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Foresight for Internationalization of Medical Sciences Universities in Iran in the 2040 horizon

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Abstract

The internationalization of medical universities is confronted with various uncertainties due to environmental trends. Therefore, obtaining insight into potential future scenarios is essential for adopting exclusive and effective strategies. Accordingly, this study aims to identify future scenarios for the internationalization of Medical Sciences Universities in Iran (MSUI) in the 2040 horizon. A scenario-based strategic planning approach was employed to create and develop possible scenarios for the internationalization of Iran's medical universities. This approach followed a four-step framework consisting of scoping, exploring, synthesizing, and scenario building. To develop the scenarios, a combination of futures study methods was employed, including a literature review, expert opinions, cross-impact analysis, morphological analysis, and balance impact analysis. Qualitative data were analyzed using framework analysis and MAXQDA software, while quantitative data were analyzed using EXCEL, MICMAC, and Scenario Wizard software. A total of 61 drivers related to the future of internationalization of medical sciences universities in Iran were identified. Key drivers such as political relations and diplomatic influence, economic sanctions, scientific supremacy, and the knowledge economy were recognized. By configuring the states of these key drivers in the 2040 horizon, a total of 81 possible scenarios were generated. Among these scenarios, 16 were assessed as plausible, with 5 of them being highly probable. These scenarios include evergreen universities, lush universities, blooming season, frost gardens, and dried-up gardens. The analysis of probable future scenarios reveals that the optimistic conditions of the driving forces outweigh those of their pessimistic counterparts, indicating that, at worst, the current situation will persist. Each university could select a probable scenario aligned with its preferred vision to implement within the study timeframe.

Keywords Futures study, Internationalization, Driving force, Scenarios, Medical Sciences University

Introduction

The role of internationalization in higher education is a proactive response to the forces of globalization, serving as a crucial aspect for universities to adapt and thrive in the face of various challenges. In recent years, universities have been prompted by the adoption of internationalization policies to consider the development of various strategies. These may include enhancing mobility, fostering educational and research partnerships, hosting international conferences, and attracting foreign students and faculty members [1].

In certain global regions, universities prioritize building an international cultural environment, while in other countries; more emphasis is placed on economic elements and generating income. The impacts of this trend on curriculum and education have become increasingly significant [2, 3]. In addition, utilizing the most recent advances in medical education and practices is crucial due to the intertwining of science and health results. The importance of internationalization in medical sciences is evidenced by the need to cultivate the capacity to explore

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and critically assess innovative concepts and methods from varied national and cultural backgrounds [4].

The internationalization of medical education at universities has multiple benefits, such as facilitating global cooperation, sharing expertise and best practices in medical education and healthcare, improving education quality, broadening research prospects, developing cross-cultural competencies and global perspectives, building worldwide recognition and status, and tackling global health issues. It equips medical students to proficiently serve as healthcare professionals in a diverse and interlinked world [3]. The adoption of international standards and beliefs by universities and the diminishing prominence of national cultures and customs are among the impacts of globalization. Furthermore, various transformations and advancements have occurred worldwide in recent years, influencing the internationalization of higher education [5].

The financial structure of universities in various parts of the world has undergone transformations due to the dual impact of heightened government investment and backing for education and research, alongside the trend of privatization and reduction in government budget al.location to universities [2, 6–9]. Moreover, the rise and proliferation of communication technologies have facilitated university researchers' collaboration and sharing of ideas irrespective of geographical constraints [9, 10]. Furthermore, the impact of the COVID-19 pandemic on higher education has illustrated the significant influence of new diseases on internationalization efforts. The COVID-19 pandemic has resulted in extensive limitations on global travel and forced international students to re-evaluate their choice of educational destination. As a result, countries that are traditional choices for students have experienced a decline in international student intake, leading a significant number of universities worldwide to confront severe financial difficulties [11].

The global spread of COVID-19 has catalyzed the adoption of the "internationalization at home" approach and the enactment of relevant policies in universities worldwide [11]. In addition, the evolution and integration of innovative technologies such as technology-enhanced learning (TEL), artificial intelligence, and similar advancements have had an impact on medical education and higher education systems. As a result, universities must now begin to proactively consider steps to adapt to these technologies and employ them effectively for internationalization. Consequently, the transformations and advancements in the internationalization of higher education stem from a variety of trends and occurrences across diverse social, economic, cultural, demographic, technological, and political arenas, leading to uncertainties and obscurities regarding the future of internationalization in medical sciences universities.

Simultaneously, developing nations are confronted with escalating uncertainty stemming from issues such as migration, brain drain, and economic and social challenges. Consequently, the internationalization of universities in these nations is significantly impacted by these shifts. Therefore, the leaders of medical science universities need to anticipate substantial transformations. Exploring future scenarios increases managers' capacity to devise appropriate measures and strategies to overcome ambiguous and unpredictable conditions.

In Iran, the internationalization of universities is influenced not only by global trends but also by the distinctive political, economic, cultural, religious, and geopolitical context of the country. Consequently, administrators of medical sciences universities in Iran operate within a highly unsettled decision-making environment. As a result, adopting a strategic approach to internationalization is crucial, and considering alternative scenarios is essential given the numerous uncertainties.

The purpose of this study was to develop potential internationalization scenarios as alternative futures for Iranian Medical Sciences University (MSUI) through 2040. The identified scenarios provide MSUI managers with a comprehensive understanding of potential future internationalization landscapes. Developing a roadmap and choosing robust strategies are effective methods for addressing key uncertainties and moving toward the most preferable and plausible scenario.

Accordingly, three specific research questions that this study seeks to answer are as follows:

1) What change drivers and certain drivers impact the internationalization of medical sciences universities in Iran?
2) What are the future scenarios for the internationalization of medical sciences universities in Iran in the 2040 horizon?
3) Which of the identified scenarios are most probable?

Main text

Study design

This study is a futures study that was designed and conducted with an exploratory approach to develop future scenarios for the internationalization of medical sciences universities by using a scenario planning method. Scenario planning is an effective method for identifying critical future uncertainties and building alternative scenarios. A scenario is a story that covers a variety of plausible future occurrences [12]. There are well-known frameworks for scenario planning, including "scenario-based strategic planning" and "global network business".

