less than 0.05. Descriptive and analytical statistics were used for data reporting. In this study, all of ethical considerations have been considered.

3. Results and Discussion

In this study, 36 approved PhRCs were participated. Results showed that 23 out of the 69 Iranian universities of medical sciences (UMSs) had at least 1 PhRC. The oldest PhRC was Drug Applied Research Center of Tabriz UMS, which was approved in 1999.

Also, 378 academic members or researchers worked in these PhRCs in 2022, with the highest number (n = 39) working in the Razi Herbal Medicines Research Center of Lorestan UMS. The ratio of faculty member to research center was 10.5. The average years of activity of PhRCs have been 12.2.

In the following, the results of the research evaluation are presented according to the main axes:

- Stewardship:

o Strategic Plan: All of PhRCs have a 5-year strategic plan. This program includes VMG, goals, strategies, SWOT analysis, objectives and activities.

o Research Priorities: 331 research priorities have been extracted by PhRCs, which means that on average each research center had six research priorities. The titles of the first ten priorities include:

- Formulation and optimization of new pharmaceutical products
- Medicinal plants including formulation, therapeutic aspects and side effects
- Creation of new drug delivery systems
- Standardization of natural products
- Nanomedicines
- Traditional and complementary medicine
- Biotechnology products and pharmaceutical raw materials
- Commercialization of new products
- Quality control of biological products
- Nano sensors

- Knowledge production:

o Research Output:

- Published articles: The total number of articles published by pharmaceutical sciences research centers in a decade of evaluation was 20166 and 70% of which were indexed in ISI –WOS. 16,133 and 12,285 articles are indexed in Scopus and PubMed databases, respectively (**Fig. 2**).
- A total of 92 books related to pharmaceutical sciences is authored and indexed in Scopus.
- The average number of pharmaceutical science article to academic member was 3.6 per year.
- The total number of abstracts presented at international congresses was 80.

o Published articles in the first quartile journals (Q1):

Since 2015, the index of publication of articles in Q1 journals has been evaluated, and since that date, 5991 articles have been published in these journals (34.2% of total published articles from 2015 onwards).

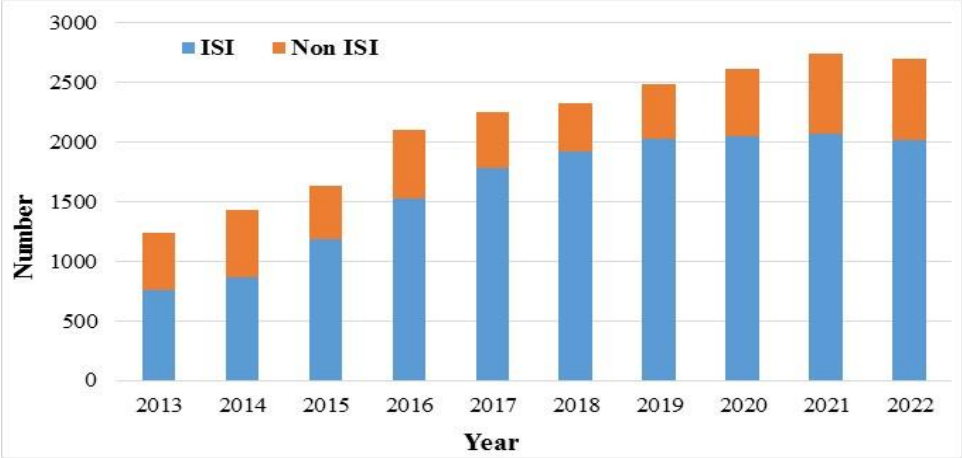

Figure 2. Total published articles of Iranian PhRCs (2013-2022).

○ Published articles with international cooperation (IC):

Since 2015, 21.7% of published articles in pharmaceutical sciences (n=3808) were written with international collaboration (**Fig. 3**).

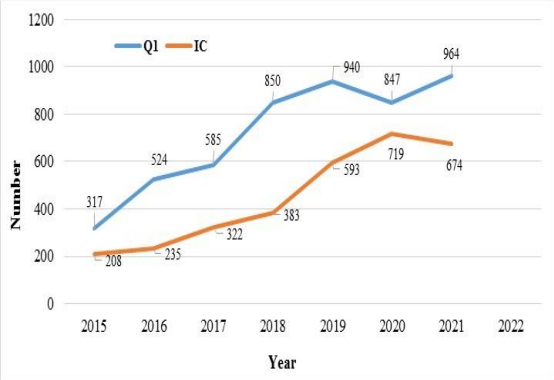

Figure 3. The number of articles published by PhRCs in Q1 journals and with international cooperation during 2015 - 2022.

○ Total citation to five past years publshed articles:

Since 2015, there have been almost 200000 citations to published articles in pharmaceutical science research centers. **Figure 4** shows the citation per article per year of Iranian PhRCs. This graph shows that the trend of the number of citations to articles is upward, and the only exception is related to the years 2016 and 2017.

