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Challenges of Iranian national health scientific map

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Abstract:

CONTEXT: Iranian National Health Scientific Map is a national plan the implementation of which remarkably influences the progress of the country, though it is facing challenges in its implementation phase.

AIMS: The present study has been conducted with the main aim of identifying the challenges facing the comprehensive scientific health map of Iran.

SETTING AND DESIGN: This is an applied and qualitative study.

SUBJECTS AND METHODS: The study was done in 2017 with the content analysis approach among experts of research and technology management. Some 18 people were selected and were deeply interviewed, meanwhile observing the credibility of research.

STATISTICAL ANALYSIS USED: Data analysis was performed based on content analysis and using ATLAS.ti software.

RESULTS: Data analysis resulted in the identification of 427 codes, 84 subthemes, and 12 themes. Twelve themes were specified including policy-making, management, university autonomy, quantitative development, consideration of science production chain, designing and monitoring of science map, finance, qualitative assessment, human resources, research ethics, as well as allocating attention to the infrastructure and communication.

CONCLUSION: The scientific map of health challenges are indicative of the need for modification of the scientific map and adhering to solutions in line with the removal of the identified challenges. Today, paying attention to the solutions capable of meeting such challenges is a must.

Keywords:

Health policy, Iran, national health programs, research and development

Introduction

Based on the Iranian vision 2025, Iran is a developed country occupying the first regional status in the economic, scientific, and technology domains with Islamic and revolutionary identity in the Islamic world and effective constructive interaction in international relations.^[1]

To fulfil the above objective, a road map titled "The comprehensive scientific map of Iran" was introduced by the Supreme Council of Cultural Revolution^[2] which

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incorporates a dynamic-futuristic complex including the principles, objectives, policies, structures, and requirements of strategic development of science and technology to achieve the prospect objectives of the country. The Iranian National Health Scientific Map (INHSM) was compiled and introduced in December 2010.^[3]

Despite the importance of the INHSM in advancing the scientific progress of the country, less attention has been paid at the national level to the challenges it faces. Although, efforts have been made in some areas such as education, and in some medical universities. The medical sciences

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universities of the country also have started presenting reports on activities pertaining to the INHSM. The report issued by the Tehran University of Medical Sciences more comprehensive than other reports.^[4] However, despite a lapse of about 6 years as of the compilation of a scientific map of health, there has been no report on the progress of the map status. On the other hand, there have been criticisms about the scientific status of the country. From such criticisms, we can refer to the reports that raise concerns about the progress of the science in the country.^[5-9]

Davari Ardakani (2007) in his paper titled "Scientific development or reproduction of papers" emphasizes the scientific development of the country versus the increasing trend of publishing papers in the foreign journals, and escalating personal scientific ranking.^[5] It is said that this map is based on the science push policy (versus policy pull) and specific highlighting of cultural-religious and ideological values instead of scientific and technological-professional values. Rahbar *et al.* (2014) in their study titled "Considerations on the comprehensive scientific map of Iran" have dealt with the critical investigation of improvement opportunities of the map, aiming at the enrichment of the future versions of the map.^[7]

Fewer researches have been published concerning the INHSM.^[4,8-13] It is recommended that Kerman University of Medical Sciences must through a compilation of a coherent plan aiming at decreasing the mentioned challenges, plays a decisive role in achieving the map objectives.^[4] In another qualitative study, the necessary activities for the development of health scientific map in medical education field were studied.^[10] Infrastructures for systems medicine^[11] and spanning foresight in the field of health and standardization^[9] are another challenges.

Despite the importance of the INHSM, less studies were done to analysis of current situation, challenges ahead the INHSM and learning from past experiences for future revision of the map. Obviously, determining such challenges currently hindering the way of INHSM in achieving its objectives can be useful in preparing plans to mitigate such challenges. In addition, it can be helpful in reviewing the map and removing its weakness points. Adopting such approach, the aim of this study is determining the challenges the INHSM is facing within the year 2017.

Subjects and Methods

This is an applied and qualitative study that has done in 2017 with content analysis approach among the experts of research and technology management and experts

of the INHSM in the Ministry of Health and Medical Education as well as medical sciences universities of Iran which were selected primarily using targeted and then snowball method.^[14] The selection process of samples and data accumulation continued until saturation of data, and finally, 18 samples were selected. Data accumulation was performed using semi-structured interviews. The interview began with the open question, "What is your opinion on the INHSM? Please describe." and afterward the main questions of the research were asked from the interviews including the following items: "What are the challenges of achieving the map objectives?" and other exploratory were asked to obtain more detailed and rich information. Every interview lasted for 30–60 Minutes. All the interviews were done at a prespecified time by the participants and without the presence of others.

Data analysis was performed using content analysis approach in a seven steps method^[15] including transcription, familiarization with the interview, coding, developing a working analytical framework, applying the analytical framework, charting data into the framework matrix, and interpreting the data. Finally, the hidden content was expressed as a study theme. Data analysis resulted in the identification of 427 codes, 84 subthemes, and 12 themes.

The data credibility criterion was investigated and confirmed through prolonged engagement of the researcher with the research subject, and member check through which part of the interview together with the initial codes were reviewed and confirmed by the participants. The conformability was measured through external checks familiar to the qualitative studies; that is, parts of the interview together with the relevant codes and the emerged codes were reviewed and confirmed by two supervisors familiar with the qualitative studies. The data dependability criterion was obtained through immediate note-taking as well as accurate and complete recording of the research procedure so that the possibility is created for others to follow-up of the study. The transferability criterion was obtained through maximum variation sampling, that is, selection of participants with age and gender differences coming from various positions and universities.^[16,17] In addition to obtaining the participant's consent for voice recording and note taking, the compliance with the ethical principles in the research process such as the conscious consent, unanimity, confidentiality, and option to leave the study was observed in relation with the participants. Before the actual interview, the study objectives, confidentiality of the information, and voice recording of the interviews were described for the interviewees. The participants' information, recorded sound files, and their names were kept secret and they all had the right to withdraw from the study at any time.