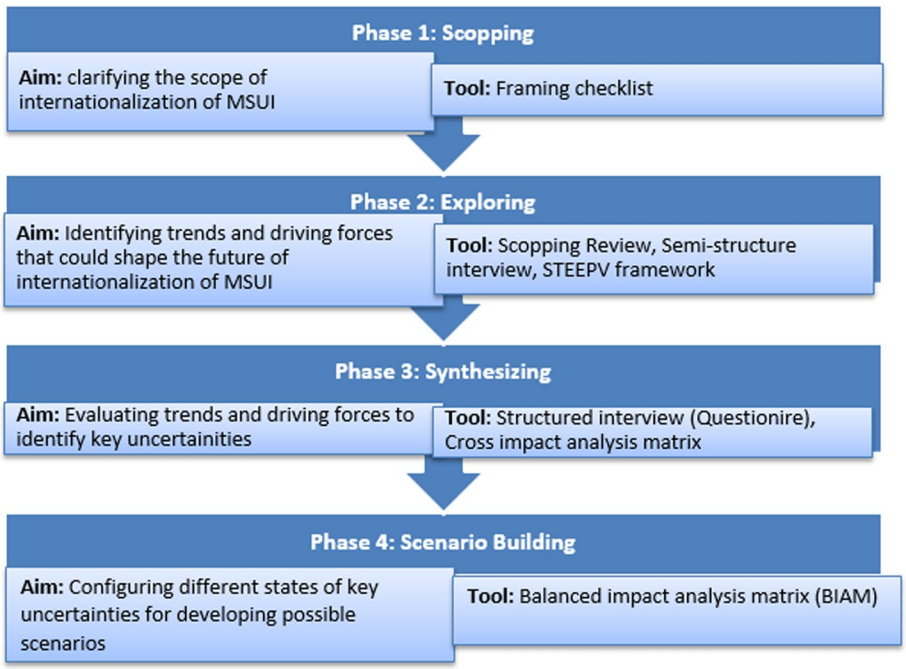


Fig. 1 Four phases of scenario building for MSUI internationalization

This study was designed by using an innovative framework based on four continuous process steps to develop multiple scenarios, including scoping, exploring, synthesizing, and scenario building. Scenario-based planning usually involves a number of foresight methods to develop alternative scenarios [13]. Therefore, in our adopted framework, a mixed-method approach and a combination of qualitative and quantitative futures research methods were used. The four phases of the study are illustrated in Fig. 1:

Phase 1: definition of scope

The aim of this phase was to define the scope of the scenario project. A standardized tool called the "framing checklist" was developed to specify key elements of the project. This checklist includes (1) goal of scenario project, (2) strategic level of analysis, (3) definition of stakeholders, (4) participants and (5) time horizon. The study framing checklist, consisting of five items, is displayed in Fig. 2.

Phase 2: exploring

In this phase, the internal and external areas of the research environment were carefully scanned by the project team to identify trends and driving forces that shape the future of the focal issue, which is known as environmental scanning in futures studies [14].

The STEEPV model was used to identify the drivers influencing the internationalization of MSUI across six dimensions, namely, social, technological, economic, environmental, political, and value. This phase was conducted in two steps:

2 – 1) Scoping Review (evidence synthesis): The search was conducted using any combination of the following keywords through the Boolean technique (AND, OR, NOT): higher education, university, internationalization, trend, driver, driving, factor, and force. Five electronic databases, namely, Web of Science, Scopus, Google Scholar, Science Direct, and PubMed, were included in the search from January 2000 to February 2022. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews checklist (PRISMA-ScR) was utilized in the retrieval process, as depicted in Fig. 3 [15]. Full-text papers published in English that addressed drivers, events, factors, and trends affecting the internationalization of universities met the inclusion criteria for this study. The search effort resulted in the identification of studies from which we meticulously selected relevant articles for the review.

After removing duplicates, reviewers assessed the titles and abstracts of the remaining papers, excluding articles that were irrelevant to the research goal. In the subsequent step, two authors independently evaluated the full papers of the remaining articles, including those considered relevant and those lacking sufficient information in the title or abstract, to make an eligibility decision. In this phase, the articles relevant to the study question were ultimately included. While a scoping review typically