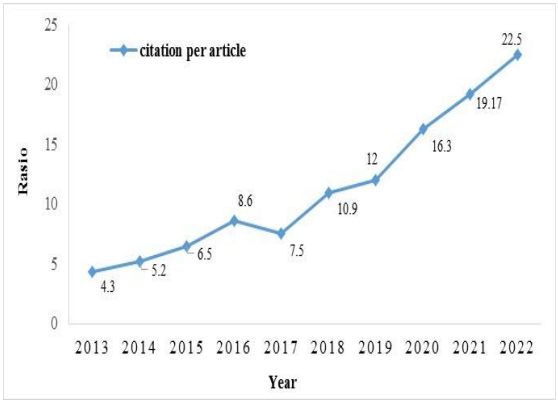

Figure 4. Citation per article per year of Iranian PhRCs (2013-2022).

Table 2 shows the ranking result of Iranian PhRCs. The results of a decade evaluation of research and technology activities of pharmaceutical science research centers indicate that the Tabriz Applied Pharmaceutical Science Research Center has been ranked first in all of evaluation domains. This research center ranks first not only in the knowledge production, but also in research impact and attracting financial resources among PhRCs. In general, Tabriz University of Medical Sciences is in a higher

position among other universities of medical sciences in terms of pharmaceutical sciences, and the first and third ranks of the evaluation are related to the research centers of this university. The second rank in research and technology activities evaluation was assigned to the Mashhad Pharmaceutical Sciences Research Center.

Table 2. Result ranking of Iranian PhRCs foe one decade.

No	Name of Research Center	Name of UMS	Output	Q1	IC	Citation	H-index 5	K P* scored	Impact score	Grant	Total Score	Rank
1	DA	Tabriz	250.00	250.00	150	400	100.00	1150	500	100	1750	1
2	Ph	Mashhad	98.36	108.33	66.79	227.93	89.20	590.61	-	-	590.61	2
3	PhS	Tehran	68.14	50.37	29.18	151.52	85.80	384.99	-	-	384.99	5
4	MP	Yasouj	22.80	21.16	14.59	32.76	29.83	121.13	-	-	121.13	22
5	MP	ACCECR	31.68	14.95	11.85	27.05	30.97	116.50	163.2	-	279.7	7
6	MP	Tehran	21.94	12.65	11.85	35.04	42.05	123.54	-	-	123.54	21
7	PhN	Tabriz	78.55	89.70	54.03	157.90	79.55	459.72	-	65	524.72	3
8	TDD	Mashhad	45.08	56.81	11.17	98.40	57.39	268.85	-	-	268.85	9
9	PhS	Shiraz	76.76	55.89	51.06	108.89	54.26	346.86	136.8	-	483.7	4
10	MP	Shahhrekord	69.42	20.93	18.01	127.11	82.39	317.85	-	-	317.85	6
11	PhS	Mazandaran	57.72	31.74	17.55	75.82	64.20	247.04	-	-	247.04	11
12	PhS	Kermanshah	54.13	57.96	52.66	72.36	38.64	275.75	-	-	275.75	8
13	Pha	Kerman	35.60	37.95	24.39	71.74	52.84	222.53	-	-	222.53	13
14	HM	Lorestan	65.49	20.70	14.82	79.89	55.11	236.01	-	-	236.01	12
15	PhMP	Mashhad	30.65	20.24	8.43	43.89	41.48	144.69	-	-	144.69	18
16	PhS	Isfahan	37.91	28.06	20.29	42.97	41.48	170.70	-	-	170.70	15
17	PhN	Zanjan	16.22	21.16	6.84	38.91	42.05	125.18	-	-	125.18	20
18	NDD	Kermanshah	34.24	41.17	22.11	44.99	34.09	176.60	-	-	176.60	14
19	RD	Iran	26.98	20.93	14.82	42.46	40.91	146.10	-	-	146.10	17
20	M&NPCh	Shiraz	29.71	27.14	17.55	43.13	51.70	169.24	-	-	169.24	16
21	DD&D	Tehran	23.39	14.95	7.98	33.57	40.91	120.80	-	-	120.80	23
22	MP	Zabol	15.37	11.73	20.74	42.12	41.76	131.73	-	-	131.73	19
23	NDDS	Isfahan	19.47	12.65	3.65	16.14	24.72	76.62	-	-	76.62	25
24	Ph B	Zanjan	9.73	9.66	3.42	16.17	27.56	66.54	-	-	66.54	28
25	Ph S	Shahid Beheshti	14.69	11.04	2.74	16.54	26.99	71.99	-	-	71.99	27
26	PM&P	Tehran	13.58	7.13	6.16	18.04	28.69	73.59	-	-	73.59	26
27	Ph P	Rafsanjan	12.89	7.13	2.96	12.85	27.18	63.02	-	-	63.02	31
28	MP	Ahvaz	11.70	5.75	4.33	8.23	19.60	49.61	-	-	49.61	33
29	FDL	FDA	16.82	8.97	4.33	19.39	38.07	87.58	-	-	87.58	24
30	HTM	Kerman	15.54	10.12	3.65	14.70	25.57	69.57	-	-	69.57	29
31	MPP	Shiraz	16.39	12.19	4.10	14.98	21.59	69.26	-	-	69.26	30
32	RUD	Tehran	11.27	4.83	2.96	6.75	18.47	44.28	-	-	44.28	34
33	TMMM	Shahid Beheshti	16.65	5.06	4.79	7.80	20.45	54.75	200	-	254.75	10
34	PhQA	Tehran	8.20	3.45	2.05	7.87	22.16	43.72	-	-	43.72	35
35	AP	Zanjan	6.32	4.60	2.51	9.07	21.02	43.52	-	14	57.52	32
36	MPS	Ahvaz	5.04	3.68	1.14	1.95	8.52	20.33	-	-	20.33	36

