




What Do Future Trends in Medical Education Mean to the Scientific Development of Iran's Health System?

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Abstract

Background: Medical education system in Iran has an essential role in responding to scientific development targets from both education and research perspectives. Investigating future trends and analyzing how they interact with the medical education system helps increase awareness and give insight into the preferred future.

Methods: The present qualitative study consists of Systematic reviews and interviews that have been analyzed using content analysis. Afterward, the themes and codes were visualized in the form of maps and presented in a focus group discussion of experts to define how medical education trends will impact scientific development.

Results: The future trends of Iran's medical education system were classified into six groups: workplace changes, demographic changes, changes in concepts, the emergence of new players, structural changes in universities, and technology development. The next point is how they will influence science development. Their impact on science development is classified into five main groups or main streams of change of new financial models, open science, redesigning the research management, the role of universities, and capacity building.

Conclusion: Our findings showed that redesigning the structure of medical education is the most important priority to make the system as agile as needed to capture the signs and act. New meanings and concepts should also be considered in restructuring, like power balance, competency-based and personalized education, cost-effectiveness, and openness.

Keywords: Medical education system, Scientific development, Future trends, Environmental scanning, Systematic review, Meta-synthesis, Iran

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Introduction

Scientific development, excellence, and authority have been on the related organization's agenda in recent years

in Iran. The leading cause is the emphasis of the upstream document and development plans on science development

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↑What is "already known" in this topic:

Medical education will undergo changes rooted in complicated interactive general or specific trends. Analyzing future trends helps in mapping different images of the future to support stakeholders in their proactive approach to future matters.

→What this article adds:

In this study, the future trends affecting Iran's medical education are investigated, and also the secondhand effects are also mapped for each main pattern of change. It shows that the most critical aspects of change are structural, and just capturing the concepts from the international academic community will not work; instead, comprehensively translating and justifying the related structural changes are needed at Macro and micro levels.

as a key for national development, so there have been many studies and developed models to respond to this essentiality (1). The health sector is a field of science that has a dual role. One is to respond to the national vision of excellence or authority in health sciences (2), and the second and primary goal is health promotion and health service quality (3). Succussing in responding to both types needs to be future-oriented and environment-aware (4).

As much as different economic, social, educational, etc. systems can anticipate future requirements and develop their structures, policies, and regulations, they will benefit the future more with less harm from uncertainties (5). Traditional approaches based on trial and past data-based analysis are ineffective in dealing with upcoming challenges and threats, meeting future needs, and moving toward the vision and aims (5, 6). Just having an action plan is no longer a competitive advantage, though it matters how systems can base their strategies on desired images and vision regardless of inevitable items of the future like uncertainties, driving forces, or wild cards (7, 8). So many countries have devised the foresight process in their systems' policymaking and planning procedures worldwide, like higher education in England, Romania, Malaysia, and OECD countries (9-12).

One of the primary challenges that all countries will face, especially those with the ministerial structure of higher education policymaking, is to respond proactively to a changing international world and complex politics (8). At the same time, their policies and frameworks tend to be

past-oriented and strategic goals are generally short-term oriented (8, 13). Especially for Iran, higher education in Iran was separated into two main categories of medical and non-medical education after the integration of medical education into the structure of the health ministry. So, discussing medical education and its trends includes the future of higher education in general.

Scientific development has been given much attention in Iran's national documents, and the health sector has a vital role by its nature as the structure is defined as the medical education system. On the other side monitoring, the environmental changes help the systems to be agile and aware enough to be proactive in moving toward the future. This study aims to investigate medical education trends in Iran and how they would affect scientific development in the health sector through a systematic approach as a base of further future-oriented studies in this regard.

Methods

This study is a mixed method and multi-stage study that uses content analysis of the systematic review, meta-synthesis, and interviewing results.

The study started in 2019, but after COVID-19 was updated due to the emergent effects of the pandemic. The brief visualized steps of the study and more details of the steps are presented in Figure 1.

Systematic review and meta-synthesis

The search strategy was "what are the Future trends of

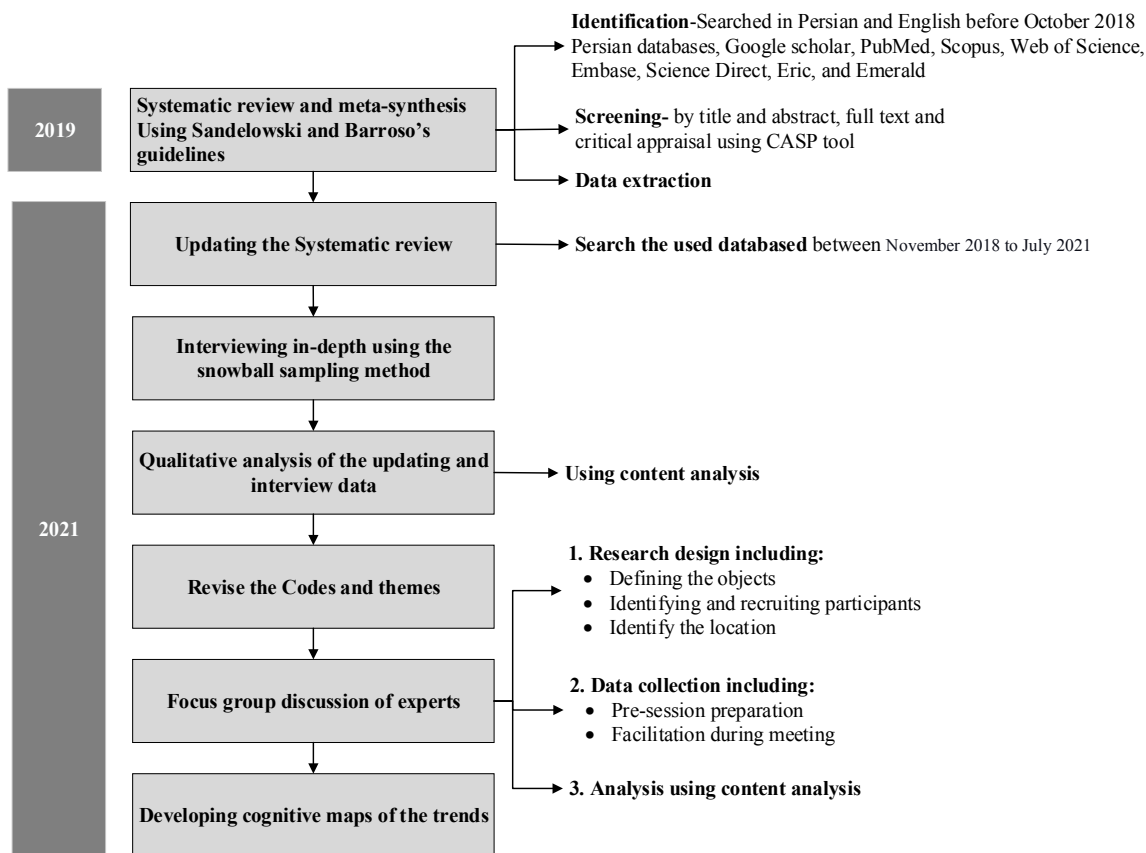


Figure 1. The overview of the study methodology and the steps in each phase

Table 1. Search strategy keywords to identify the Future trends in Iran's medical education using SPIDER tool