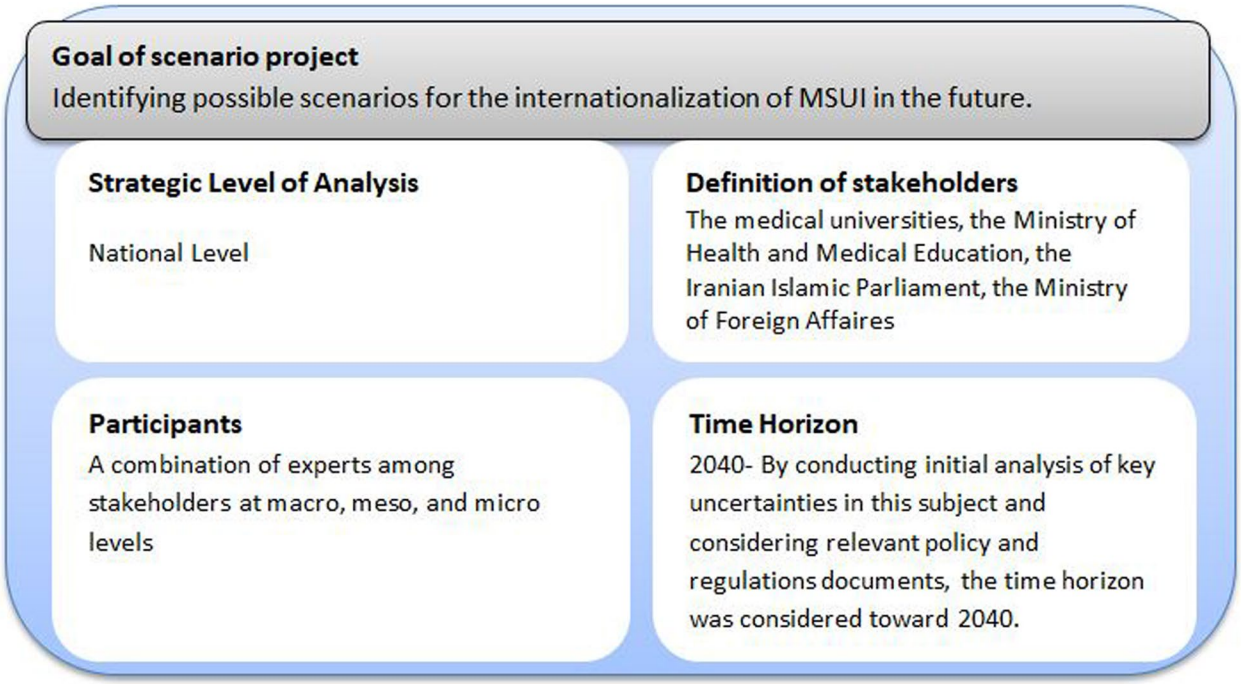


Fig. 2 Framing checklist for project scoping

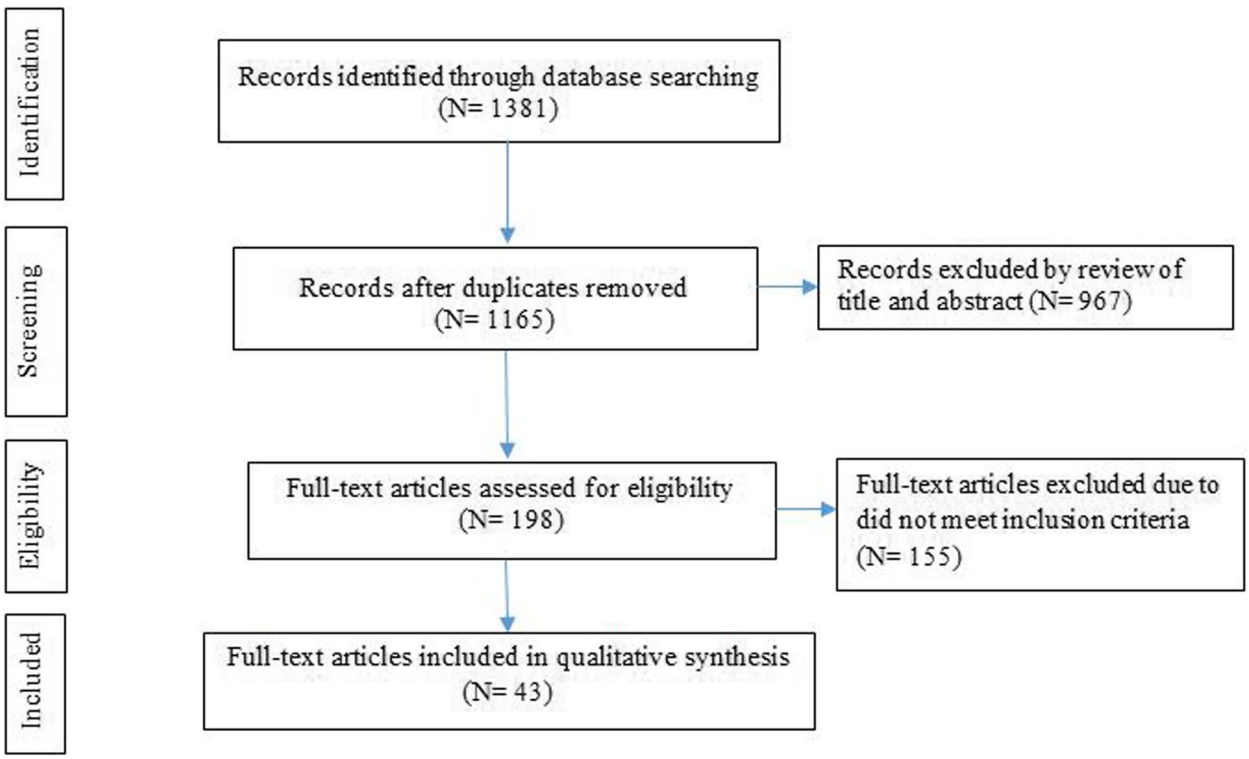


Fig. 3 Study screening and selection flowchart according to the PRISMA-ScR checklist

does not assess the quality of the included studies, the selected articles in this study were not evaluated for their quality [16].

2–2) Perception analysis: In futures studies, analyzing stakeholders' perceptions and identifying the mental models of experts is a fundamental principle [17]. Therefore, this step was carried out to validate and complement the information gathered in the initial phase. The sampling method employed was purposeful and continued until data saturation was reached. A total of 26 key informants, selected from the macro, meso, and micro levels, including current and former managers, policymakers, faculty members, and experts from the Ministry of Health, Ministry of Foreign Affairs, Health Commission of the Parliament, Universities of Medical Sciences, faculties, and research centers, were interviewed. These key informants possessed the richest information on the topic.

The data collection tool utilized was a semi structured interview guide based on the STEEPV framework. Participants were asked about the driving forces and internal factors affecting the internationalization of universities within each of the aforementioned dimensions. The interviews were digitally recorded with the participants' consent, and the interviewer also took notes during the interviews. On average, each interview lasted approximately 65 min. At the conclusion of each interview, the researchers transcribed the recorded information.

For data extraction and analysis in this phase, the reviewers developed a primary data extraction table that included the following information: title, author(s), year, country, and identified driving forces. The framework analysis technique was used for data analysis, and all the data were organized into clusters based on the dimensions of the STEEPV model. EXCEL software was utilized for analyzing and categorizing the information obtained from the scoping review, while MAXQDA software was used for analyzing the interview data. Throughout the entire screening and selection process of the identified articles, interview transcription, coding, and data extraction, two reviewers independently carried out the steps. Any disagreements were resolved through discussions and in cases where a consensus could not be reached, a third party acted as an independent mediator to resolve discrepancies through further discussion and adjudication.

Phase 3: synthesizing

The purpose of this phase of the study was to determine the key driving forces that must be considered as the axes of future scenarios. This phase was conducted in two steps:

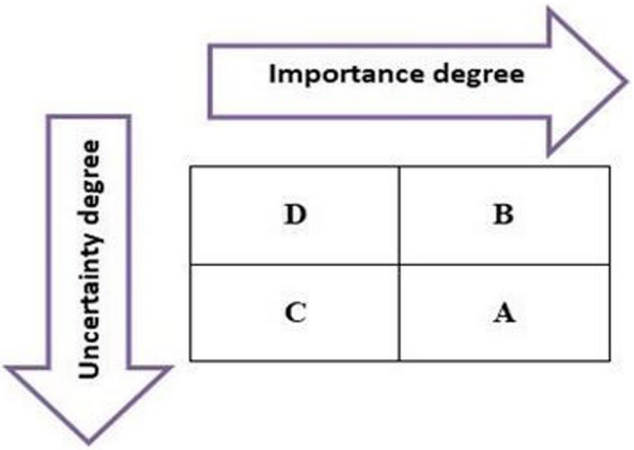
3 – 1) Importance/uncertainty assessment:The purpose of this step was to prioritize the identified drivers based on their level of importance and uncertainty. Important drivers are those that exert a significant impact on the future of MSUI internationalization, while uncertainties refer to drivers that lack predictability. To achieve this goal, a structured questionnaire comprising the identified drivers was created and distributed among experts and study participants. The participants were asked to rate the importance and uncertainty of each driver on a 5-point Likert scale ranging from 1 (low/weak) to 5 (high/strong). The data collected from this step were analyzed using EXCEL software to calculate the average ratings. Drivers with the highest levels of importance and uncertainty were selected to proceed to the next step for cross-impact analysis. Other drivers that were highly important and highly predictable were considered trends and formed the basis of the certain scenario.