Results

In total, 18 experts in research and technology management in the health system were interviewed. Participants included 7 men and 11 women. The age mean was 44 years and the mean work experience was 19 years. All participants were in key positions in Iranian health system including Deputy of research and technology in the Ministry of Health and Medical Education, Deputy of research and technology in universities of medical education, and R and D directors.

In this qualitative study, data analysis resulted in the identification of 427 codes, 84 subthemes, and 12 themes to which we will deal with by describing them separately [Table 1]. Twelve themes are identified including policymaking, management, autonomy of university, quantitative development, consideration of science production chain, design, and monitoring of the scientific map, finance, qualitative assessment,

human resources, research ethics, consideration of infrastructure, and communication are among the challenges and problems identified in the way of success of INHSM [Table 1].

Policymaking

This theme relates to the role and influence of the policymakers and politicians in advancing the INHSM. "Intelligence means timely discovery and careful recognition of Society scientific problems and requirements, and giving a creative response to this requirement, and learning from it, meaning obtaining the results from the application of these teachings in the instructions, methods, and educational texts." (P8) Policymaking must be actively implemented. Reactive policymaking results in weakness of the policymaker's status, "The increase in the number of students was a response to the previous policies including "Population increase." (P4) Numerous policy-making centers constitute a major challenge to which we are engaged. (P1)

Table 1: Themes and subthemes of challenges of the Iranian National Health Scientific Map

<i>n</i>	Theme	Subtheme
1	Policymaking	Weakness in policy intelligence, inattention to innovation system, reactive policymaking, numerous policymaking centers, public-private role misrule, lack of policymakers commitment to the map, excessive attention to quantitative ranking, support moving on the edge of science, expansion of interdisciplinary areas of science, weakness in policy for persuasion patenting by the private sector
2	Management	Inattention to foresight and long-term strategic planning, lack of management stability, weakness in management commitment to the map, inattention to mega-project management, collaborative management, need to changing manager's culture and attitude, parallel research centers, lack of need-based research priorities
3	Autonomy of university	The meddling of politics in the university, weakness in university authority, political decision-making for academics, rigidity to becoming third generation university, unclear role of universities related to the science map, political pressures to expand the universities
4	Quantitative development beyond the capacity	Quantitative development of the research centers, quantitative growth of the number of students and articles, focus on the number of papers, need-based research center, expansion of the disciplines, importance of quantitative indicators, inactive journals
5	Science production chain	Inadequate explanation of scientific authority, misleading of science production process, more attention to scientific fashion and prestige, weakness in transformation of scientific capital to technology, weakness in transformation of technology to product, less attention to diffusion of products, weakness in reverse engineering, disproportionate of scientific outputs to outcomes
6	Revision and monitoring of the map	Necessity of fact-based revision, lack of the road map, imperfect monitoring, monitoring the map, supervising the method to achieve the goals, don't publishing of monitoring results
7	Finance	Lack of financial annexure, don't allocating enough and approved the budget, financial dependence of research centers, limited grants, lack of activity-based costing, insufficient investment for the export of knowledge-based products, weakness in intellectual property of patents
8	Human resources	Disproportional distribution of scientific activities of the professors, less attention to training peers, motivational incuriosity of professors and physicians, weakness of education, knowledge deficiency of managers and non-professional management, teamwork weakness, undetermined researcher's career, high number of young researchers
9	Focus on quality	Faculty promotion regulation, inattention to the qualitative indexes, poor quality of doctoral education, undefined requirements of scientific and technological products, poor quality of patent registration, a smaller amount of qualitative monitoring of research centers, unbalanced quality assessment
10	Infrastructure	Low scientific productivity, weakness in sustainability and competitiveness, lack of integration of facilities, undefined research line for research centers, the unsuitable situation of private r and d, low legal transparency, a smaller amount of society-based research priorities
11	Research ethics	The occurrence of unethical issues, fraud and producing pseudoscience, weakness in supervision of research ethics, unethical role modeling
12	Communication	International politics, export sanctions, economic decay and insecurity, little international communication of research centers, unemployment of graduates, dissociation in industry-university relationship

Among things relative to policymaking, is paying attention to the innovation system; a system in which the science is injected and published; an innovation system that becomes the property of the owner; and becomes its ideal (P4). It seems as though the segregation of private sector role from the public sector in the comprehensive health map needs a review so that the interviewee number 4 states that: "When we were writing the map, we thought the patent belongs to the public sector. A patent must emerge from the private sector. This means that research and development in private companies file patents to protect their intellectual property rights. Patent by the government is nonsense. These roles must be separated" (P4). On the other hand, the policymakers must feel obliged to the implementation of the map. Currently, it seems like that excessive attention is paid to quantitative ranking. "We must see how much the world emphasizes such things; i.e., how many papers were they, how winy papers they are. To what extent we must have concerns about such things" (P4). Policymakers must support moving on the edge of science, "Because any stoppage leads to lagging behind, the rest of the world in terms of science" (P18). They must support the expansion of Interdisciplinary areas of science and specifically in policymaking, must focus on the production and use of the patent by the private sector. "The Samsung Company singly has more patents than Iran because they must compete and survive. One of the problems is that the private sector in our country and research and development in this sector did not grow in parallel with scientific growth". (P4)