Sample	Operator	Phenomenon of Interest	Operator	Evaluation
Keywords		Keywords	Operator	Keywords
"Higher education" OR "medical education"	AND	"Future" "upcoming" or "emergent"	AND	"Trends" OR "driving forces" OR "uncertainties"

Table 2. The sources of the gray literature

Source of Data	Why Consider
Institute for Research & Planning in Higher Education Panels	There have been conducted more than 23 panels on the future of higher education with the participation of known related experts (17)
Master and Ph.D. thesis in Futures Studies	The thesis about the future of higher education or medical education is included so that "Futures Studies" is a field of study as a discipline in Iran (44).
The Global Futures Intelligence System (18)	Two members of the research team are involved in the GFIS so that they have access to data on the future of education and learning.

medical education?" which has been developed based on SPIDER (14) and aimed to identify the main changing paths affecting medical education, also shown in Table 1.

The initial systematic and meta-synthesis were done using Sandelowski and Barroso's guidelines (15). The Persian form of the strategy was searched in related Persian databases and Google Scholar. The English form of the strategy was searched in PubMed, Scopus, Web of Science, Embase, Science Direct, Eric, and Emerald. Due to the nature of the research question, the gray literature needed attention, so the research team identified the sources also presented in Table 2. The Persian databases used in the study were Element, Civilica¹, Irandoc², google scholar, scientific information database³, and Google local domain.

The steps of the review and the results of each one are presented based on the 2020 updated version of the PRISMA (18) consisting of title screening, full-text screening, critical appraisal, and data extraction for research articles and screening for other related records obtained from gray literature. The peers screened the record to avoid selection bias. The inclusion and exclusion criteria were as follows:

- Inclusion criteria: The research evaluated or mentioned the main trends or patterns of change in finisher education or medical education. Higher education and medical education were both considered in the scope of the review due to their dependency.
- Exclusion criteria: researchers' approach and design were not future-studies-based or were not future-oriented like the studies that focus on current challenges of medical education.

In the third step of the screening phase, the CASP tool was used for a critical appraisal (19), and peers did the data extraction to ensure consistency. They analyzed the

content analysis approach to find the mainstream trends of the future of Iran's medical education. This phase of the study was done between October 2018 to May 2019.

Updating the systematic review

Meanwhile, after finalizing the analysis of the data, COVID-19 happened. On one side, it caused an interruption in the study; on the other side, it was a turning point for education, so the research team updated the systematic review using the Garner et al. checklist (20). First, the decision framework is used to assess the feasibility and necessity of updating. The interviewing added another source of data to capture the insight of the experts, too. To update the systematic review, the same PICO was searched in the same databases with a time limit between November 2018 to July 2021. All the phases and steps of the systematic review were repeated for the new records. Finally, three more records were entered in the data extraction and content analysis step.

Interviewing

The interviewing was done in-depth using the snowball sampling method. The interview added to capture the experts' comments by considering the pandemic's potential effects. The interview continued till the saturation of the data, and a total of 20 interviews were done, each taking 40 minutes on average. Eight participants were female, and 12 were male, between 35 to 69 years old. The interviewees were medical-education-related policy makers, senior managers of medical education or higher education, vice-Chancellors of Medical Sciences Universities, Futurists active in higher education or medical education future, and the heads of education development centers of medical education universities. The experts were asked to introduce the other related experts as well. The experts were communicated to set the interview time and send the questions before the session. The responsible researcher also explained the objects and the study phases to the experts. The sessions were all virtually by the Microsoft team, via Skype, and by phone. The study was done in the Kerman province of Iran. The interviews were recorded with permission and transcribed by peers to ensure the validity of the data. The interview questions were:

- What are the future trends that affect medical education?
- How do you anticipate how the trends will affect Iran's

¹ CIVILICA or Knowledge Reference is a private website that indexes and publishes a collection of conference papers and conferences in Iran. Civilica is a member of the National Content Consortium and, in this national consortium, is the only provider of data from specialized conferences and seminars in Iran. Available at <https://civilica.com/>

² Irandoc's core mission is research, science and technology information management, education, research and information collaboration, and science and technology policy support, which is carried out in an organization affiliated with the Ministry of Science, Research, and Technology and under the auspices of the Board of Trustees. Available at <https://irandoc.ac.ir/>

³ Scientific Information Database (SID) of Academic Center for Education, Culture and Research Persian is an Iranian free accessible website for indexing academic journals and access to full text or metadata of Academic publishing. Available at <https://www.sid.ir/>

medical education in the future?

The qualitative analysis

The data obtained from the updated systematic review and the interviews were analyzed using content analysis by MAXQDA 2018. The findings added to the initial review results, updating the codes and themes.

Focus group discussion of experts

The focus group discussion was based on Nyumba guidelines in three main phases research design, data collection, and data analysis (15). The phases and their steps were as follows:

Research design

- **Setting the objectives:** The main goal was to investigate the pattern of change and the identified trends in previous phases of the study that would affect the scientific development of the health sector in Iran. The codes and themes of the future of education were presented, and the related relations were discussed in the session.

- **Identifying and recruiting the participants:** The participants were selected homogenous in gender, education, and all Persian speaking. The number of participants was 4, two men and two women. The location of the session was Kerman, Iran.

Data collection

- **Pre-session preparation:** The participants were interviewed in the last phase, the preform of the graphs, and the relations before the session.

- **Facilitation during the meeting:** The objectives and the graphs were presented at first, and all the experts had 10 minutes to mention their perspectives. After the discussion started, it was recorded by the research team and analyzed later.

Data analysis

The discussions were transcribed by peers and analyzed using content analysis.