3 – 2) Cross Impact Analysis (CIA): To construct scenarios, it is crucial to identify high-impact drivers among important and uncertain driving forces. These drivers, known as "critical uncertainties," can influence the occurrence of other factors. To accomplish this, a cross-impact matrix of drivers was created and provided to experts to assess the potential mutual impact (pairwise comparison) by assigning numerical values ranging from zero (weak impact) to three (high impact). The collected data from the CIA matrix were then analyzed using MICMAC software, which generates an influence-dependence map of the drivers. The aim of this step was to identify critical drivers with high influence and low dependency, as they serve as the foundation for scenario logics.

Phase 4: scenario building

Scenarios are not wish lists. They are narratives of real events [13]. Therefore, we used critical factors to construct scenarios that describe the future environments of MSUI internationalization. This phase was conducted in the following two steps:

4 – 1) Balanced Impact Analysis: The initial step in this approach involves identifying the potential states of each driver within the designated time frame. To achieve this goal, a morphological analysis was employed to determine the various states in which the drivers could exist. Three probable situations were considered for these factors: preferred, static, and critical. After defining these states, the BIA matrix was constructed. Subsequently, this matrix was shared with 16 key informants to analyze the impact of the potential states in terms of amplification or limitation through pairwise comparisons. The informants assigned a numerical value ranging from −3 (very high limiting impact) to 3 (very high amplifying impact) to assess the impact of each state.



A : Important and uncertain drivers
B : Important and certain drivers
C : Unimportant and uncertain drivers
D : Unimportant and certain drivers

Fig. 4 Ranking of the driving forces based on the degree of importance and uncertainty

4 – 2) Scenario description To identify future plausible and consistent scenarios, the data collected in the previous step were analyzed with Scenario Wizard software. Among the extracted scenarios, plausible and probable scenarios were selected and described. These scenarios were selected based on their consistency score and evaluated for feasibility (having enough evidence to prove feasibility), utility (being valuable for future decision-making), challenge (challenging conventional knowledge), and differentiation (highlighting the distinctions between the scenarios) according to the opinions of key study participants.

Results

Exploring drivers

A total of 1381 studies were identified, 43 of which met the inclusion criteria for the study and were used for exploring driving forces. Figure 3 shows a flowchart of the study selection process according to the PRISMA-ScR checklist.

Through a scoping review and interviews, a total of 61 driving forces influencing the future of internationalization of medical sciences universities in Iran were identified and categorized as social, technological, economic, environmental, political, and values. The social category encompasses the greatest number of forces (22), followed by the technological (13), political (12), economic (8), environmental (3), and values (3) categories. Table 1 displays the identified driving forces for each area.

Synthesizing

Driving forces identified in the past phase were ranked in 4 different ranks according to their degree of importance and uncertainty. Figure 4 shows the ranking of these forces. The identified driving forces and their rankings are shown in Table 1.

According to the rankings, 10 driving forces, namely, economic sanitation, political relations and diplomatic influence, the knowledge economy, scientific supremacy, the resilient higher education system, scientific competitiveness, financial stability, health diplomacy, international commercialization, and networking, are expected to have greater importance and uncertainty in the 2040s. Figure 5 displays the direct influences of the important and uncertain driving factors.

Considering that the future of the internationalization of medical universities in Iran depends on the status of these recent forces, we opted to determine the critical uncertainties that have a great impact on all the forces of the system by designing an influence-dependence map. MICMAC software produced an influence-dependence map, as shown in Fig. 6. The critical uncertainties of the studied system are placed in the upper left part of the map, including political relations and diplomatic influence, economic sanctions, scientific supremacy, and the knowledge economy.

Table 1 Driving forces for the internationalization of MSUI and their rankings

Row	Category	Driver	Degree of importance	Degree of uncertainty	Rank
1	Social	Resilient higher education system (RHE)	Most	Most	A
2		Integration of higher education system	High	Low	B
3		Independence and decentralization of universities	Most	Low	B
4		Standardization and accreditation systems	High	Low	B
5		International rankings	Most	Low	B
6		Changes in global patterns of health and disease	High	Least	B
7		Migration patterns	Low	Least	D
8		Population transition	Low	Least	D
9		Brain drain	Most	Least	B
10		Social capital	Medium	Low	D
11		Lifestyle change	Low	Low	D
12		Cultural pluralism	Medium	Low	D
13		Racial discrimination	Medium	Least	D
14		Globalization	Most	Least	B
15		Regionalization	High	Least	B
16		Becoming multilingual	Medium	Low	D
17		Religious pluralism	Low	Least	D
18		International networking	Most	High	A
19		Management and policy stability	Most	Low	B
20		Multi skilled employee	Most	Low	B
21		Discourse and concern of internationalization	Most	Low	B
22		Reengineering of structures and processes	Medium	Low	D
23	Technological	Emergence of new technologies (artificial intelligence, robotic, Nano medicine)	Most	Low	B
24		Open higher education system	Most	Least	B
25		Virtual universities	High	Least	B
26		Digitization	Most	Low	B
27		Cloud Computing	Medium	Low	D
28		Virtual reality and Augmented reality	Medium	Low	D
29		Cyber medicine	High	Low	B
30		Information technology infrastructures	High	Low	B
31		Expansion of science, technology and innovation monitoring systems	Most	Low	B
32		Scientific Supremacy	Most	High	A
33		Formation of startups, knowledge-based companies, and science and technology parks in the field of health	High	Low	B
34		Interdisciplinary science	Most	Low	B
35		Scientific competitiveness	Most	High	A
36	Economic	Sanctions	Most	Most	A
37		The shift of Economic power from the West to the East	High	Least	B
38		Knowledge economy	High	High	A
39		Financial sustainability	Most	High	A
40		Commercialization of higher education	Most	High	A
41		Customization of higher education	High	Low	B
42		Personalization of higher education	High	Low	B
43		Transition to third and fourth generation universities	High	Low	B
44	Environmental	Climate change	Low	Low	D
45		Environmental Change	Medium	Low	D
46		Green universities	Low	Low	D
47	Political	Development of legal capacities	Most	Low	B
48		Expansion of political relations	Most	High	A

Table 1 (continued)

Row	Category	Driver	Degree of importance	Degree of uncertainty	Rank
49		Ideological changes of politicians	Most	Low	B
50		Political discourses	High	Low	B
51		Support from political elites	Medium	Low	D
52		Propaganda	Most	Least	B
53		Development of health diplomacy	Most	High	A
54		Political orientation of alliance and coalition	Medium	Least	D
55		Stability and security of the Middle East region	Most	Low	B
56		Political stability and domestic security	Most	Low	B
57		Terrorism	Most	Low	B
58		Soft War	Medium	Low	D
59	Values	Changing moral patterns	Medium	Low	D
60		The emergence of the learning community	High	Low	B
61		Professionalism	High	Low	B