Management

Management to achieve success needs the foresight and focus on long-term strategic planning. "We lack foresight and strategic planning; (P18) managers prefer short-term objectives over long-term goals. "Every new university director wants to escalate the university research score. One of the managerial problems is the lack of management stability. "Some managers mention that because the non-permanent is a temporary job without stability, new university head seeks rapid yield and discards the previously obtained achievements. Moreover, the management commitment to the execution of the map is highly influential. When a director replaces another and the distances from the research and innovation, we would fall downward (P18). "First we need planning and then the managers must be bound up to the goals of plan. (P5). Furthermore, the necessary attention must be allocated to the project management at the macro level. Those centers defining a major goal and directing all the researches toward that goal would succeed. If a mega-project is divided into smaller projects, we will probably have 10 smaller projects after 4 years, all targeted toward that main objective (P18). The collaborative management was also

noticed as one of the managerial needs. "If we adopt collaborative management and thereafter execute this management in the roadmap that the organization depicts for itself, then there will be a good chance for success. In implementing collaborative management, we must prepare the ground for defining the individual share of duties and works (P15). The interviewees did refer to cultural development and the necessity of changing the managers' attitude. "Our problem is mainly cultural. We need culture development. For example, what are the management of faith and attitude? When a manager thinks only for increasing the number of papers and acquiring scores, in comparison to a director thinking 4 years thought, the result would be quite different. (P15) Multiple research centers cause negative parallelism in the research activities. Some experts believe that the merger of some research centers must be taken into consideration. "We have fragmented centers. Our research centers are worthy. They are valuable, but the merger of some of them is necessary (P1). The issue assumes more importance when it is viewed in light of the establishment reasons of research centers. The research priorities of the universities must be determined based on the mission and actual needs. "Every university must work on a specific issue and context. (P18) The establishment of our centers is more prescriptive than the base on the society requirements. It is more dependent on individual capacity than society requirements (P8).

Autonomy of university

Preservation of the university autonomy is of the identified themes, with its role emphasized on in the progress of the INHSM objectives. The meddling of politics in the university can endanger achieving the goals. "Universities have become mixed with the politics. In the west, the presidents are changed, the university director not. In our country, all university managers are changed in every presidency period. (P7) In this respect, the empowerment of the university authorities must be seriously considered. "We should not meddle in the university procedure; there is too much intervention in the university affairs. In whatever place in the world, a ministry does policymaking for the university? (P7) Decision-making on the university affairs must be left to the academics. "Currently, we assign the university issues to non-academics. The university bylaw is written by those who have not grown up step by step in the university; the same assistant professor who has become the head of the university. For the scientific development the third generation university must be established. "Our universities are basically educational and are not yet from the third generation, of entrepreneur type (P18). Establishment of the third generation university cannot be of imperative issue. Scientific development must be endogenous, coming out from within the university. (P8) Furthermore, the university role in the science map

must be carefully considered. "If a plan is based on the map, it could be excellent." The map objectives and each university duties must be determined. They must know what they must do. If other groups also could pay more attention to the map, it could go ahead perfectly (P5). Political pressures to expand the university without proper consideration of the requirements would harm the scientific development and the scientific map itself. "The provincial universities have put pressure on the authorities for the establishment of university branches without considering the consequences" (P4).

Quantitative development beyond the capacity

One of the discovered themes that are effective in the fulfilment of the INHSM is the quantitative development without due consideration of the existing capacities appearing in different forms. "When the map takes on a quantitative approach, it is not too hard to achieve (quantitative) goals and when you get there, you will not sense there has been something extraordinary in the country (P5). Quantitative development of the research centers is a challenge. "We can say that we have 800 centers on the paper, while in many of them there is no news (P4). Concerning the quantitative growth of the number of students and articles, there was a relative agreement between the respondents. The pace of admission students beyond the capacity is traceable in all disciplines. "In research-oriented doctoral degree, the capacity of admission of some disciplines was only two candidates but actually 20 people were recruited. We have no such a capacity for a doctorate degree. The number of professors is not enough to cover such a large number of students (P1, 4, 7, 8, 18). Regarding scientific growth, we have focused on the number of published papers. "Paper publication was focused on because ranking was based on the number of papers (P1) and payments were made based on that (P8); from all the scientific growth, we only emphasized paper publication." On the other hand, very often the research center set up is not based on the requirement. "Establishment of the research center is not need-based. It is for the sake of ranking; efficiency is not important. Having a research center is important because it allows privileges (P18). Quantitative development beyond the capacity is obvious in the expansion of the disciplines. "We can see that admission of students has increased significantly and any university is adding a series of disciplines for the sake of its own expansion (P1, 4, 18). This development without due consideration of the capacity has resulted in the increase in the number of inactive journals; journals that are not operating at the international level and are facing with various problems. Who said we need 800 magazines in the medicine sciences? Every place (university) has created 4–5 journals that have no paper input; "it has published 15 papers that 13 of which belongs to its own." This is a local magazine. It is a news magazine. It is not

a scientific journal. No reference is made to it (P7). The interviewees believed that the weight of the importance of quantitative indexes in the comprehensive health map is high. "We are drowned by the quantity to the extent that we unable to assign importance for the quality (P7).

Paying attention to the science production chain

In line with reaching the status predicted for Iran in the comprehensive scientific map of Iran, there is the need for serious attention to the science production chain. For this purpose, the scientific reference must be explained. "But the scientific reference is not enough (P1). In other words, "we have confused the scientific reference meaning with the number of papers (P4, 7). In this respect, we still need reviewing and activation of science production process. "We must know about how the scientific cycle is operated. We may fulfil this goal with only 10 articles and we may fail fulfilling it even with 500,000 articles. The output of scientific cycle means the production of science that part of which is consumed in different applications, another part is entered into the educational books and some other part is delivered to the industry, etc." (P7) One of the other challenges relating to the science production chain is the consideration of the real science and avoiding from fashionism; allocating too much value for fashionism instead of the science. "We must see how the world emphasizes these things. The number of papers is not important. We must evaluate the output of these things; the amount of concern we must tolerate. Currently, all the scientific acceleration is prestige based (P4). In the science production chain, weakness is obvious in the transformation of scientific capital to technology. "Scientific capital must result in technology." (P4) Also, weakness exists in the transformation of technology to the product. "Technology must result in the production of products" (P18, 5, 4). Another challenge in the science production chain lies in the diffusion of products and improvement of health and livelihood of people. Also, reverse engineering must be conducted in an acceptable manner. "We should be able to correctly copy some parts and manipulate some others if necessary.; we must start from small equipment" (P18). Finally, in science production chain, the proportion between the outputs and outcomes must be considered. "We have learned only publication of paper; but the world says how many good papers you have; how many of them have been patented; and how many of such patents have turned into an application and commercialized. Such consequences, however, have been stuck in the death valley.

