



Foresight in health sciences using Causal Layered Analysis method

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Abstract

Background: Development in health is not possible without progress of science. Rapid changes in the various areas make the future health system more complex and risky. Therefore, foresight of health sciences is very important.

Methods: This futures studies was conducted in 4 steps; also, literature and documents review, statistics and information review, focus group discussions, working group, and scenario planning were used. Causal layered analysis (CLA) was used for data analysis and syntactic as main frameworks.

Results: The findings in legal health sciences documents revealed that the value system was not defined clearly and coherently and that logical linkage among myths, discourse, and social structural layers was ambiguous. In trend analysis, 24 trends were recognized; however, political and economic streams were strong, independent, and uncertain factors which created 4 main scenarios although the social and environmental factors divided them into 16 subscenario tunnels. Postmodern discourse in probability scenarios will be dominant and science will be understood as tools for generation of wealth. University structure will be decentralized and transformed into similar R&D to join the health industry, and our quantitative growth (articles, disciplines, and students) in health sciences will decrease.

Conclusion: If the current trends (probability scenarios) continue, we will move to an undesirable situation. The main challenge in this regard is the lack of a unique and dominant discourse in health sciences based on the Islamic Republic of Iran doctrine. Therefore, in this study, shifting the paradigm by a new approach and discipline in the health sciences is suggested.

Keywords: Casual layered analysis, Health sciences, High level documents, Foresight

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Introduction

Health is one of the most complex issues of community management and a major element of its development. Health sciences have been developed to protect and promote public and individuals' health to solve problems in this area. Due to the rapid and extensive changes as well as the challenges in today's society, health fulfillment has become complicated (1). In such circumstances, competitive advantages of every country are based on science and technology, which help develop every country by affecting its political, social, cultural, and economic aspects. There is no doubt that the future world will be a place full of changes and instabilities, and only those who move

towards these changes in a pre-emptive manner and are the agents of the desired changes are able to tolerate these changes (2). The pace of changes is so fast that we cannot cope with it if we use traditional methods (3). To confront the powerful changes that cover all aspects of our lives, we must be prospective (4). Survival and progression in the upcoming world requires pre-emptive detection and recognition of events and a desirable world architecture that can be the birthplace of ideals of an organization or a nation. Achieving this capability requires the mastery of futures strategic knowledge and its application in practice and future competition (5). Since science is a factor that

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↑What is "already known" in this topic:

There is no logical linkage among myths, discourse, and social structural layers in legal health sciences documents. The main challenge is the lack of attention to the sciences related to these layers and lack of a unique discourse in health sciences.

→What this article adds:

This study suggests that the sciences should progress to a preferable status and that health system reforms should be done based on the Islamic Republic of Iran discourse.

promotes health and helps solve problems in this field, public health foresight and consequently health and science foresight in this field are highly necessary.

Foresight is a process that takes a systematic long-term look at science, technology, economy, and society in the future (6); it also seeks to identify areas of strategic research and emerging technologies, which seem to result in valuable socioeconomic advantages (7). Foresight must be considered as a useful tool for progressive exploration and planning, and provision of necessary facilities for policy-makers (8).

Future studies can be done using different methods (9). These methods are usually categorized into 2 groups: (1) quantitative, qualitative, or semi-quantitative methods; (2) normative or exploratory methods. Casual layered analysis (CLA) is considered a qualitative method of future studies (10). It has an exploratory approach and seeks to integrate different recognition models, i.e. empirical, interpretative, critical, and learning (11). Causal layered analysis is the proposed method to analyze the system using creativity (12). CLA has been used by a few researchers (13-15). It is a critical method that belongs to the structural methods of future studies and helps understand layers that produce a problem (11). In this method, the cause of a phenomenon is examined in 4 layers, and each layer examines the problem more generally and deeply than the previous layer. Based on this method, the first layer, which is called litany layer, analyzes the most superficial data and represents the official and accepted view of reality. The second layer is the layer of social causes and represents organized views. The third layer is the ideology and discourse layer that observes the understanding of the structure, which not only supports claims related to the future, but also gives them legitimacy and forms the social reasons that constitute the first layer. The final layer represents the myths and metaphors, which represents the unconscious motivational aspects of the problem that are realized in the form of myths and metaphors (16).