Results

Systematic review

By searching the databases, 4149 records entered the title and abstract screening after omitting the duplicates. Three thousand seven hundred forty records were excluded in this phase, 309 entered the full-text screening, 61 entered the critical appraisal analyzing phase, and finally, 26 records entered the data extraction phase. It is necessary to mention that three were added after updating the review. Twenty-nine records were data extracted, and three sources were entered from gray literature consisting of 20-panel reports, one Ph.D. thesis, and one report from GFIS. The steps of the initial systematic review are presented in Figure 2.

The included studies and their extracted data are presented in Table . The included studies and their extracted data are presented in Table 4, and Appendix 1 shows the results of the review and interview, including selected quotations for themes and codes. The main trends of change in six categories presented in the focus group discussion and revised six main trends of the change were identified. The trends are workplace changes, demographic changes, changes in concepts, the emergence of new players, and structural changes in universities and technology, presented in Figure 3. More information on the trends and their impacts are accessible as follows.

Workplace changes

The workplace-related changes of the future regarding medical education are presented in Figure 4. Long-life learning will be an inseparable part of the jobs that need an aligned education system, more agile, mobilized, and

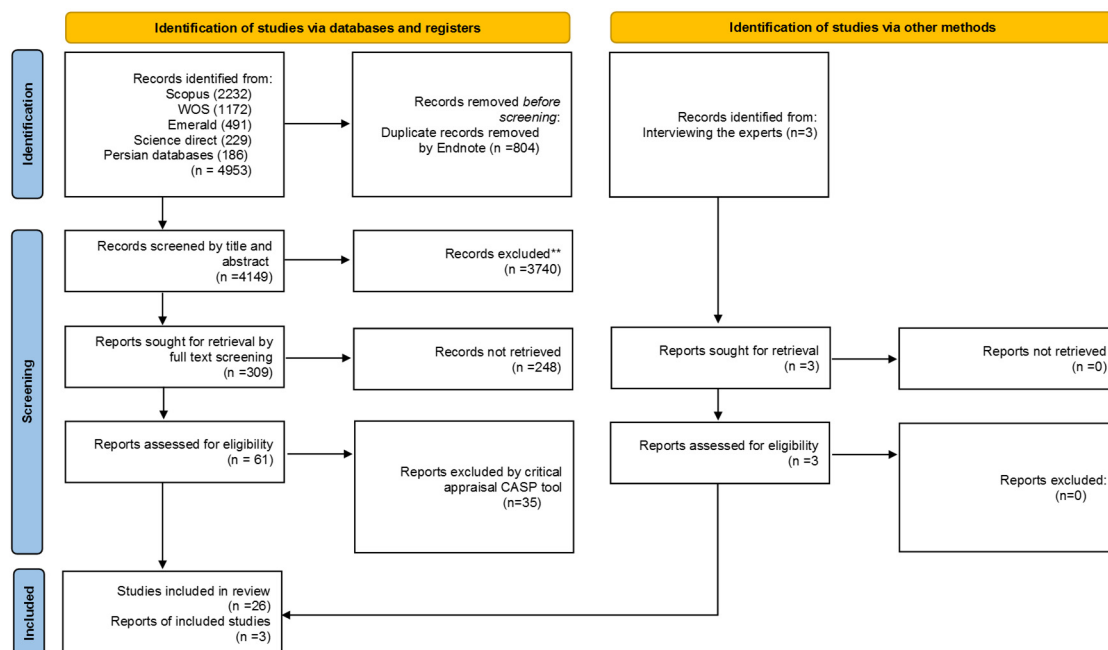


Figure 2. Systematic review PRISMA 2020 flow diagram

Table 3. List of included studies

Num	Title	Lead author & year
1	Leadership and governance in higher education 2025: can Malaysian universities meet the challenge?	Inayatullah, 2016 (32)
2	Opportunities and challenges for the future of MOOCs and open education in Europe	Inamorato dos Santos, 2016 (37)
3	Austrian higher education workforce of the future	Price Waterhouse Coopers, 2016 (16)
4	Multigenerational Challenges and the Future of Graduate Medical Education	Boysen, 2016 (35)
5	Future sustainability scenarios for universities: moving beyond the United Nations Decade of Education for Sustainable Development	Beynaghi, 2016 (37)
6	The Role of Virtual Patients in the Future of Medical Education	Berman, 2016 (47)
7	University futures: Wikipedia uni, core-periphery reversed, incremental managerialism or bliss for all	Inayatullah, 2012 (36)
8	What is the Net Generation? The challenge for future medical education	Sandars, 2007 (26)
9	Medical Education for a Changing World: Moving Beyond Cultural Competence into Transnational Competence	Koehn, 2006 (24)
10	The future of student life: learning	King, 2017 (29)
11	Future-oriented higher education: Which key competencies should be fostered through university teaching and learning?	Rieckmann, 2012 (22)
12	Using the past to predict the future: what futures are documented for higher education?	Stephens, 2013 (48)
13	Tales of adventure and change: academic staff members' future visions of higher education and their professional development needs	Tynan, 2009 (30)
14	The three horizons of educational change	Bishop, 2012 (27)
15	Universities and the Emerging New Players: Building futures for higher education	Havas, 2009 (31)
16	A Delphi-based approach for detecting key e-learning trends in postgraduate education The Spanish case	Lopez-Catalan, 2017 (22)
17	Sustainable higher education understanding and moving forward	Waas, 2012 (49)
18	Futures for higher education analyzing trends	UK university, 2012 (25)
19	The future of higher education: How technology will shape learning	Economist intelligence unit, 2008 (50)
20	Global Education Futures: Agenda	Luksha, 2015 (38)
21	The Future of Teaching and Learning in Higher Education	Casares, 2013 (28)
22	Opening up: higher education systems in global perspective	Van der Wende, 2017 (20)
23	International Trends in Higher Education 2015	University of Oxford, 2015 (19)
24	The future of medical education	Khay-Guan, 2019 (51)
25	Medical education trends for future physicians in the era of advanced technology and artificial intelligence: an integrative review	Han, 2019 (21)
26	The future of higher education	Deloitte, 2021 (52)

personalized. New skills and competencies change the concepts of literacy so that the education systems need to be more focused on skills; meanwhile, the demand for just-in-time education increased instead of just-in-case. Cognitive-based new jobs will emerge instead of physical-based ones. The new generation is gradually entering jobs with their differences in characteristics while the paradigms are also changing by redefining the concepts like justice, peace, power, etc.