Revision and monitoring of INHSM

From the discovered themes regarding the map challenges, we can refer to the revision and monitoring of the map. INHSM needs revision based on the facts and realities. "That map is ineffective know anyway. (P7) The present situation must be specified and the real requirements are identified,

so that the compilation of could be effected based on true needs. "The existing comprehensive map was prepared without the identification of present situation (P18). The map has been incorrectly composed from the beginning and is not based on the realities (P7). The other issue is the lack of the road map. We need a roadmap to better fulfilment of the objectives we expect from the INHSM. "We needed planning for the roadmap, equipment, and facilities required for the favorite status of the map. (P8,18) "The required resources have not been predicted for the map; the preparation of road map is a must; resources, duties and projects must be determined" (P7).

Moreover, the manner of complete monitoring of map must be determined; such monitoring must be comprehensively conducted including all the map axes. All the economical indices especially those related to health but out of the ministry of health domain must be monitored. "Currently, there is no unit to monitoring the map (P3, 5). "People no access to the market share and investment indexes results. (P3) "There should be a program for monitoring of the map (P5). Monitoring must include a series of indicators including: number of papers, grant acquisition, technology indexes, economic indexes, export indexes, registration of patents, publication of books, research and development, scientific ranking in the world, prize-winning, number or citations and self-citation, etc. Such indexes must be simultaneously investigated. "In science survey, we must avoid looking only at one index. We must put different indexes together. A number of published papers, references, h index, quality one (Q1) articles; all together must show this person is making a good job; each and every individual (researcher) must be analyzed. The references made by me to my own work are not good. The number of Information Sciences Institute (ISI) articles is not important. (P7)

It is necessary to provide a plan for monitoring; currently, there is no plan for monitoring of the map. (P5) The monitoring plan must feature a supervision and assessment mechanism for the achievement method of goals. "No one is supervising whether this method of achievement of goals is acceptable or valuable (p18). Ultimately, the monitoring results must be published and distributed among the relevant individuals and the decision making institutions. Lack of knowledge among the experts regarding the overall results of the map was observed. "Patents? I am not aware" (P5). Knowledge-based information is not related to our center; it relates to the health technology center (P3). "No aggregation of results has been made by the center and it has not been published (P18).

Finance

The finance theme is among the important identified themes to which the interviewees have referred. From

the concepts relative to the comprehensive health map challenges are the lack of financial annexure to this national document. "When they were writing it, we said it is too ideal and lacks financial annexure (P7). Nowhere in the map, reference has been made as to the funds necessary for the fulfilment of objectives, and the amount of credit needed per student, research center and paper as well (P8, 18). Furthermore, allocating enough and approved the budget is another challenge requiring attention. "Budget holds top ranking among the challenges the map is now facing with (P18). "The approved budgets are not allocated. Funds have vanished and we have received 4% of the approved budget after 7 months (P7). From the other items effective in the achievement of the map goals are paying attention to the cost price of research in various disciplines. "Nowadays, they pay someone 3 million Tomans to prepare a thesis together with the publication of two ISI papers. In immunology, we need to spend 50 million Tomans to have a good paper. No attention has been made as to the cost price of research or activity-based Costing in research" (P7). Financial independence of research centers is of another identified challenge. "The government must supply budget for several years and then you must make income, otherwise we need to close it. They would not do that. In Austria, they have the law denoting the support of government besides the requirement of the main objective of the center as well as the time required for the center to achieve its goals. During the initial years, the center is financially supported and afterward the governmental support is decreased stepwise, after which the center must reach commercialization and market its products (P18). Acquisition of internal and external grants requires attention. "Is there capacity for absorption of the budget for our research centers? Such centers must be established beside the industry. They must obtain grants from the industries. The centers must acquire grants from outside of the university (P18). Obtaining grants from global research centers or countries must be encouraged (P1).

The success of the map depends on investment for the export of knowledge-based products. The success of the map can be best proved by the knowledge-based exports' indexes. "If we consider carefully and wish to realize whether we have traveled all the way correctly so that it could be something valuable at the international level, we must look at the exports. Our knowledge-based exports are not something considerable compared to the total amount of exports. Hence, we are at the beginning of the journey" (P4). "In export activities, the products must be supplied at the international level quality, something requiring adequate investment" (P18). The intellectual property of patents also needs proper consideration. "The patent status is not acceptable at present situation unless we define appropriate indexes

for registration of patents. The intellectual property of patents is not respected properly in Iran and copying is customary" (P7, 18). "Registration of patents is performed with the aim of profitability; very often stuff are registered with no actual value" (P5).

Human resources

One of the discovered themes is the human resources development. From the challenges pertaining to the human resources, the inappropriate distribution of scientific activities of the professors; fewer numbers of professors are the authors of the best part of the papers and a significant percentage of them are idle regarding scientific activities. "Any professor if issued one or two good scientific paper, this country could achieve the status of five top ranking of the world" (P4). The other concept is paying due attention to training peer counterparts. "We must work on training peers" (P1); the question is that how many professors we have to define research-oriented doctoral students for them (P7). The motivation of other professors and clinical physicians is another challenge needing consideration. "Clinical physicians do not perform any research because either it is not a top priority for them or it is not beneficial to them (P18). The present assistant professors state that if they reach full professor status, they will abandon research work" (P8). The other challenge is the weakness of education. Training is performed in this way only as an evasion of responsibilities. It is only form filling and documentation. The education must be direction oriented" (P18). Clinical physicians have not been trained what so ever" (P8). Knowledge of managers and non-professional management are of effective factors in the success of the scientific health map of Iran. The major problem in all the institutions is that the manager is a physician. We must consider at least a few units of management for them; because they are not familiar with scientific theories of management" (P18). Teamwork is one of the other concepts. "We do not teamwork. We have a group; none of the members, however, plays his role properly. In addition, the specialized research orientation of the researchers must be considered. "How many defined research career we have in the universities? We have a problem; because the manager cannot give any direction" (P18). "Mostly, the personal development is considered as empowerment of individuals, to which the organization is playing no role. This has made the people to take the lead" (P18). Ultimately, the high number of young researchers is among the challenges requiring due consideration. "We have 120 researchers <45 years of age in our university, comprising 65% of our total number of researchers" (P1). "Researchers during the past several years were mostly assistant professors and have done more research activity; however if the incentive dimension fades, they will suffice to their salary (P18).