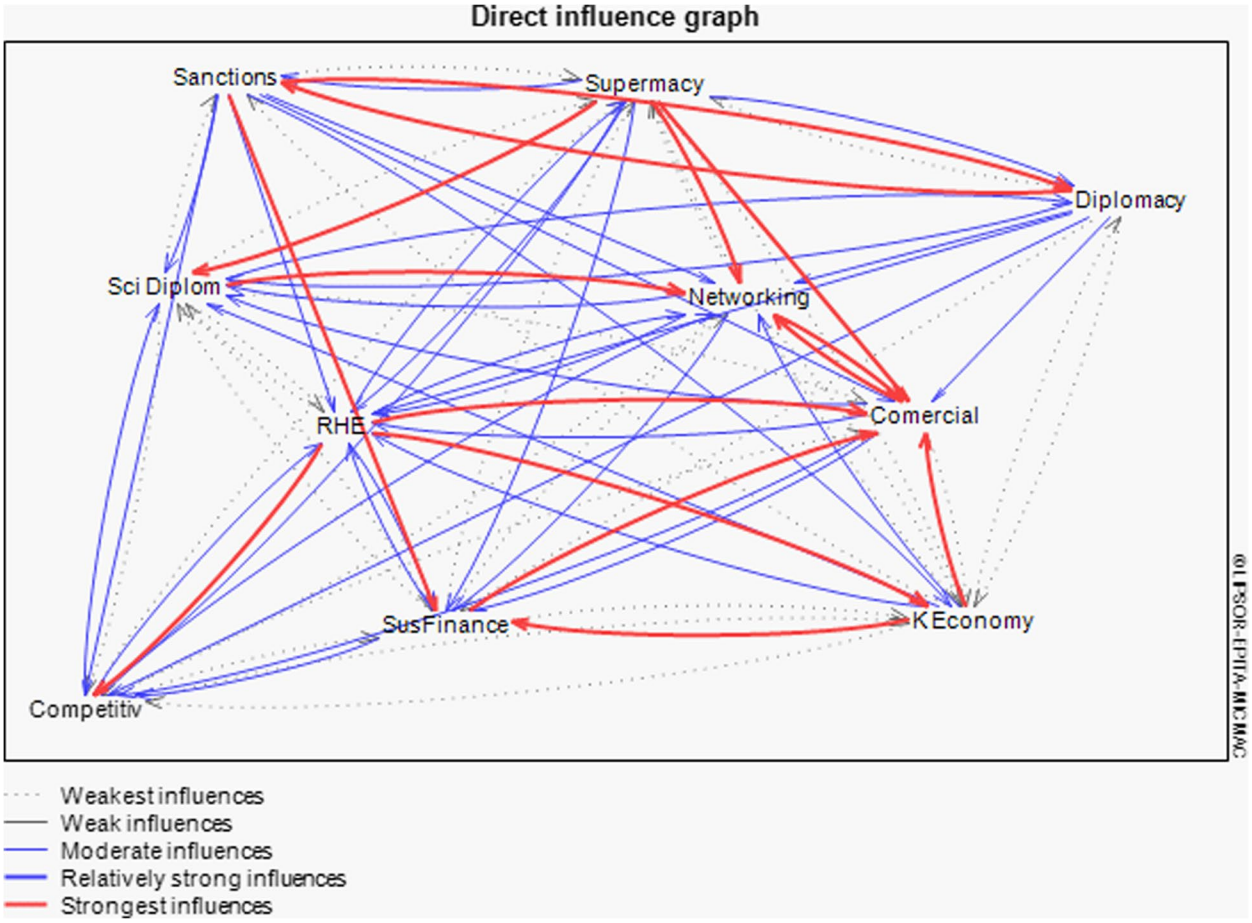


Fig. 5 Direct influence graph of critical uncertainties for MSUI internationalization

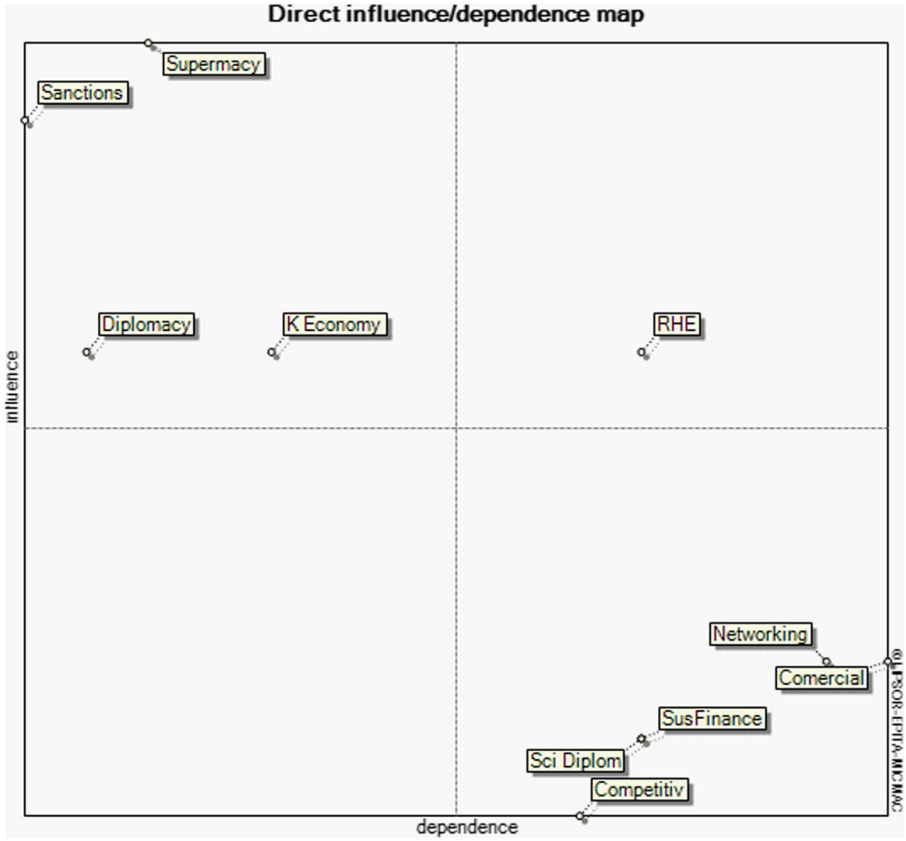


Fig. 6 Influence-dependence map for MSUI internationalization

Scenarios

By using morphological analysis and applying a balanced impact analysis technique, a configuration of 12 states of critical uncertainties was obtained, and their mutual relationships were investigated. Morphological analysis is a method for rigorously structuring and investigating the total set of relationships in sociotechnical problem complexes that are inherently unquantifiable [18]. The information obtained from this step was entered into the Scenario Wizard software to create alternative scenarios by combining these states. Finally, 81 possible scenarios were identified for the future of the internationalization of medical sciences universities in Iran. According to the consistency score, 16 scenarios with higher scores were identified as plausible scenarios, five of which were identified as probable scenarios based on the participants' evaluations. These scenarios are shown in Table 2.