Demographic changes

Due to the aging trend, there will be an increase in the average age of key players like professors and staff. On the other side, Long-life learning leads to widening the age range of the students as well. Other trends will be changes in the burden of age-related diseases, laws, and regulations, service delivery, and entrance exam. The share of education expenses will decrease, and new financing models will emerge. There will be more education-related mobility in the presence or virtual enhancing the human-resources-related aging challenge. There will be more health-related expectations like providing trained human resources for the elderly, revising the curriculum, and setting related priorities for research. The variation of faculty members' and students' age will omit aging stereotypes, so that needs cultural considerations. Even people with higher organizational positions may need to be trained by younger people in a particular skill or training

course.

Changes in concepts of higher education

The universities will be more competency and technology-based, moving toward personalized education to meet agile and responsive requirements, covering various educational services. Disabled people will receive more attention, and technology will enhance their access to educational services. New concepts lead to redesigning the structures, so the standards of accreditation and one basic pattern of change expect the universities to set their processes to be cost-effective and community-based. New concepts will emerge, like openness, in data and services, power shift, innovation, long-life learning, and agility.

Emergence of new players

Universities will not be the leading players, and being public will no longer be their competitive advantage. Attention to academic degrees will significantly reduce, and educational services will be need-based. New service providers will emerge and provide customized services in the form of open curriculums or skill-oriented short courses. Other competitors will be academic units affiliated with industries and businesses which have already started in engineering sciences, like those providing learning by doing educational models, and will expand in health.

Iran Medical Education Future Trend

Table 4. The included studies and their extracted data

Num	Workplace	Demographic changes	Changes in concepts	The emergence of new players	Structural changes in universities	Technology
1	Post-university success using trans-disciplinary learning	-	<ul style="list-style-type: none"> Focusing on research, learning, and community engagement Moving toward education mall Social responsiveness 	-	consortium of universities	-
2	-	-	Open education as an emerging concept	-	<ul style="list-style-type: none"> Open education helps in being more open and dealing with the related challenges and opportunities and goes beyond MOOCs and OER OE needs attention regarding strategies, vision, and trained human resources and 	Technology development as a requirement for open education
3	Work-ready human resources are needed.	-	-	More competition globally with online presence, non-university higher education providers (NUHEPs), and other non-traditional private sector providers	-	digitalization of curriculum design, delivery, and research
4	-	<ul style="list-style-type: none"> Insufficient resources to retire human resources Predominance of Millennial Generation Workforce 	-	-	Adding games, simulations, and interactive videos to the curriculum to engage students	-
5	-	-	More focus on sustainable development and the role of universities on	-	Education, research, and outreach will increasingly constitute a core mission for universities.	-
6	-	-	-	-	-	Virtual patients as multimedia, screen-based interactive patient scenarios It helps in moving toward competency-based education and deep learning

Table 4. Continued

Num	Workplace	Demographic changes	Changes in concepts	The emergence of new players	Structural changes in universities	Technology
7	-	Globalization	<ul style="list-style-type: none"> • Democratization in science • Rise of Chindia • Multiculturalism in terms of new ways of knowing 	-	-	Web 2 and virtualization
8	-	The emergence of a new generation being more exposed to computer-based technology.	-	-	-	-
9	-	It is rapidly changing global demographic dynamics.	Transnational competence (TC) education	-	<ul style="list-style-type: none"> • Competency-based education emphasizes five skills domains of TC analytics, emotional, creative, communicative, and functional; • Patient-centered learning and competency assessment. 	-
10	-	-	Students are increasingly influential.	Students bypass the system by finding ways to meet their learning needs separate from the official education system, such as the rise of massive open online courses (MOOCs), certificate programs, and even the use of YouTube videos	<ul style="list-style-type: none"> • New learning models are more experiential and focus on outcomes, more technology-based, and more aware of and support non-traditional learners • Learning differs in four aspects of purpose, objectives, approaches, and places 	-
11	-	-	More focus on sustainable development and the meaning of competency in new classifications	-	-	-
12	-	-	Changes in the needs of the economy/labor market	-	Changes in access, moving from elite provision to mass higher education Virtual education mixed with traditional delivery New institutional design for higher education institutes New models of funding More engagement of students	ICT/ virtual delivery

Table 4. Continued

Num	Workplace	Demographic changes	Changes in concepts	The emergence of new players	Structural changes in universities	Technology
13	-	New aware learners, new needs, new expectations New self-aware learners and staff	A new level of awareness is needed for staff	-	Changing in institutional imperatives	More use of ICT in the tertiary education
14	-	-	-	-	The ultimate educational content on the internet Open source education Decoupling of learning from credentialing	Learning analytics by analyzing the big data of students to manage their learning environment Using big data
15	-	More share of mature students are also being reinforced by long-life learning	Cost-efficiency of education as a major objective	<ul style="list-style-type: none"> • Global competition in higher education activities • More organizers of studies/degrees and accreditation organizations • More universities affiliated with firms • NGOs-affiliated virtual universities 	<ul style="list-style-type: none"> • Increased competition among HE organizations for restricted funds • Multi-task universities teaching, academic research, joint businesses; scientific advice for NGOs and policy-makers • More practical courses for job-seekers and regular re-training of middle and top-level managers and policy-makers, as well as researchers (as required by lifelong learning) • More demand for self-development courses 	More sophisticated and expensive equipment
16	-	-	Open education	-	E-learning development, especially in using mobile learning, gamification, social media, and open education	-
17	-	-	<ul style="list-style-type: none"> • Emphasizing the role of higher education in moving toward sustainable development • Sustainable Education • Sustainable research 	-	-	-
18	-	More educational mobility	-	Market-based deliverers	Changes in funding models Innovative service design and delivery	-