The climax of foresight projects occurred in the 90s during the implementation of national programs related to IT. The most frequent subject of foresight projects is devoted to sciences and technology (17). However, few studies have been conducted on health sciences. As mentioned above, futures studies are considered strategic sciences and a suitable tool to achieve progress in the society. The realization of health is the most important right of every individual in a society and is a governing role, which is considered in the development path of every society. Therefore, having a prospective and futuristic view in long- and medium-term programs is essential to improve all societies and all sectors affecting health (8).

This study used CLA to examine foresight health sciences and answer the following questions:

- What is the status of health sciences in Iran in high level documents based on the doctrine of health sciences?
- What is the status of science based on health environmental analysis?
- What are the megatrends affecting health and what are the considered scenarios for the future of health sciences?
- What methods does science propose to achieve the

ideal situation?

Methods

This was a foresight study, with a critical approach and 4 steps. It explained the doctrine of the Islamic Republic of Iran in the following aspects: field of health; the review of megatrends affecting the health field; science; environmental analysis of status of health science, development of scenarios related to the health sciences.

In the first step conducted by reviewing the documents, 15 documents were examined including the constitutional law, perspective of the Islamic Republic of Iran in 2025, Iran's comprehensive scientific plan and its supporting documentation, a comprehensive health scientific plan, the first to fifth development plans, documents of the strategic development plan, the health system reform plan, and general policies of the science system announced by the Supreme Leader of Iran on the situation of science in Iran. In this study, the status of science was categorized based on the CLA method.

To conduct an environmental analysis, literature, statistics, and information related to the status of education and research in the health field had to be examined. At this step, information was extracted by searching the articles published in prestigious and valid medical journals, books containing statistics for higher education, scientific documents, and statistical reports, and statistical sites, such as the Ministry of Health and Medical Education site, Statistics Center site, site of the Regional Information Center of Science and Technology, Medical Research Information Management System, Institute of Higher Education Research and Planning, and Iran Statistical Yearbook.

The third step was done using environmental scanning, literature review, and focused working groups. First, megatrends affecting health sciences were examined using environmental scanning and review of the literature; then, these trends were separated based on the casual layered analysis using focused working groups.

Scenarios were developed based on the analysis of the results of the previous step. The megatrends identified in the previous step were examined in a focused working group; of them, 2 trends were selected as the driving ones. The selection criterion was "importance and uncertainty". In writing scenarios, 3 main scenarios were developed. According to these scenarios, future of the most important trends affecting the health sciences was predicted based on the experts' viewpoints.

Experts, who were selected to develop scenarios and analyze the trends, were a group of health experts (10 people) and a group of foresight experts (5 people). All statistics, data, and documents available at the time of the Islamic Revolution were considered. Given the critical approach, CLA was used to analyze the data and develop scenarios in each step. This study was related to the public health science that has considered all layers of the society based on CLA. In this research, a specific time wasn't defined as a year or month; the time period of this study was considered in the form of a vague future. For a better understanding of the vague future, for example, a 20-year period can't be considered for attainment the perspective.

Accordingly, the period of attainment of the state and the ideal Islamic society is considered as a perspective in this study.

Results

The present study consisted of 5 basic findings, which are as follow: The doctrine of the Islamic Republic of Iran in the field of health sciences; megatrends affecting health; status of health sciences; scenarios considered in the health sciences based on megatrends; and future status of sciences based on the first and second scenarios according to CLA analysis.

The doctrine of the Islamic Republic of Iran in the field of health sciences

In this part, the high level documents were examined in the field of science using the CLA model. Accordingly, the findings were categorized into 4 layers; namely, litany layer, structural layer of a society, discourse layer, and myth/metaphor layer (Table 1).