A good set of scenarios has several characteristics. They should be acceptable, internally consistent, challenging, attractive and useful. After evaluating the scenarios by experts based on their consistency, feasibility, utility, challenge and differentiation, five scenarios were ultimately recognized as highly probable for the 2040 horizon. According to the states of the key drivers, scenario numbers one and two represent the preferred scenario, scenario number eleven represents the scenario on the threshold of desirability, scenario number five is the continuation of the current trend, and scenario number sixteen is the pessimistic scenario. The following tables describe five probable scenarios Tables 3, 4, 5, 6 and 7.

Conclusions

This study was a futures study that first identified the driving forces affecting the future of internationalization of medical sciences universities in Iran; then, the mutual relationships between them were examined to identify the critical uncertainties for the purpose of scenario building. The critical uncertainties that have the greatest impact on the future of the studied system include scientific supremacy, knowledge-based economy, sanctions, and political relations. By configuring the states of the critical derivers, 16 plausible scenarios were identified. The analysis of plausible future scenarios reveals that the optimistic conditions of the driving forces outweigh those of their pessimistic counterparts, suggesting that, at worst, the present situation will continue.

Table 2 Plausible future scenarios for the internationalization of medical universities in Iran in the 2040 horizon

Driving forces / States	Political Relations and Diplomatic Influence			Economic Sanctions			Knowledge Economy			Scientific Supremacy			Compatibility score	Impact score
	Constructive and effective diplomacy	Limited diplomacy	Inefficient diplomacy	Complete removal of sanctions	Phased removal of sanctions	Continuation of sanctions	knowledge-based economy	Establishing a knowledge-based economy	Traditional economy	Visible scientific supremacy	Scientific supremacy in a number of medical sciences	Scientifically dependence		
Scenario 1	■			■			■			■			1	23
Scenario 2	■				■		■			■			1	20
Scenario 3	■			■				■		■			-1	25
Scenario 4	■				■			■		■			-1	22
Scenario 5		■				■		■		■			-2	5
Scenario 6			■			■		■		■			-2	5
Scenario 7		■			■				■	■			-4	3
Scenario 8	■			■			■				■		-6	13
Scenario 9	■				■		■				■		-5	11
Scenario 10	■			■				■			■		-6	15
Scenario 11	■				■			■			■		1	13
Scenario 12	■			■					■		■		-4	12
Scenario 13	■				■				■		■		-3	12
Scenario 14			■			■			■		■		-5	7
Scenario 15		■				■		■			■		1	15
Scenario 16			■			■			■			■	1	17

Future scenarios

According to the evaluation of the scenarios, the probabilities of the five scenarios were greater than those of the others. In the first scenario, an ideal situation is presented where Evergreen University has ample capabilities to enhance its scientific standing and numerous opportunities for future development.

The second scenario is the most favorable option after the first scenario. In this situation, which we refer to as the "Lush Universities", the institutions seize opportunities to foster international collaboration through their scientific standing and by leveraging health diplomacy. The third scenario represents a situation at the optimal threshold. During this period, known as the "Blooming Season", it is crucial for universities to prioritize industry requirements and enhance the commercialization of scientific knowledge.

In the frost gardens scenario, universities aim to deploy their expertise to address industry and market demands, alleviate sanctions, and enhance the nation's political standing and global relationships. Scenario five depicts a dire situation referred to as a "Dried up Gardens." In this scenario, the university's influence is waning as a result of international restrictions, leading to a diminished ability to generate innovative ideas and practical solutions for societal issues and industrial demands. The collaboration

Table 3 First probable scenario for the internationalization of MSUI in the 2040 horizon

Scenario number 1: Evergreen universities		
States of Scenarios Logic	**Description of scenarios logic**	**Conditional section of scenario**
-Constructive and effective diplomacy **-Complete removal of sanctions** **-Knowledge-based economy** **-Visible scientific supremacy**	In this scenario, Iran maintains positive political relations with numerous nations and actively cultivates political and economic connections with the global community without facing sanctions from influential countries. Iran has attained significant progress in various areas of medical science, establishing itself as a leader in scientific research. Through the utilization of cutting-edge scientific innovations, the economic framework enhances the nation's productivity and stimulates business growth, leading to the creation of wealth.	In this scenario that Iran has established positive political relations with various countries across the globe; ample opportunities have arisen for professors and academics to engage in international scientific networking. Considering that industries and organizations seek to apply the latest scientific and technological advancements, universities are implementing effective strategies to advance in this competitive environment. Through a research-oriented educational approach, the establishment of scientific hubs, supports for technological research and knowledge-based enterprises, as well as international networking, universities are leveraging the scientific capabilities of their professors and students. The overarching objective for universities in this scenario is to attain global recognition, generate societal value, and bolster the nation's prosperity. Iran's scientific supremacy, coupled with its constructive political alliances worldwide, has led to the development of a robust scientific diplomacy for the country, which universities are keenly utilizing to maximize the commercialization of their services and products. Over time, extensive international collaborations and a fundamental role in advancing medical sciences and technologies will enhance the universities' prestige on the global stage. Subsequently, universities will witness a diversification of funding sources, ultimately culminating in the establishment of a sustainable financial system characterized by adaptability and resilience against potential future crises

Table 4 Second probable scenario for the internationalization of MSUI in the 2040 horizon

Scenario number 2: Lush universities		
States of Scenarios Logic	**Description of scenarios logic**	**Conditional section of scenario**
-Constructive and effective diplomacy **-Phased removal of sanctions** **-Knowledge-based economy** **-Visible scientific supremacy**	In this situation, Iran has forged constructive and positive political relations with numerous countries worldwide, resulting in a gradual reduction of imposed sanctions. The country has achieved remarkable progress in various medical fields, establishing itself as a pioneering force in scientific research. By leveraging advanced scientific innovations, Iran's economic framework boosts national productivity and spurs business expansion, fostering the generation of wealth	In light of the country's successful expansion of diplomatic relations and easing sanctions, the university now has unprecedented opportunities for international collaboration and engagement. Iran's remarkable achievements in various medical fields continue to draw specialists and scholars from around the globe. Under these circumstances, the university has the chance to participate in international conferences and forums, fostering meaningful discussions and knowledge exchange. By strengthening ties with the industry, the university is able to innovate and share cutting-edge knowledge through technical advancements. Additionally, commercialization services provide avenues for addressing weaknesses and enhancing capabilities, fostering a culture of excellence and competitiveness across the university community. As a result, the university's scientific reputation and influence grow, attracting esteemed professors and scholars, facilitating advanced technology production, and securing sustainable financial resources. Leveraging these strengths, the university further amplifies its networking capabilities and advances its international relations, amplifying its impact through robust scientific diplomacy