Table 4. Continued

Num	Workplace	Demographic changes	Changes in concepts	The emergence of new players	Structural changes in universities	Technology
19	-	Globalization in higher education	-	-	Online learning foothold in universities The increasing role of corporate-academic partnerships	The growing impact of technology on higher education
20	-	-	-	-	-	<ul style="list-style-type: none"> • Semantic internet • Development of AI • Extensive development of the Internet by: <ul style="list-style-type: none"> ○ Increasing channel capacity and data-transfer speed ○ Developing wireless access ○ More and more accessibility to the internet ○ More need for digital workflow management
						Cognitive revolution by: <ul style="list-style-type: none"> ○ The interaction of the body, as an interface, with the digital environment and the digital environment adapting to the states of the body and mind, as well <ul style="list-style-type: none"> ○ Development of Artificial psychological components ○ neurotechnologies begin to operate directly with the nervous system Virtualization
21	-	Changing demographics and shifting expectations for the learning environment require universities to examine teaching and learning practices		-	New-entrant skills requirements The need for an agile, responsive University Changing employer needs Changing expectations	Technology development Online learning is more accessible, less expensive, and appeals to the Net generation's unique needs and expectations.
22	-	More international students	The knowledge economy paradigm emergence	-	-	-
23	-	Students mobility	-	-	Internationalization consisting of international students and universities as international brands New expectations of students	-
24	-	-	-	-	-	Overwhelming technology transforming medical education
25	-	-	Responding to changing community needs Respect for diversity	-	Humanistic approach to patient safety in medical education Early experience and longitudinal integration Student-driven learning with advanced technology and active learning with individualization	-
26	-	-	-	-	New markets and business models The more extensive role of different partners within universities The new expectations of students new teaching contents	Development of technology and increasing technological achievements in education

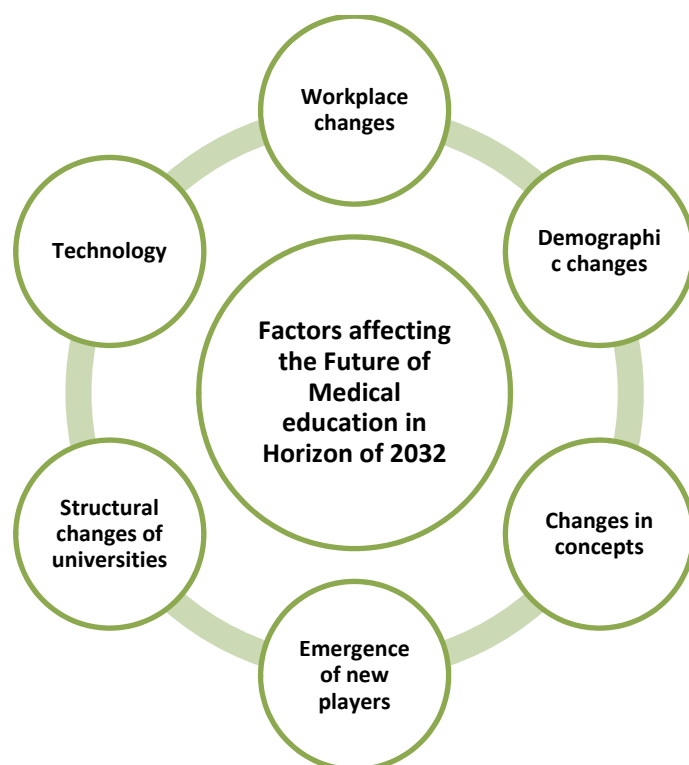


Figure 3. The main future trends of medical education

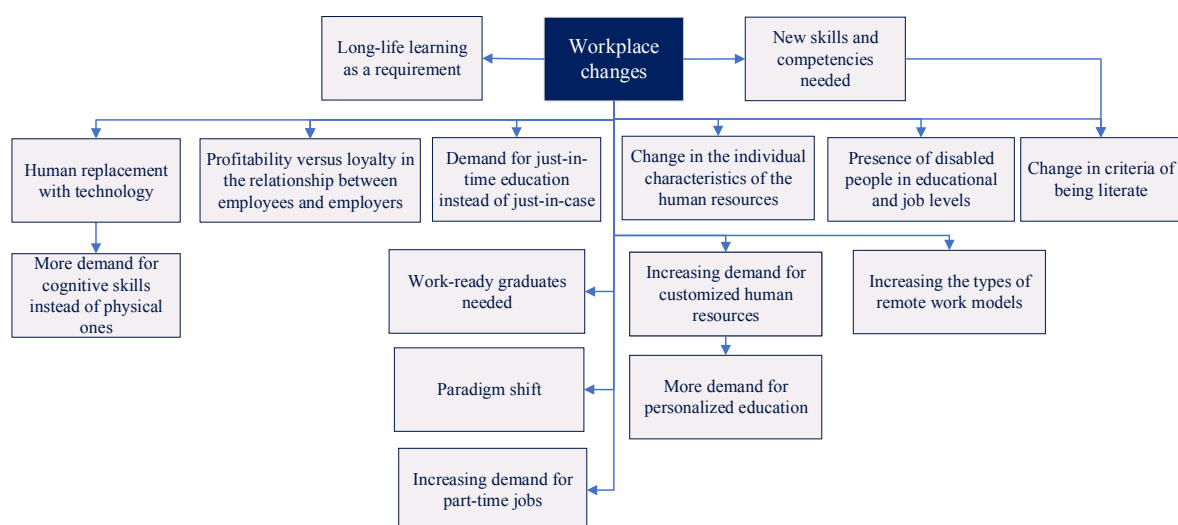


Figure 4. Workplace-related changes in Iran's medical education system in future

The financing models also will have less cost for students by using emerging financing models like using sponsors and linking to industry.

Structural changes in universities

Decentralization will be the dominant stream of future universities. Three main structural changes will focus on outcomes instead of processes, learning instead of teaching, and being just in time instead of just in case. Universities will go beyond the multidisciplinary collaborations,

and besides the personalized education dominance, mixed open floating branches of knowledge will also emerge, aligning with the convergence of science. New structures will collaborate with other educational units, industries, and communities with national and international collaboration scopes. New structures need to redesign the rules and regulations supporting new financial models like using cryptocurrencies in transactions and sponsored-based service delivery. New structure designs are justified regarding power balance, competency-based, participatory, future-oriented, and agile.

Technology development

The cryptocurrencies will enter educational transactions, enabling to deal with sanctions-related limits in international scientific collaborations. The technology will provide new educational methods or tools and facilitate knowledge management and remote education, while open sciences, scientific democracy, data visualization, and internationalization will also be sped up. Vaccines and drugs will still be the priority in the health sector. New ethical-related challenges will emerge as technology develops in some fields, like human genetics. The figures of the last five trends have been presented in [Appendixes 2-6](#).

The scientific development

After presenting the results in focus group discussion, their impacts on scientific development have been identified in five main categories.

New financial models

The composition of research funding is changing, and the influence of government providers on research priorities will decrease. Due to the aging and environmental challenges, the government budget for supporting research and science development will decrease. On the other hand, attention to applied research will increase. The social effects of research will be given more attention while it will be one of the essential criteria that provides direction to the pattern of scientific development. The limited budget and a more severe and social-oriented evaluation system increase competition for attracting research grants. So, the need to conduct interdisciplinary studies and research collaborations increases. Financing models will move towards free access to research results, and new financial models will also emerge.