Results revealed that there was no clear, transparent, and codified knowledge to develop a value system for health and science. The doctrine of the Islamic Republic of Iran failed to completely and philosophically explain the health and science. Moreover, there was inconsistency among different levels of documents in general orientation based on the knowledge system. According to the CLA model and based on the study of high level documents in the field of science, it was revealed that high level documents did not cover all social layers (social level, social structures, discourse, and myth layer) completely and appropriately; moreover, these layers did not cover each other in cohesion and logical chain. In other words, the conceptual, attitudinal, and discourse content specified in the field of science did not comprehensively explain litany layers and causal systems.

Megatrends affecting health

Analyzing the trends resulted in the identification of 57 trends affecting the health sector: 23 trends in the social sector, 11 in the science field, 10 in the environmental field, 9 in the political field, and 4 in the economic field. After scoring the trends based on the effect level, the number of affected population, independence level, and their preventive roles were found to be the most important trends in social levels. Findings of this section were classified into 3 layers of litany, social, and discourse (Table 2)

After prioritizing the trends affecting the health field, 24 trends remained. Of them, 13 trends were related to the litany layer, 7 to the social layer, and 5 to the discourse layer. According to the experts, none of the trends identified in this part was related to the myth/metaphor layer.

Status of health science

The findings of environmental analysis on the status of health sciences resulted in identifying the conditions of quantitative and qualitative research and educational indicators in the health field. Accordingly, the findings were categorized into 4 layers; namely, litany layer, structural layer of a society, discourse layer, and myth/metaphor layer (Table 3).

Reviewing the number of medical students from 1996 to 2012 indicated that the total number of students increased from 2008 to 2012. The number of female students was more than that of the males during these years; this figure has doubled in recent years. Examining technology growth centers in the field of medical sciences during 2003 and 2012 revealed an increasing trend, as there was only one center in 2003, but this number increased to 36 in 2013. Examining the growth trend of research centers during 1992 and 2013 showed that these centers increased in number. There were 561 active research centers in the field of medical sciences, 55% of which were clinical research centers and the remainder were biomedical centers.

Table 1. The doctrine of the Islamic Republic of Iran in the field of health science

Layer	
Litany	Scientific authority in the world public access to an appropriate level of public knowledge and eradication of illiteracy Achieving the top position in the field of research, development, and production of high-tech health products Designing, building, and launching satellites into the geostationary orbit (GEO) in association with the Islam World and international cooperation Increasing life expectancy and improving the Human Development Index Family financial protection against health costs Reducing the effects of social damages Reducing the levels of important and harmful pollutants Providing justice in health by the year 2025
Social causes	Increasing active, constructive, and inspiring cooperation and interaction with other countries in the field of science Ethics and responsibility of all members of the scientific society and its related entities Training a specialized group with an emphasis on prevention Paying attention to physical health and vitality of spirit Improving accountability of services-providing systems to the non-medical needs of service recipients Dealing with different types of addiction
Discourse	The primacy of public interests over individual and group interests and reinforcing the spirit of cooperation and partnership Scientific competence needed for cyber security in different fields of jurisprudence Having health, welfare, food security, social security, equal opportunities, suitable distribution of income, the strong structure of the family away from poverty, corruption and discrimination
Myth/Metaphor	Guiding sciences and the futuristic purpose of science Justice-based, equal opportunities, and training talents in accordance with the model of religious democracy Healthy lifestyle patterns in accordance with the Islamic teachings Empowering and wealth-creating science (lucrative science)