Table 5 Third probable scenario for the internationalization of MSUI in the 2040 horizon

Scenario number 3: Blooming season		
States of Scenarios Logic	**Description of scenarios logic**	**Conditional section of scenario**
-Constructive and effective diplomacy **-Phased removal of sanctions** **-Establishing a knowledge economy** **-Scientific supremacy in a number of medical sciences**	In this scenario, Iran enjoys constructive and positive political relations with numerous countries globally. Simultaneously, the ongoing reduction of sanctions on the country is opening up opportunities for enhanced financial and economic relations with various parts of the world. Additionally, considering that Iran has achieved superiority and leading position in a number of medical sciences, the way has been paved for the establishment of a knowledge economy in the country	The removal of sanctions has facilitated the financial transactions of the university and has led to an increase in the number of university contracts and international agreements. In addition, the country has developed its scientific diplomacy, resulting in increased collaboration between Iranian universities and international counterparts The establishment of a knowledge economy has accelerated the university's movement toward commercialization, enabling the university to offer financial and spiritual support to the novel and inventive ideas of scholars, as well as provide the necessary platforms for idea transformation, product provision, and technology advancement. Increasing opportunities for commercialization of university services has made it possible to diversify financial resources, which helps to increase the sustainability of universities' financial resources Consequently, the universities are striving to achieve a competitive advantage in the global market by enhancing the quality of their educational services, engaging foreign professors and experts, fostering international collaborative research, and addressing common clinical issues in research and technology generation, all aimed at gaining international recognition and expanding their clientele, while also generating revenue In light of the rising domestic and foreign investments in the university, the educational system is moving toward establishing a robust and sustainable framework

Table 6 Forth probable scenario for the internationalization of MSUI in the 2040 horizon

Scenario number 4: Frost gardens		
States of Scenarios Logic	**Description of scenarios logic**	**Conditional section of scenario**
-Limited diplomacy **-Continuation of sanctions** **-Establishing a knowledge-based economy** **-Scientific supremacy in a number of medical sciences**	Iran maintains political relations with only a few countries in the world and facing ongoing sanctions from influential Western nations. Amidst this challenging scenario, the country is actively working toward developing a robust connection between the industrial sector and academia, with the objective of building a knowledge economy and leveraging its scientific expertise in specific fields	In this situation that Iran maintains political relations with a limited number of countries and ongoing sanctions have significantly diminished the country's diplomatic influence and economic partnerships, the government is grappling with a financial shortfall, leading to reduced funding for universities. Additionally, international travel restrictions have curtailed opportunities for collaboration with foreign universities and participation in global academic communities. With the impetus to transition from a traditional economic framework to a knowledge-based one, there is an increasing focus on fostering innovation and creating fresh concepts within the university environment. Consequently, universities are cultivating connections with the business sector, especially within the medical and health industries, in order to foster ideas with prospects for becoming commercially viable To mitigate the impact of reduced government funding, the universities are striving to diversify their revenue streams through the commercialization of research accomplishments and by revising the objectives of their faculties and research centers to prioritize applied and demand-driven research. Furthermore, in an effort to bolster international standing, universities are delving into the educational, research, therapeutic, and technological needs of neighboring countries to establish partnerships and collaborations. In addition, universities are increasing their focus on the quantity and quality of research, teaching, and services to enhance their visibility and impact. The combination of research, education, and practical experience contributes to train skilled scholars, a critical factor for fostering collaborative networks and promoting scientific exchange with international partners

Table 7 Fifth probable scenario for the internationalization of MSUI in the 2040 horizon

Scenario number 5: Dried up gardens		
States of Scenarios Logic	**Description of scenarios logic**	**Conditional section of scenario**
-Inefficient diplomacy **-Continuation of sanctions** **-Traditional economy** **-Scientifically dependence**	In this scenario, the country's diplomatic framework endeavors to uphold political relations with a select group of nations around the world. On the other hand, the nation continues to face sanctions from western powers. The country's economic system operates in a traditional way and is reliant on revenue generated from the sale of oil reserves. Scholars and experts across various disciplines have experienced a decline in scientific progress due to limited access to global scientific institutions, resulting in the country's scientific reliance on knowledge and research originating from other parts of the world. Over time, the nation's standing and expertise in the field of medical sciences have waned as a consequence of obstacles and limitations imposed by sanctions and scientific isolation	As a consequence of ongoing sanctions, the government's public resources have dwindled, leading to a reduction in the budget allocated to universities. These circumstances, along with strained and ineffective political relationships with other countries, have reduced the university's ability to expand its network and forge scientific cooperation with foreign academic institutions. University administrators and faculty members are working to maintain a limited number of international relationships. Travel restrictions and limited international cooperation have hindered the introduction of new knowledge and the emergence of fresh ideas within the university environment. Consequently, the university's capacity to engage with industry and generate income through the development of new technologies is restricted, and its ability to market and commercialize products and services internationally is waning. Furthermore, the university is grappling with budgetary shortfalls and lacks alternate financial and support resources to meet its obligations. As a result, the university is unable to adapt and withstand future crises. The incentives to contribute to the economic and social progress of the country will steadily diminish, and the drive to make an impact in the region and globally will fade. In this scenario, the university falls behind in acquiring the necessary resources and capabilities to compete with other universities around the world

between the university and the industry is dwindling, compounding economic pressures on the institution.

Managers and policymakers of medical sciences universities in Iran should use these scenarios as a foundation for adopting and implementing sustainable policies and strategies.

Effective exclusive strategies

The formulation of research interventions to address global issues and priorities might be an effective approach in both the first and second scenarios. According to research, a university aiming for internationalization could benefit from focusing on current scientific challenges and global issues to collaborate on international projects with renowned foreign universities [19].

For the third scenario, the implementation of an internationalization monitoring system, the promotion of commercialization culture, the customization and personalization of educational and research programs, and the diversification of financial resources are effective strategies. Several studies have shown that the implementation of open door policies plays an important role in increasing the recruitment of prominent foreign professors and foreign students in postgraduate studies, increasing the number and diversity of research, decentralizing the financial resources of universities, and commercializing science and technology [20, 21].