Regarding to the research impact, PhRCs in Tabriz, Shiraz, Shahid Beheshti and ACCECR have received scores. The drug research centers of Tabriz and Zanjan universities of medical sciences were also privileged to receive grants.

In this study, the intervention model was used to evaluate the pharmaceutical science research centers. In this model, based on pharmaceutical science's needs, goals and objectives will be defined and according to the existing input, the process of knowledge production (research outputs) and its mid-term (outcome) and long-term effects (impact) will be evaluated [14].

In this evaluation system, needs assessment and research priority setting have been evaluated through stewardship axis indicators. One of the main challenges in this axis, is the lack of organizing the research priorities at the national level. Determining mission based oriented programs according to needs, human resource, research capabilities for research centers and universities of medical sciences is necessary [15]. One of the main challenges of the evaluation system is not paying attention to the input. In the current evaluation, research centers have been evaluated regardless of human resources, budget, equipment, and facilities. Defining the input based indicators such as paper to academic member, research scores of budget is necessary. In addition, in the intervention model, there is a need to design indicators to observe the process components. Monitoring activities in order to achieve goals is another challenge of the current evaluation system. In the output section, most of the indicators have focused on the quantitative and qualitative evaluation of the published articles. One of the limitations of this axis is the use of simple indices and not paying attention to composite indices. In evaluating the mid-term effects of research, service, production, medical equipment, laboratory kits and technology creation are the main indicators that have not been addressed. Obviously, the design of appropriate indicators is one of the basic needs of this sector. Impact assessment was the final sector which has been added to the evaluation system since 2021.

Paying attention to the ten guidelines for impact assessment, including the context, purpose, stakeholders' needs, stakeholder engagement, conceptual frameworks, methods and data sources, indicators and metrics, ethics and conflicts of interest, communication, and community of practice will help in solving the existing challenges in this section [16].

Knowledge production is the answer to the increasing demand for evidence-based decision making in pharmaceutical sciences. One of the characteristics of this knowledge is its transcendence in such a way that its scope exceeds one field and operates in the form of multidisciplinary [17]. The basic question is; how can this knowledge be used for the benefit of community health? It is clear that pharmacists have a duty to use their knowledge both in relation to other health care professionals and directly with members of the public [18]. The PhRCs of the universities of Tabriz, Mashhad and Shiraz have three top research centers in knowledge production.

In fact, pharmaceutical sciences have a special place as one of the major inputs of the

health system in all countries and has allocated many resources of the health system. The results of the study showed that the production of new drugs is one of the 10 priorities of PhRCs regarding Iran. In 2020, the world spent about 1.43 trillion dollars in the pharmaceutical industry. Meanwhile, pharmaceutical companies have invested more than 150 billion dollars in research and development projects in this sector. South American countries, European and Asian countries mainly contribute to the composition of the drug market. The participation percentage of American and European companies in the pharmaceutical industry is 30% each of the world production, followed by Japan with a production rate of 21% and the remaining 19% is distributed to other countries [19]. Several factors such as population growth, technology development, international regulations and research and development play a role in the development of the pharmaceutical industry. Therefore, the role of research centers cannot be ignored due to conducting research in this industry [20]. Medicinal plants are another priority of pharmaceutical science research centers in Iran. They are used as a medical resource in almost all cultures. Ensuring the safety, quality and efficacy of medicinal plants and herbal medicines has recently become a key issue in industrialized and developing countries. By standardizing and evaluating the health of plant-derived active compounds, herbal medicines can help usher in a new era of health care systems for the treatment of human diseases in the future [21].

Achieving scientific authority requires adherence to six basic values in producing knowledge and conducting research. These include advancement of global knowledge and practice, practical/ feasible and cost-effective solutions, social value beyond a technocratic exercise, mutual learning in the community, transparency and neutral approach to framework and tools [16].

4. Conclusion

Mission oriented research activities in Iranian pharmaceutical research centers may lead them in achieving scientific authority.

Acknowledgement

This study was implemented in Deputy for Research and Technology, Ministry of Health and Medical Education with no approved expenditure. The authors express their sincere appreciation to all individuals who have participated in this study.

Conflict of interest

The authors declare to have no conflict of interest.

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