Table 2. Megatrends affecting the health field

Layer	
Litany	<ul style="list-style-type: none"> - Decreased population growth - Decreased fertility and birth rate, increased infertility, increased marriage age, and marital distress - Presence of demographic bubble in the middle age period - Increased level of divorce rates and decreased number of marriage rates - The aging population - Increased number of brain drain - Immigration from neighboring countries, particularly Afghanistan - Decreased amount of security in the region and increased number of wars and conflicts - Globalization process - Decreased amount of security in the region and increased number of wars and conflicts - Lack of cheap energy resources - Decreased level of revenues from natural resources
Social causes	<ul style="list-style-type: none"> - Increased air pollution, especially in metropolises - Increased urbanization trend and complexity of social relations - Depopulation of rural areas and small towns - Changes in women's roles in society and education based on the economic driving force - Development of unstable political structures and increased terrorism - Oil economic structure and economic resources - Increased level of employment in the service sector compared with the agricultural and industrial production
Discourse	<ul style="list-style-type: none"> - Paying attention to knowledge as the main source of production (knowledge-based economy approach) - Increased trend of individualism - Increased trend of materialism and material hedonism (based on the material aspect) - Certificate orientation - Priority of the view of individual physical therapy over the individual and social health-based view - Decreased level of confidence and relationship between patients and service providers.

Table 3. Status of health sciences (Past to future trend)

Layer	
Litany	<ul style="list-style-type: none"> - Increased level of students' admission (1.4 times) - Increased number of female students than male ones (2 times) - Increased number of researchers - Increased number of scientific and research journals and articles in the field of health (4.3 times) - Increased number of new health technologies and patents (121.1 times)
Social causes	<ul style="list-style-type: none"> - Low proportion of health technologies to total technologies - Structural development of higher education centers (1.2 times) - Structural development of research centers, science and technology parks, and knowledge-based companies (36 times) - Changes in the higher education levels and courses - Increase the virtual structures in science
Discourse	<ul style="list-style-type: none"> - Increased number of academic fields
Myth/Metaphor	<ul style="list-style-type: none"> - Certificate-orientation and expertise orientation - Considering science as the production of wealth

Studying the technology growth centers in the field of medical sciences during 2003 and 2012 revealed an increasing trend. Moreover, these centers had a share of 7.1% among the active centers in other areas. Growth centers affiliated to the Ministry of Health constituted 5.1% of the total centers in 2011. The number of medical journals increased from 76 in 2003 to 331 in 2014. In this study, conditions and situations of medical universities were examined during 2003 and 2012. The number of medical universities increased from 42 in 2003 to 51 in 2012. Information related to patents in the field of medical sciences was available from 2003 to 2014 and reflected an increasing trend of patents in these years. The number of patents increased from 10 in 2003 to 1211 in 2014.

Health sciences scenarios

Three main scenarios (the pessimistic scenario, the intermediate scenario, and the optimistic scenario) and 16 minor scenarios were found at the social layer and its structures. Of the 16 scenarios, 3 were pessimistic, 2 optimistic, and 11 intermediate (Fig. 1).

The pessimistic scenario illustrates crisis and emergency situations. The main axes in this scenario show unstable security and political status (war, terrorism, and civil

strife) and poor economic situation (reduced oil revenues). Secondary axes reflect the worst social (aging population, decreased childbirth, increased number of divorce, and decreased social capital) and environmental (continued drought, earthquakes, and increased air pollution) situation. In such a situation, health is a vital and key factor, which is linked to security.

In the optimistic scenario, the region has security and political stability, suitable economic situation, and the best social and environmental situation. In this scenario, health paradise governs, health is the development stage, and the emphasis is on health civilization sciences in discourse and semantic layers. Moreover, the country has presented a right pattern in all layers of the society for the society and the Islamic World.