Open Science

Scientific development will be based on free, shared data sources and platform-based. New methods of open librarianship and data sharing will emerge. There will be more public partnerships in science development with new participatory-evaluation models that lead to increasing democracy in research and types of crowdsourcing to answer research questions.

Redesigning the research management

The research management will change processes, evaluation mechanisms, expected outcomes, and informational systems. New technology achievements like blockchain will change research management from research question determining to knowledge transfer in open science. Other fields are artificial intelligence and machine learning, which improve data screening, personalized dashboards for research bodies (individuals and organizations), and prevent plagiarism. Regulations need to be redesigned to respond to social responsiveness of research, new concepts, and expectations, enabling higher education service providers in their science development role.

Role of universities

The universities are known as key players in science development, but in the future, they need to collaborate more with society, media, NGOs, and corporate or firm universities. Science development and benefiting society will still be the primary missions of the universities, which shows they have to focus on education and research but in an updated mechanism that aligns with emerging expectations and structures. Concepts like innovation or entrepreneurship are not new, but universities must redesign the tool they want to act on based on them.

Capacity building

Capacity building will still be one of the essential functions of the science development system but with new requirements for the future. New skills and competencies must be educated and evaluated based on updated and future-oriented structures. Human resources are at the forefront of knowledge production, and investing in it means investing in the future.

Discussion

The trends affecting medical education are categorized into six groups workplace, demographic changes, new concepts, new players, structural changes, and technology development. As Price Waterhouse Coopers (PWC) mentioned in its report on the future of graduate medical education, there will be a need for work-ready human resources emphasizing the changes in the workplace's requirements (16). The main effects of demographic change are academic mobility and aging, which also change the structures and concepts like long-life-learning or deep learning (19). The other aspects of conceptual changes are knowledge economy (20), respecting diversity in education (22), open education (22), and sustainable development (23). Also, there will be structural changes like competency-based higher education and patient-centered learning (25), new models of learning (23), and funding model variation (25).

The demographic changes mean a lot for medical education, from multigenerational challenges to a lack of resources for retirement (26, 27). With their characteristics, skills, and expectations, Millennial generations have started to come (28, 29) by their worldview of science and how they can contribute to its development, which means new aware learners, new needs, new expectations, and new self-aware students and staff (30) that the systems like medical education should be updated based on. Aging is another demographic-based item of change with less uncertainty, while more share of mature students is also being reinforced by long-life learning (31).

A consortium of universities has been on the agenda of many developing countries like Malaysia by focusing on research, learning, and community engagement with defining new models like education mall (32), but studies showed that despite the future scenarios of higher education, research and education are the main missions for universities with potential alternatives in structures and models (33). In debates on the mission of universities re-

garding the changing world, two developed modes of learning are proposed. Mode two focuses on teaching students to be ready for an uncertain and changing world, and mode three focuses on learning in and with uncertainty (35). Learning in new modes is changing regarding purposes, objectives, approaches, and places (29), and they also require new modes of skills and competencies. At least there has been mentioned to 12 classifications for competencies as general, from anticipatory thinking to empathy and solidarity, and 19 more from a sustainable development perspective (23). Another aspect of the structure relates to departmental divisions that will diminish, multidisciplinary teams will be replaced (35), and the physical boundaries will fade. Instead, Focus will be on creating a new not-for-profit publishing community in digital and physical spaces (32). Moreover, besides the competition among universities, there will be new higher education models affiliated with firms or NGOs (31).

The third category of change is emerging concepts. Multiculturalism as a trend in higher education (33), covering all functions, at least education and research, prepares a concurrent stream through emerging new concepts. One emerging concept is open education with nine main aspects of quality, strategic business models, access, pedagogy, content, collaboration, recognition, technology, and leadership; that one element of facilitating the OE is the technology, while the main requirements are setting strategies, visioning, and training the staff in scientific development (37). Some concepts intensify the current-started trends, like how the norm of diversity as an upcoming one will provide the context for long-life learning. The higher education providers will focus on coaching and mentoring, which is how the power shift begins (35). However, the point here is that enhancing access to educational content does not mean an increased usage rate; users need to have a worldview on what they need to find and how it completes the puzzle of their education path (38).

The next category is technology; as technology progress, new methods of education also emerge, like virtual patients, specifically for medical education, which enables deep learning and moving toward competency-based education (39, 40). Some progress in technology also leads to defining new concepts like learning analytics or structural transitions like decoupling of learning from credentialing (27). Technology development provides a mass of information for educators, but it may cause cognitive dependency, so knowing the path to identify the data is as important as accessing it (38). There will be more focus of universities on branding and marketing and strategies like hiring marketing professionals, increasing digital activities, growing internationalization, and using new methods of service delivery like flipped classrooms or gamification (41). The available big data of educators help in gene testing and comprehensive continuous monitoring (that can be game-based). Gamification can improve academic motivation through competitive motivation, achievement motivation, and making education something of pleasure (38).

What is concluded from all mentioned points is that more involvement of stakeholders is needed to face the

upcoming future, as Austin says in her commentary on Simon C. Barrie's 'A research-based approach to generic graduate attributes policy (2004) and Ronald Barnett's 'Learning for an unknown future, "*The daily work we do within higher education institutions must be understood within, and connect and respond to, a rapidly changing world and should offer both visions and practical paths to aid our students and the broader society in moving forward with hope, wisdom, integrity, and courage*" (34). The common fact in many studies is visioning from the health research system (42), futures studies (36, 43), higher education (33), and medical education (44) perspectives. More Focus on know-why instead of know-how (32) needs the research systems reform. Policy-making level support is required over the HRS beyond the Ministry authority (42). Visioning is essential for Iran's scientific development through two primary functions education and research (30, 40). Specifically for medical education, service-delivered people and usual patients must be considered in a broader context, so students need to be educated through global competence education approaches (24). From the service deliverers, they should be considered in their context and needs, enabling personalized education or new concepts like Supermarket university (45). Sustainable development and the role of universities in achieving the criteria make it a new concept focused on by higher education providers, especially universities (40, 41). The competition of industry members will continue, so new innovative working models are needed, as are jobs (16).

Conclusion

To achieve the goals and targets of national science development, all fields of study need a future-oriented plan. The health system and its educational and research activities should also be aligned with the national vision. Continuous monitoring of the environment helps capture the insight to move toward the goals. Scanning the future trends of medical education is not a cross-sectional activity and needs a systematic approach. Investigating the future trends in medical education and their impact on scientific development shows that the most crucial point is to reframe the structures, capture the new meanings and concepts, consider the generational differences, and be as flexible as enough to benefit the future and avoid threats.