Focus attention on quality

One of the themes discovered during consideration of the challenges of INHSM is focused on quality. And one of the relevant concepts is the code of faculty promotion. The code of promotion is one of the effective tools in orientating the health research environment. "The major part of work in the field of orientating the scientific products was the code of promotion" (P4). "On the other hand, assessment of the professors showed that they must seriously focus on the papers and paper production issue. Hence, there was the student and the professor attempted to use the student. They added incentives (P3). Even considering the regulations set in the code of promotion, the individuals began acquiring privileges, and thus started producing papers" (P5). "Quantitatively, we achieved the percentages determined in the comprehensive scientific map; indexes like the number of papers and research centers. Qualitatively, some measures have been taken from the year 2011" (P2). Paying attention to the qualitative indexes is another challenge the map is faced with. The map has been neglectful toward some important qualitative indexes. "The number of references has not been calculated" (P5). "The number of high-quality papers and the Hirsch index has not been considered" (P18) "We must go upwards without quality." (P4)

The education quality at doctoral degree is another concept, influencing the map success. "Some people (professors) had the capacity of two Ph.D. students; they acquired 20 students. The Ph.D. student with 3 years of education is unable to publish 2 papers to graduate.; Ph.D. student must be a full-time student. Nowadays one works for several places. The Ph.D. student is graduated beside his other jobs." (P7) "Professor to student ratio in Ph.D. degree is very low in some universities. Although the number of Ph.D. candidates has increased, it has added to bureaucracy than problem solution" (P8). The qualitative requirements of scientific and technological products before marketing must be determined. "The state must define the qualitative requirements and prevent the goods from entering the market without quality.(P18) At first, they targeted the quantitative increase; though they noticed its inconsistency with quality in the end.(P3) One of the other identified concepts was the quality of patent registration. "Patent has no promotion privilege; so they refrain from working on patents. The patent is not equivalent to the paper. They register anything, however. There are the goods in the market, they register it as a patent. Patent cannot be a good criterion at the present situation. It must be promoted to the commercialization stage." (P18) "Patent in the current conditions is not much agreeable and we must define some new criteria for the patent. Intellectual property of patent is not seriously respected and copying is extensively done." (P8) Qualitative monitoring of research centers is

another concept requiring more attention. "If efficiency is regarded as criterion, research centers are inefficient. With the thought we have at present, we cannot attain quality at all (P18); we can say that we have 800 centers, while there is no news in 700 of them.(P7) Although important steps have been taken in this regard, it needs the expansion of qualitative evaluation of research centers by independent and international scientific groups.

Ultimately, it must be said that quality assessment requires paying attention to balanced different dimensions and various indexes that must be simultaneously considered when evaluating the INHSM. "We need to make the indexes more qualitative in research" (P3). They had pretty much quantitative views; they noticed later however that it was inconsistent with the quality" (P3). Encouragement of faculty members to promote higher quality products seems necessary. "Encouraging the faculty members to write credible articles to be published in credible journals" (P5). "Beside the references, we should pay attention to Self-Citation too." (P7)

Paying attention to the infrastructure

Among other identified themes, the need for consideration of infrastructure to achieve INHSM objectives seems necessary. "Provisioning legal infrastructures and establishing regulations, and facilities including the establishment of intellectual property law is necessary for commercialization of research results." (P8) Our infrastructure is not suitable for producing science, knowledge, and innovation." (P15)

The interviewees believe that productivity in the field of science production is low at present conditions and there is the possibility to increase it compared with the current rates. "Prestige constitutes all of the scientific acceleration. There is an infrastructure behind this prestige. That it must convert to claim means that the infrastructure should not remain useless. It increases productivity. If any professor could provide one or two good scientific paper, the country could achieve top ranking among the five superior countries of the world. Thus, the productivity is low"(P4).

On the other hand, the infrastructure must be sustained and competitive. "The infrastructure must be sustained and competitive. Practically, we are drawn into a situation where it could manage to solve the challenge, we can scape and survive, if not, this could annihilate us and we cannot survive for long. Our infrastructure could prove useful more than this. (P4) Another concept is the integration of the existing facilities. In experts' views, the scattered resources must be integrated and be optimally used. "Libraries are scattered; laboratories have little interaction with each other. Although we

have good and valuable research centers, still the integration of some of them is necessary (P1). "We must adopt an integrated perspective, that is, treatment, research, etc., must be integrated" (P9). Furthermore, the research path in the research centers requires focus and management. "Research line of all centers must be evaluated" (P2). "How many defined research path we have in universities and research centers? The situation is problematic for us" (P18). Another challenge concerning the infrastructure is providing a suitable situation for research and development of the private sector. "One of the problems lays in that the private sector its research and development unit did not grow parallel with the scientific growth; meaning that we failed in preparing the suitable bed for that (P4). The other challenge is the requirement for establishing legal transparency. "Other countries have clear regulations and provide support. They insist on incentives but we have no specific law in this regard" (P18). "Legislation of laws and regulations including the establishment of intellectual property law for commercialization of research results is necessary" (P8). Finally, the need for co-ordination of society priorities with research priorities was identified as a basic requirement. "Policymaking for each university and research center must focus on teamwork specific topic." (P18) Research priorities must be determined based on the society requirements (P8).