Intermediate scenarios are categorized into 3 groups including pessimistic-oriented scenario, optimistic-oriented scenario, and intermediate scenario. They embrace a wide range of secondary scenarios and form undesirable, preferred, and non-preferred futures. Nowadays, Iran enjoys the intermediate scenario and has preferable conditions in the optimistic perspective. Considering the fact that these trends do not change, this scenario is highly fragile and moves towards pessimistic-oriented intermediate scenari-

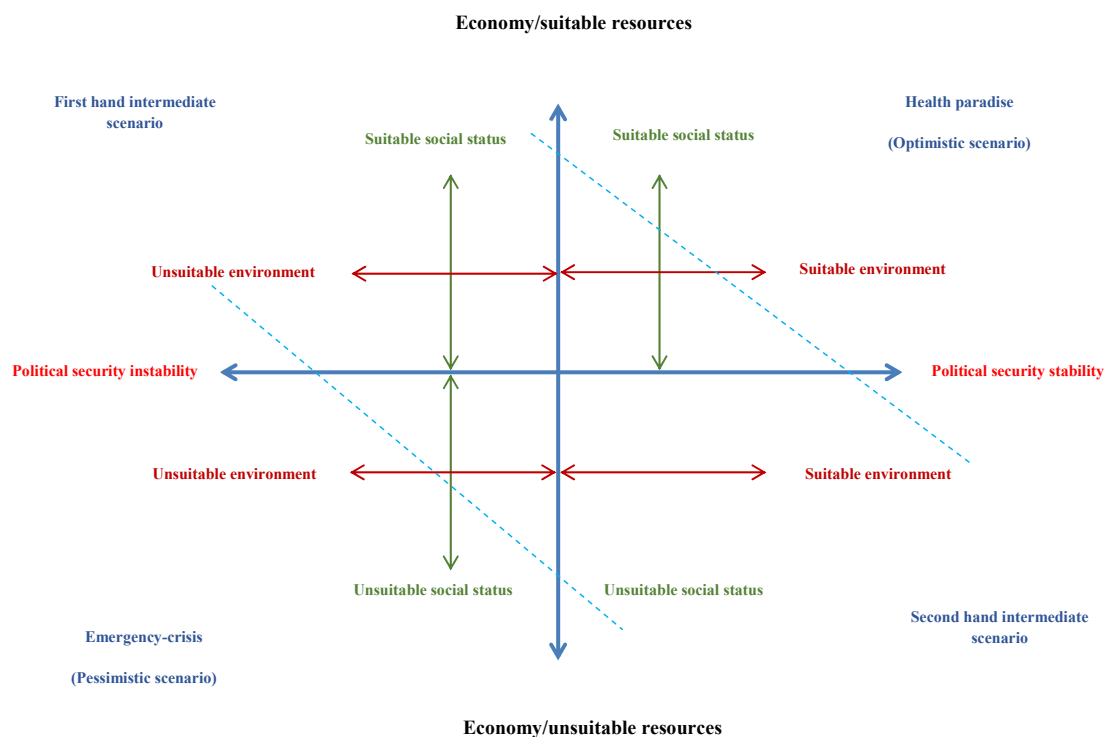


Fig. 1. Scenarios considered in the health sciences based on megatrends

OS.

Future status of health sciences

According to the first and second intermediate scenarios examined in this scenario, the impact of these scenarios was predicted on the future of trends of health sciences in the CLA framework (Table 4).

Table 4. Future status of health sciences based on the first (suitable economic & social status/unsuitable political & environmental status) and second (unsuitable economic & social status/suitable political & environmental status) intermediate scenarios according to CLA analysis

Layers	Current trends	Future situation
Litany	Increased ratio of medical specialists to the whole society	The current trend continues and there will be no good balance between specialist doctors and other doctors.
	Increased student admission	Due to population bubble exit, university age will decline sharply.
	Increased ratio of female students to male ones	This increasing trend will continue for some time and then will decrease significantly due to the shortage of marriage.
	Increased number of academic fields, especially at postgraduate levels	This increasing trend will continue and after a while the structure of fields and levels will completely change. The number of interdisciplinary fields will increase, especially in social and human science fields.
	Increased ratio of assistant professor to associate professor	This increasing trend will continue and after a while teachers' ranking type will change.
	Increased number of health articles	Due to a sharp decline in the number of students, the ratio of assistant professors to associate professors will decrease sharply.
	Decreased references to articles	The current trend continues
	Increased growth of research and scientific journals	It will decrease and eventually the number of these magazines will decline.
	Emergence of human and social topics in the health field	It will increase.
	Emergence of new health technologies in the international markets.	It will continue due to the globalization pressures.
	Increased number of medical technologies and patents in the production chains	It will have a very fragile increasing trend and it is much likely to decline.
	Telemedicine technology and Nano-genetics technology	It will have a rapid growth. The use of technology products will be more than production of technology; this trend will cause the health field to change to the consuming market of these types of technologies
	Decreased ratio of health technologies to all technologies	It will not change much, but it will increase in the frequency of production of these technologies, especially pharmaceutical technology