Limitations of the study

One main limitation of the systematic review was being limited to English and Persian, while some other languages, like Chinese, also have relevant records. The other limitation was access to some types of gray literature like unpublished or processes studies that the researchers may not have reached out to, and last interviewing with other groups of stakeholders like NGOs or community presenters have not been done due to time, human resource, and financial limitations.

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Conflict of Interests

The authors declare that they have no competing interests.

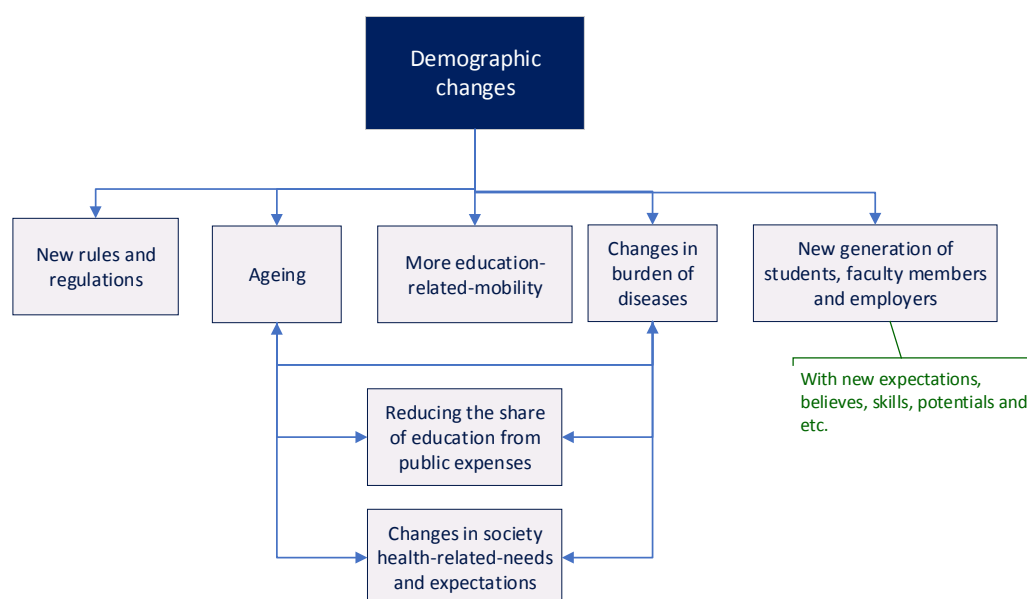
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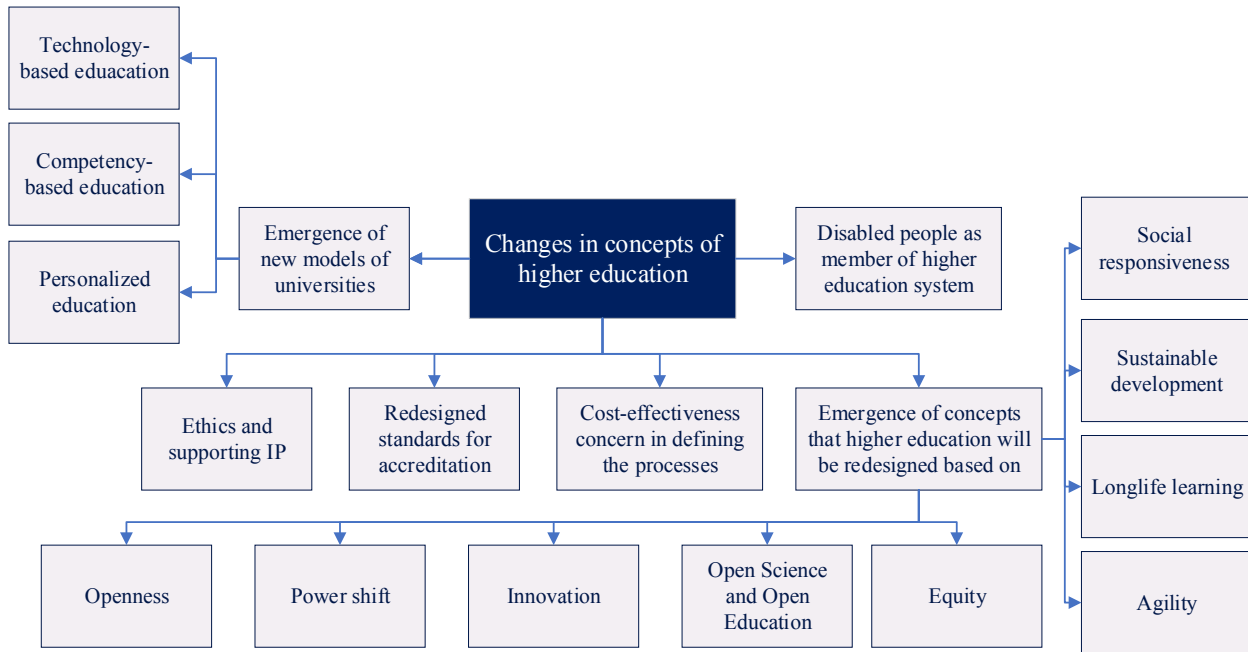
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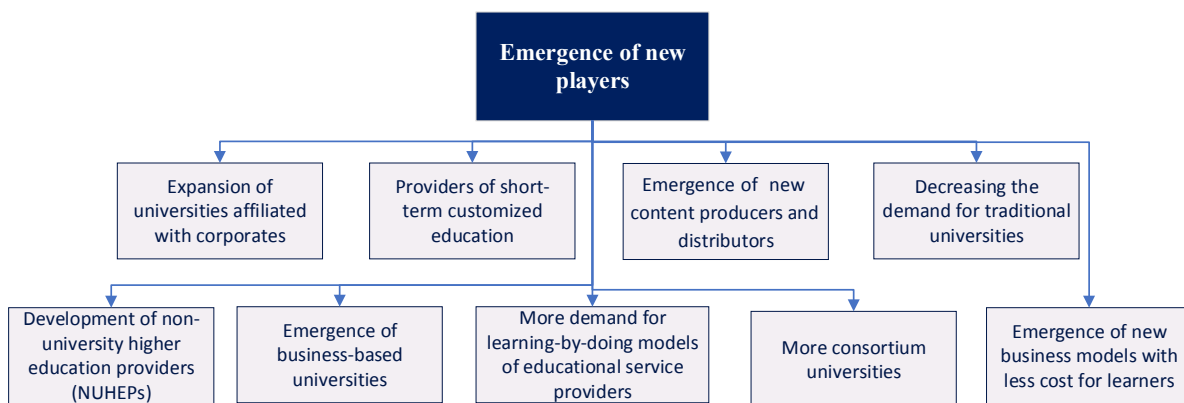
Appendix 1. Selected quotations for themes and codes