Research ethics

Research ethics was another identified themes and it appears that the INHSM is facing numerous and important challenges in this field. The occurrence of unethical issues is one of the concepts to be considered. "When we assign an assistant professor the task of the chief of the university, this means plowing of the university. Anything unethical he would use to achieve full professor." "We work only for the present time." Because we want to achieve that rapidly through any means, this "any means" is problematic for us, and would result in low quality and valueless papers, not acceptable at international level; they would be having no scientific privilege" (P18).

Fraud and producing pseudoscience is another challenge of INHSM. Where the realities are not considered, the budgets are not allocated truly and hence, one cannot expect high-quality outputs. A resume is made through unethical ways, for example, defining individuals' names without having real share in conducting research. When Ph.D. graduates cannot find a market to supply their specialty, they will create a source of livelihood for themselves by writing fake papers. This would cover up the real achievements of our scientists which are often fortified by suspicions about their articles, resulting in deteriorating the scientific credibility of our country. "How much credit is needed as per each student, each

research center and each paper to produce a good paper? When the per capita amount is not paid, this in fact means fake data, fake paper (P7). One of the ethical problems is mentioning the authors' names. "Today, one (graduate) person prepares the paper and mentions different names as authors" (P18). "Fake papers are all written by same unemployed graduates. He has no choice. This market is worsening day by day." (P8) "This method of student admission has destroyed the scientific process. Huge amounts of pseudoscience produced by our universities cause disbelief of anyone claiming by the oath he has done real work. Pseudoscience has destroyed the scientific face of us, which is in turn a result of our quantitative views. Who is to be blamed for the papers removed by the Nature magazine?" (P7)

One of the concepts demanding attention is the supervision mechanisms through which the observation of research ethics by the professors and students can be monitored. Who supervises? Whoever intervenes? To what extent this intervention can be preventive? Although the medical ethics committees exist, dealing with the cases of non-observation of medical ethics is often inactive and reactive. It is not actively identified and intervened. Whoever monitors the supervision of professors on the students' workflow? Is it necessary at all? The need for such supervision can be indicative of research ethics weakness among the researchers. We have had cases where the paper was rejected after publication because it is mostly student work and the professor has been careless about it. "Every new manager wants to increase the university research privilege within only 1 year. Hence, they say outsource this work but it must be counted toward us and no one supervises whether the resulting paper is acceptable. Is it worth?" (P8)

Another challenge is the unethical role modelling of previous managers, professors, and students. When a researcher realizes the way the others work, the definition of success is changed. "A building in a university was presented to three groups of visitors. This would change the signboard every time to get scores. We always make a show of things". (P18) "When we make an assistant professor the head of a university, we would probably plow that university. He would do anything unethical to attain full professor ranking. Young students understand that this is the way of growth in Iran" (P7).

Communication

One of the subthemes identified in the communication theme is the international politics and communication that greatly influences the level of success of the map. These external communications are influential on the science production. From among the effective factors in the interviewees' opinion, the study opportunities and contribution in joint projects are interesting. "The facilities

that are put at the disposal of professors and employees are very important" (P18). The global policies can affect our success" (P5). From other identified concepts, is the existence of the export sanctions. "Access to the export percentage may be impossible due to other factors like sanctions for the export" (P5). Another important concept is the economic security which is influential on the scientific growth. "Economic growth and security are effective on the research budget and development as well as researcher retention." (P8) International communication of research centers is among the concepts emphasized by the interviewees. Our knowledge is not separate from that of others. "A center must be active at the international level. Some centers that are good at the quantitative level are not qualitatively good as well." (P2) "In the European universities, the patents outnumber the number of papers. "This is just the opposite in Iran. (P15) The other challenge is the unemployment of graduates, "we must solve the unemployment problem of the graduates" (P4). Moreover finally, the relationship between industry and university greatly affects the success of a scientific map of health. "Can our research centers observe their budget? Such centers must stand beside the industry; obtain grants from the industry; considering the requirements, they should acquire grants from outside of the university"(P18).

Discussion

In this study, attempt was made to determine the most important challenges ahead of the INHSM by referring to the experts' views. In short, we can state that these 12 themes are among the challenges that identified in the way of the success of the INHSM.

Findings of this study showed that concerning policymaking, the most important problems identified for this theme deals with the role of policymakers and political officials in advancing the INHSM. Weakness in policy intelligence, inattention to innovation system, reactive policy-making, numerous policymaking centers, public-private role misrule, lack of policymakers commitment to the map, excessive attention to quantitative ranking, support moving on the edge of science, expansion of interdisciplinary areas of science, weakness in policy for persuasion patenting by the private sector are among subthemes effective in the execution of the comprehensive health map. Similar studies have demonstrated that the major part of the national innovation system of the country has its root in the weakness of policymaking.^[18] Other failures include weakness of systemic thinking of some policymakers and shortage of trained people in the field of policymaking.^[11] The study conducted by Seifadin-Asl also highlighted similar problems in the policymaking context.^[18] Ghazinoori also in his study has mentioned

to the inexistence of coherence in the policymaking of the national innovation system of Iran.^[19] It seems as though the separation of the private sector from the public sector in the INHSM needs a revision. A patent must emerge from the private sector; in other words, R and D departments in private companies applied for patent to protect their intellectual property. On the other hand, the policymakers should feel responsible for the execution of the map.^[9] It appears that nowadays excessive attention is paid to quantitative ranking.^[5] Policymakers must support the move on the edge of knowledge. Although attempts have been made in Iran during recent years pertaining to intellectual property, such attempts do not seem adequate. Numerous studies have reported failures in intellectual property laws.^[18,20,21] The inexistence of intellectual property of university results in a decrease of motivation and participation level of the faculty members (P4). Dehbashi *et al.* in their study referred to the inappropriate basis of decision-making by the health sector managers.^[22]