Discussion

In the CLA method, by moving up and down the layers, the futurist seek to challenge assumptions and create transformative spaces that can support new types of thinking about the future and lead to more effective policies

Table 4. Cntd

Social causes	Increased income gap and social position of health graduates	It will increase significantly.
	Structural growth of high centers	It will decrease sharply and this trend will continue.
	Growth of health research and scientific centers	It will decrease and will be integrated with educational centers.
	Growth of science and technology centers and parks	It will grow and the number of knowledge-based companies will increase.
	Changes in the higher education system and its academic levels	It will change drastically.
	Development of virtual structures in virtual research and education and the application of information technology	It will grow significantly.
	Growth of high private education and research centers and research structures	It will grow.
Discourse	Growth of research and development structures close to the service sites	It will move towards creation of an integrated science and technology structure; in this case, IT and communications will play an important role.
	Paying attention to the sciences and disciplines that produce more wealth or have individual social status	It will increase.
	Certificate-orientation and specialization-orientation	This trend will continue, but its shape and type will change.
Myth/Metaphor	Simultaneous growth of holistic view and individualistic view	It will Find a better position than the status quo; however, it will increase dramatically by pluralism of the definition of science from the postmodern perspective. It will also be accompanied by uncertainty and realistic methods and approaches.
	Considering science as a production of wealth to obtain welfare	It will not change

and actions (9).

Moreover, achieving knowledge and recognition changes objectively and subjectively when we move from the first layer, which is the most tangible layer, to the myth and metaphor layer, which is the most intangible layer. The first and second layers are more tangible, while the third and fourth are more intangible; in this case, their recognition is more difficult and time-consuming (18). Many studies have been conducted in various fields using this method. Hosseini Moghaddam (2011) examined foresight in political sciences with a focus on the CLA method. Hampson (2010) and Reidy (2008) also used this method in their studies (18-20). However, no research has been conducted on the health field using CLA.

Results of the present study indicated that if the litany layer and social structure layer continued their trends, we could have moved from a preferable situation to an undesirable situation. Therefore, this is an alerting situation, which calls for changes and reforms to the structure, discourse, and metaphor layers. The lack of transparency in myth and discourse layers and the lack of discourse were obvious; no attention was paid to the sciences related to this layer of the society. Thus, to avoid undesirable situation, it is highly important to make profound changes and reforms to the structure, discourse, and metaphor layers.

It must be specified that which sciences are necessary and prerequisite for these profound transformations and changes in different layers of the society. Therefore, implementing this mega-strategy in the inner layers of the society is essential to achieve health in the society. In this case, the scenarios do not continue their current situations and move towards the desirable states defined in the framework of the Islamic Revolution of Iran. In other words, to change the status quo and to achieve the Islamic discourse goals, a fundamental transformation and change in the inner layers of the society (structural changes, discourse, and semantic changes) seems necessary.

To solve this challenge (lack of an integrated intellectual and knowledge system based on Islamic values and knowledge), paying attention to sciences such as linguistics, semantics, cognitive sciences, history, philosophy, humanities, and social sciences based on the principles of the Islamic revolution is highly necessary. In fact, sciences of this layer are basic sciences for the structural layer. It must be noted that these sciences include all individual and collective dimensions; in this case, to overcome the weaknesses of this layer, adopting an established approach in the health field seems essential.