Themes	Sample Quotations
Workplace	"If the country's medical education system does not see the mid-term future for future jobs, it will be out of date, and the industrial needs, market, businesses, and jobs will be met from somewhere else."
Demographic changes	"If we used to talk about the difference between generations, it would be a fantasy and far-fetched issue, but now with the arrival of young people as students and even professors, we see the differences, and the same thing will happen with the aging of the workforce. Now this workforce may work in any system. Higher education or industry or pre-university education."
Changes in concepts	"Future changes, either fundamental or gradual, are based on changing concepts, definitions, and paradigms or on achievements that will change these definitions and concepts. Sustainable development in higher education, equal rights of men and women, attention to ethics, especially about the new achievements of medical genetics, personalized education, and many other concepts will initiate gradual changes and transformations in higher education shortly...."
The emergence of new players	"The period has passed when the universities are unrivaled due to their government status, and all the outstanding students seek to pass their tough entrance exams. Now the work is important. Learning is important. Security and job security and earnings are important. Do our universities have the ability to respond to these needs? We can see how much the demand for some courses has decreased, especially in postgraduate courses. The emergence of new actors in the world started a long time ago, and in the field of engineering sciences in Iran, it also started a few years ago. We must wait for the emergence of new educational models in medical education, too...."
Structural changes in universities	"We have seen how Corona acted as a catalyst for the development of distance learning. This pandemic has taught universities that they must be flexible. The focus shifted from administrative and bureaucratic processes to learning. On the other hand, future teaching methods will change with the adoption of new technologies and will move towards deep learning. However, the question is, will we have the necessary funds to provide these technologies, are our laws and infrastructure ready for such changes? Another important point is how much these future changes will become a requirement, and if so, can universities prepare themselves for new accreditation systems?"
Technology	"No trend will change education as much as the growth of future technology, and if its gifts are properly used, it will help to achieve education goals better. No matter how much you explain anatomy to a student, it cannot help him learn as deeply as the experience of augmented reality. The multi-year corpses period is over, which is promising for medical education at least...."

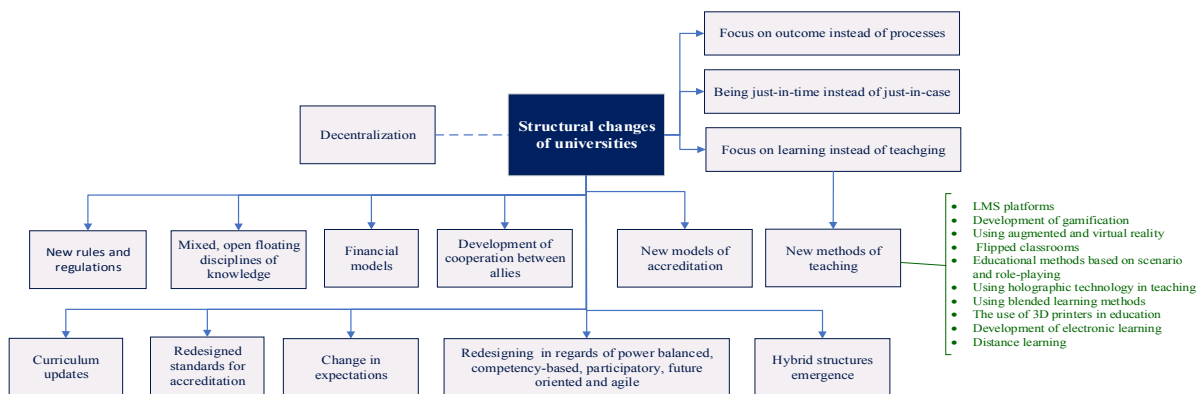
*Appendix 2. Demographic-related changes in Iran's medical education system in future*



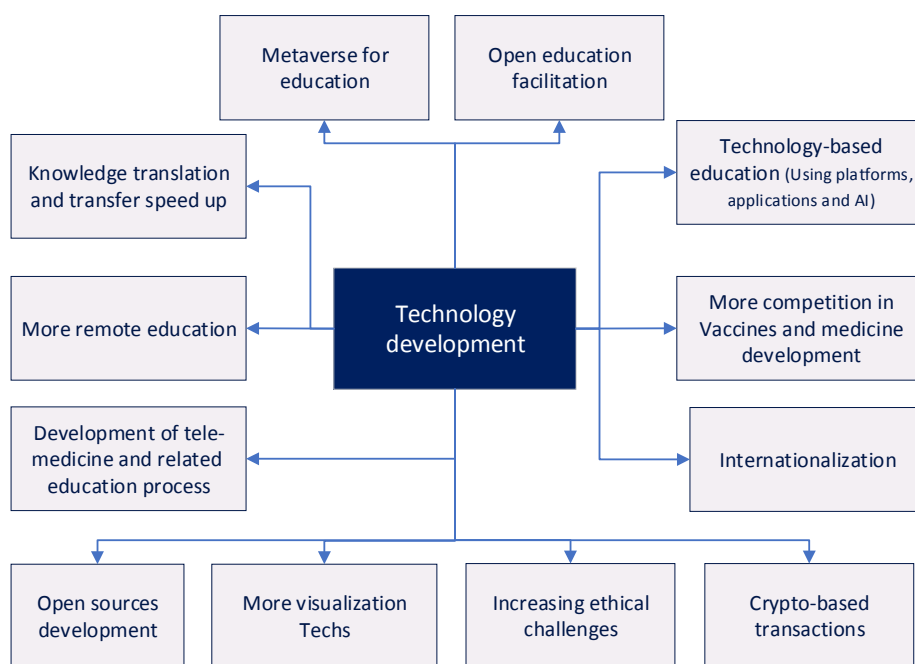
Appendix 3. Concepts-related changes of Iran's medical education system in future



Appendix 4. How the emergence of new players will affect the future of Iran's medical education



Appendix 5. Structural changes of Iran's medical education system in future



Appendix 6. Technological aspects of future changes in Iran's medical education system