The “management” theme was identified as an important challenge. Subthemes related to the management theme include inattention to the foresight and long-term strategic planning, lack of management stability, weakness in management commitment to the map, inattention to mega-project management, collaborative management, need to changing managers’ culture and attitude, parallel research centers, lack of need-based research priority setting. Studies have demonstrated that Iranian universities have been mostly politics affected and their management has been mostly individual-based one. This situation adds to the complexity, difficulty of the conditions, confusion, and lack of planning due to the shorter management life cycle and frequent changes in the regulations and by laws^[4] which is consistent with findings of this study. Zakersaleh in his study concluded that assigning attention to new missions and functions in the universities was necessary.^[23] In this respect, the manager’s characteristics have considerable importance in terms of achieving the map’s objectives. Those who conduct the university innovation through participatory methods, appreciation of the people, and playing a role as an example for others can better act against rapid and unpredictable changes of academic activities. Undoubtedly trust of the followers toward the leader and the leader’s necessary skills, promotes the motivation of human resources and fosters their feeling of possession toward the university.^[24] Although the concept of project management is necessary for the research and development literature, the presence of macro-projects and breaking them into small projects in different units have been identified as very effective method. Dehnavieh *et al.* have dealt with the policymaking and management pertaining to the role of Kerman University of medical sciences to achieve the objectives of comprehensive health

map in that university which is consistent with the results of the present study.^[4] This study tried, considering the importance of policymaking issue in the technology research literature, to distinguish the managerial issues and explain the management challenges in the form of management duties.

One of the identified themes in this study is the autonomy of the university. The intervention of politics in the university, the academics not making decisions for their university, the problems relating to the establishment of the third generation universities, political pressure for the university expansion amongst others, are the subthemes that can affect the achievement of goals of the health map. Hashemnia *et al.* in their study concluded that the universities must review their executive management and finance methods, internal structures, and their external relationships. Their internal structure must change with the aim of creating appropriate conditions for acting based on entrepreneurship approach including emphasis on commercialization of research results.^[25] The researchers, however, did not directly refer to the autonomy of the university. Also, Eslami *et al.* found similar results.^[9]

One of the discovered themes which is influential on the fulfilment of the objectives of INHSM is the quantitative development without due consideration of the present capacity that have emerged with different forms. Quantitative development of the research centers, quantitative growth of the number of students and articles, focus on the number of papers, need-based research center, expansion of the disciplines, inactive journals, and on the whole, the high priority of quantitative indexes in the decision makers’ strategy are among the important challenges, having been identified in the form of quantitative development in this study. Quantitative growth are criticize by many researches.^[5,9,10,23]

Regarding the finance, the study findings are indicative of serious challenges pertinent to the lack of financial annex, do not allocating enough and approved the budget, financial dependence of research centers, limited grants, lack of activity-based costing, insufficient investment for the export of knowledge-based products, and weakness in the intellectual property of patents. Esmaili *et al.* in their study reported that the average status of facilitation and financing the R and D by the faculty members, the students and managers of the industry fall below the mean scores.^[26] This doubles the effect of financing challenges on the success of the INHSM. Zakersalehi in his study determined the supply, absorption and empowerment of competent financial managers as well as increasing the efficiency of the financial department of universities and higher education institutes and

their affiliated research centers as important factors of financing performance.^[23] It is said that budget financing is by far greater problem than budget management. Hashemnia *et al.* explained that diversification means decrease of dependency share to the governmental finance and more utilization of external income resources in the academic research sector.^[25]

A number of challenges were identified in this study pertaining to failure in due attention to science production chain, including inadequate explanation of scientific authority, misleading of science production process, more attention to scientific fashion and prestige, weakness in transformation of scientific capital to technology, weakness in transformation of technology to product, less attention to diffusion of products, weakness in reverse engineering, disproportionate of scientific outputs to outcomes. Taban *et al.* posited that scientific authority is a status that is established through long-term personnel and group attempt, in accordance with own and society needs for the production of science. Scientific authority comprises the following six main categories: (1) The economic and environmental procedure, (2) Motivating factors, (3) Structural elements, (4) Characteristic and behavioral features, (5) Strategic and systemic thought, (6) Science-production based education and research system (scientific and research competencies.^[27] Although in recent years, there has been high quantitative growth in scientific products context, however, there are doubts in terms of the consistency between the scientific content production process and the actual needs of the society.^[23] Explanation of 55 challenges for achieving scientific authority in Iran by the next 50 years^[9] reinforce our results.

The necessity of redesign and monitoring of the INHSM is one of the identified themes. The requirement for reviewing the map based on the reality, redesigning the roadmap, comprehensive map monitoring, supervising the map execution, evaluation of the fulfilment method of objectives and communicating the monitoring results to the users are among the challenges influential on the execution of the map. Emphasizing the map content analysis, indigenous development of science and technology maps' monitoring tools, and ultimately holding interview sessions with the canonical groups (academic experts), the maps' principal orientations are reviewed and modified and in the end, dynamic and flexible processes aimed its continuous review and evolution shall be predicted.^[8] The authors' recommended model can be used for the evaluation of the INHSM.

The identified challenges concerning the human resources theme are as follows: Improper distribution of the professors scientific activity, lack of attention to

creating peer counterparts, low motivation of professors and clinical physicians, weakness of education, low level of the managers' knowledge and non-specialized management, weakness of teamwork, lack of attention to the research path of researchers and high number of young researchers. Human resources as an important capital of the university need suitable and talented management. Esmaili *et al.* also in their study concluded that the investigation results are below average in terms of the development of human resources status, especially assigning importance and attention to the curiosity spirit, innovation, entrepreneurship and teamwork in technical engineering faculties.^[26] Arasteh in his study concluded that one of the important elements for the creation of motivation is appreciation of desirable activities of the individuals. The individuals that spend a long time on their academic profession expect to be treated suitably to the culture of experts' reverence. Yet after a short time, they realize that they have superficial dignity and academic-social status.^[28] Dehnavieh *et al.* in their study describe that removing the problems relevant to the researcher like (1) motivation of undertaking applied researches, disproportionate education, and research and targeted empowerment of individuals, (2) determining research priorities and (3) structuring applied researches are necessary.^[4] One of the most important concerns about the research undertaking category relates to the non-applicability of studies.