Internal changes of the society should not make us ignore superficial social recommendations and interventions, which are the main and the observed demand of the society. To emphasize supply-oriented and demand-oriented issues, internal changes of the society must be monitored simultaneously to improve and achieve the Islamic discourse and to consider accountability to the important existing issues in the society (litany). The most important issues in health sciences, necessary sciences, and concerns of each layer are demonstrated in the attached table at the end of the article.

In a study conducted on the CLA of Bangkok traffic, the solution was found in the layers of metaphor and myth. Similar results were obtained in another study on analysis of the problem of decreased enrollment at a university in Australia (11). In some other studies, the discourse layer was considered more important. For example, Michel Foucault regards truth as the discourse product. He believes that various knowledge systems determine what is right and what is wrong, so the search for the pure truth is futile without discourse. In his views, there is an interactive relationship among discourse, power, wisdom, and truth; he also emphasizes discourse interventions on interaction with power changes (Discourse is a power vector, its producer, its driving force and its corrosive force.). He also believes that some discourses, such as truth, are the

cores of power (21).

Conclusion

As to the health field, sciences that deal with individual health have been taken into consideration, but less attention has been paid to the social sciences and governance, and discourse sciences have been mainly neglected.

Therefore, the health sector requires fundamental changes in the structure, discourse, and semantic layers. Therefore, some centers, such as the Academy of Medical Sciences, the Center of Iranian Islamic Progress Pattern, and the Expediency Council, should pay attention to the internal layers, especially the discourse layer, in creating a cultural revolution in the health field and creating health structure and system proportionate to the Islamic revolution discourse. Moreover, an emphasis should be placed on the sciences related to this layer. This science-oriented framework is suggested in [Appendix 1](#).

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Conflict of Interests

The authors declare that they have no competing interests.

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Appendix 1. Suggested science-oriented framework

Comments	Types of The impact of the Academy	The main issues of health sciences	Science level according to the academy mission	Position in a square				Science aspect		Health science category
				External	Internal	Group	Individual	Applied	basic	
Explanation of discourse and theory-making (special culture-making) the comprehensive plan of ontology and epistemology of man and society. Designing a comprehensive value and moral system semantics and linguistics plan(presenting vocabularies) a comprehensive legal, structural and behavioral system	Direct	Lack of knowledge and intellectual integration based on Islamic knowledge and value resources (comprehensive pattern)	Much		✓	✓	✓		✓	Quran and Hadith Linguistics and semantics Cognitive Sciences History Philosophy Human sciences Moral Sciences Social Sciences
Macro-monitoring environmental scanning system stewardship and equity in health and service providing system Financing system(insurance and pay-ments) Production of resources (educating and training human resources, managing knowledge and facilities)	Indirect	Frequent and numerous changes, Inequality in the distribution of resources, Inequality in pay systems and inequality in financing Weaknesses in managing science and technology, weakness in training skilled human resources and its fair distribution Weakness in managing knowledge and knowledge experience in organizations	Average	✓		✓		✓		Policy making Statistics and Information Epidemiology Management Economy Hard technology and equipment Communications and IT
	Indirect	natural disasters environmental pollution due to urbanization	Low	✓		✓	✓	✓		Prevention and management of risk factors environment Food and nutrition
Public Culture-making with a focus on family health	Indirect	High-risk behavior (physical inactivity, murder and suicide, addiction, sexual behavior, violence) changes in family structure and its health	Much	✓		✓	✓	✓		Promotion of health and lifestyle Health communications and media Management and population health (social Medicine) Family Health
	Indirect	<ul style="list-style-type: none"> •injuries •noninfectious diseases: <ul style="list-style-type: none"> o cardiovascular o Cancer •emerging diseases 	Low	✓			✓	✓		Clinical diagnosis, treatment and care
	Indirect	<ul style="list-style-type: none"> • Antibiotics • Genetics • Side effects 	Low	✓			✓		✓	Drug Laboratory Cellular Molecular Nano