Paying attention to the quality is one of the requirements necessary for the success of the INHSM. Reviewing the code and regulation of promotion, inattention to the qualitative indexes, poor quality of Ph.D. education, undefined requirements of scientific and technological products, poor quality of patent registration, a smaller amount of qualitative monitoring of research centers, unbalanced quality assessment are among the subthemes identified as effective in fulfilment of the map objectives. If the university fails to adopt its performance and outputs with these emerging and diversified expectations, not only will be engaged in financial and credibility crisis due to the limitations of governmental resources in a competitive world but also because of the inability for satisfactory interactions with different stakeholders of the society, it will certainly be affected by the efficiency and effectiveness crisis.^[29] Dehnavieh *et al.* have concluded that the defect in different functional layers of the innovation system in the university is observed. The impact of such deficiencies in the first place causes the output of the university innovation system both qualitatively and quantitatively lacks the required features for proper fulfilling the role of provisioning the objectives of scientific health map of Iran. In their opinion, policymaking and management, culture and norms as well as development and promoting education produce more impact on university performance.

Development and promotion of education through affecting the performance of human resources can greatly influence other challenges determined in the present study.^[4] Hence, to promote innovation in the health sector of the country and to achieve Iran's 2025 vision objectives in the health sector through INHSM, serious attention is assigned to the rectification of such deficiencies, especially factors like culture and norms as well as expansion and promotion of education.

Although many attempts have been made for the establishment of university system infrastructure and well as research and development, findings of this study, however, are indicative of the need for further attention. Low scientific productivity, weakness in sustainability and competitiveness, lack of integration of facilities, undefined research line for research centers, the unsuitable situation of private R and D, low legal transparency, a smaller amount of society-based research priorities with the research institute are identified subthemes of this study. Provisioning legal infrastructure and legislating the relevant rules and regulations, preparing the facilities for the universities required for commercialization of research results,^[26] and infrastructures for systems medicine^[11] seems necessary. One of the important rules in this respect is the intellectual property. The effect of the university intellectual property policy on the science committee motivation for more participation in registration of patents, issuance of license and concluding joint contracts with the industry were emphasized by the findings of this study.^[30] Based on the results of this study, it would seem like no suitable context for the activity of growth centers of the health sector has been established.^[4] In another study referring to this problem, it was explained that Iran innovation authorities have used the developed countries innovation system as benchmarking without considering the infrastructures and prerequisites. In fact, it seems like building a large and heavy construction on small and weak bases.^[4,21]

Research ethics is one of the other challenges that unfortunately identified as a theme in need of attention in the present paper. The prevalence of unethical cases, fraud and producing fake science, lack of supervision of respecting the research ethics, and unethical benchmarking by the students are among the recognized subthemes in this study. Esmailzadeh *et al.* in their study emphasize that professional ethics together with Islamic ethics dignities are trained practically and objectively to the young human resources and academics.^[31]

Regarding challenges relevant to the internal and international communication, we can refer to the effect of the international policies, sanctions affecting to the export, economic decay and insecurity, limitation of

international communication with research centers, unemployment of graduates, and the manner of relationship between industry and university. Evidence demonstrates that organizational communications are the main vital vessels of the organization and play the data exchange and facilitator role of the organization affairs in both internal and external levels of the organization. The absence of enough interaction between the system players can result in weakening of innovative performance of the system.^[4] There are tangible challenges in the inter- and intra-organizational relationships of the university. Shahi *et al.* in their study described that the most important problem of the understudy universities in the globalization path was their weakness with the environment. This is evident in the execution of the researches required by the organizations existing in the area and concluding contracts with them.^[32] Unemployment of academic graduates is one of the important challenges of the higher education authorities of the country.^[33] Esmaili *et al.* in their study concluded that using the experts' experiences, their participation in interactions between scientific-research staff of the university and industry is lower than average despite the students' need to such interactions.^[26] Furthermore, in another study, the average rate of research supply by the universities for the industry has been assessed as low by the industry managers. Results of a study demonstrated that about 25% of technical knowledge created by the universities has been used by the industry.^[8] The health system also seriously has been affected by this same problems; so that the health system has not been enjoying enough of the requirement-based, service market-based and health services researches. Similar studies have referred to the weaknesses of research and development activities including specifying the needs and capacity.^[3] Unfortunately in the developing countries and especially in Iran, under the effect of numerous problems and obstacles such as weak relationships, the university and industry have incomplete recognition and knowledge of each other and each party is performing activities in a path different from that of the other.^[26] Paya explained that the three groups of scientific and technology concepts (38%), economical concepts (16%) and managerial concepts (14%), respectively, have the highest share in the conceptual structure of the national scientific map. Afterward, there are sociological concepts (rank 4), cultural concepts (rank 5), futurology concepts (rank 6), political concepts (rank 7) and finally legal concepts (last rank 8).^[6] The results of the study are shown that these aspect must be revised in the future revision of the INHSM. Larijani *et al.* have identified the most important challenges ahead of the scientific health map of the country as paying enough attention to the equality issue, balance in the selection of priorities, and the role of government in management of knowledge.^[3]

Conclusion

Although the present study is in line with other relevant researches,^[3,4,9,10,23,33] it laid its emphasis upon the challenges the INHSM is facing with to fulfil its objectives. The themes that emerged from the qualitative analysis highlighted the pervasive factors that impact the INHSM. Moreover, it is recommended to conduct a study to identify weight of these challenges and priority setting for practical solutions to improve development of the INHSM. The low sample number in this study may limit the generalization of the survey results. Of course, this is considered as the inherent limitation of qualitative studies.

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Conflict of interest

There are no conflicts of interest.

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