In the fourth scenario, driving internationalization discourse and pinpointing the capabilities for fostering international cooperation, addressing regional issues, integrating scientific disciplines, and advancing interdisciplinary sciences appear to be promising strategies.

According to the research conducted, universities can utilize branding and advertising approaches to draw external support and funding as part of their internationalization strategies. This also serves to enhance the university's connections with industry and prospective employers in the market [22]. Some countries play a role in designing guidelines for evaluating the quality of overseas education in international organizations such as UNESCO organizations [23]. Moreover, there is evidence indicating that the internationalization of universities is enhanced through cooperation and educational exchanges with countries within a particular region, as exemplified by the Bologna Process [24, 25].

Fostering the recruitment of international professors, as well as the attraction and development of foreign students who can later be employed as faculty members, plays a crucial role in enhancing connections with academic institutions overseas and expanding international influence [26].

Enhancing the competencies of faculty and staff and garnering the backing of international and regional entities appear to be viable remedies for the pessimistic scenario. Based on the research, enhancing proficiency in the English language in countries where it is not the primary language, improving the professional competencies of faculty members, and empowering professors to engage in collaborative international research are crucial elements for the internationalization of universities [27–29].

Certain scenario

Thirty-three forces with significant and reliable effects are regarded as unchanging driving forces, representing enduring trends from the past that will persist in the future. Therefore, administrators of medical sciences universities need to develop appropriate strategies to address these issues.

Certain drivers identified in this study include advanced technologies such as robotics, artificial intelligence, machine learning, virtual reality, augmented reality, cloud computing, the Internet of Things, smart implants, Nano medicine, and big data, all of which have substantial impacts on the future of healthcare and medical education worldwide. These forces are gradually fostering the development and evolution of monitoring systems for science, technology, and innovation on a global scale. Therefore, there will be a need for standardization and accreditation systems to validate universities through technological evaluations. Furthermore, ranking systems will assess universities based on the newly emerging dimensions of education and research, leading to an increased demand for alignment with global standards in higher education institutions, including universities of medical sciences in Iran.

Advances in technology and information infrastructure will lead to the virtualization and digitization of education in universities and, as a result, the emergence of satellite and virtual institutions. In response to the growing focus of policymakers on social and economic instabilities, emerging diseases and environmental concerns, and high-burden diseases, medical universities are transitioning toward third- and fourth-generation institutions. They will actively engage in addressing domestic challenges and health issues, thereby contributing to the growth of startups and knowledge-based companies in the health sector.

The traditional demarcations between universities, educational groups, and departments will diminish, leading to a shift toward interdisciplinary studies and research. This trend will further intensify the convergence of the sciences. Economic power will soon shift from the West to the East, which will lead to an increase in the importance of Eastern universities in educational and economic cooperation in the world. This shift

questions the status of western universities as exclusive models for knowledge-based economies, as the eastern university system contributes significantly to global economic development.

Globalization and the growing significance of global villages blurs geographic borders between nations, leading to the emergence of international and multinational labor markets. This necessitates culturally and linguistically adept multi skilled human resources, sparking internationalization discourse, increased awareness and emphasis on internationalization in universities. Universities will increasingly customize and personalize their curricula and educational programs in response to the demands of foreign governments and international students seeking education in their desired fields of study. Laws will be expanded to promote global scientific collaboration. Regionalization will persist, leading to predominantly regional scientific interactions and cooperation between countries.

The region's security will remain unstable due to the presence of foreign countries and their military and political bases, leading to various forms of terrorism. Iran will experience satisfactory security and political stability. Organizations' need for diverse skilled professionals drives demand for continuous learning and pushes societies toward lifelong learning.

Considering the positive impact of integrating medical education into treatment, it is anticipated that in the near future, medical education in Iran will not be separated from the Ministry of Health, and higher education will continue to be supervised by both the Ministry of Health and the Ministry of Science. Most likely, frequent changes in management create instability in internationalization policies. It is anticipated that the trend of elite migrants to developed countries will continue in the mid-term.

Strengths and limitations

This research is among the earliest studies to examine the future alternative situations for internationalization of medical sciences universities with an exploratory approach. We suggested that universities could select one of the probable scenarios if it aligns with their preferable vision and map the path and necessary actions by performing the backcasting.

To enhance the study's credibility, a blend of quantitative and qualitative research methods, as well as triangulation, was employed. This approach aimed to offer a comprehensive understanding of the subject and provide robust evidence at different stages of the study, ultimately supporting the achievement of the results. Effort was made to enhance credibility by choosing key informants with a diverse range of experiences. Additionally, the interview codes were shared with the participants for their review and approval, and any inconsistencies were addressed and resolved.

To increase confirmability, researchers collaborated to reach a consensus on the interpretation and significance of the study's findings. Additionally, to increase dependability, an external auditor with experience in qualitative research was used during the study to review and confirm the entire process of data collection and analysis. To enhance the transferability of the study, the research process was explained comprehensively to eliminate any ambiguity for the readers and make it possible to apply and compare the findings in comparable contexts and populations. Furthermore, the principle of reflexivity was considered to reduce potential bias.

However, this study has its limitations. Given the recent economic and political issues in the country, it was possible that participants would unconsciously consider the effects of this area more than other areas (social, technological, environmental, value). To address this issue, participants were encouraged to focus on issues with a long-term perspective (as per the 2040 horizon in this study) and avoid restricting their responses to the immediate effects of factors.

Key message

The results of this study indicated that the future of the internationalization of medical sciences universities in Iran is influenced by macro trends such as scientific supremacy, a knowledge-based economy, a robust and influential diplomatic system, open scientific collaboration, the commercialization of goods and services, extensive communication networks, and a competitiveness and resilience education infrastructure. Therefore, monitoring the identified trends is crucial for the internationalization of medical universities in Iran and represents a significant step toward prioritizing the internationalization of Iran's medical science universities. Put simply, as these trends interact and clash, they give rise to scenarios that can be identified in advance as a preventive measure against potential surprises, as well as to minimize the loss of resources and capital.

According to the findings of this study, the internationalization of medical sciences universities in Iran appears to have a promising outlook. Additionally, the identified scenarios indicate potential favorable outcomes for the future, given that universities utilize them strategically and implement effective strategies based on these findings. By implementing suitable strategies, universities can better prepare for potential future challenges and capitalize on potential opportunities. Identifying and promptly addressing threats, as well as aligning strategies with

future conditions, are crucial for successfully overcoming future obstacles.

As a result of this study, managers and policymakers at medical sciences universities in Iran can utilize the findings to develop a concise overview of potential future prospects. This will enable them to take proactive measures such as goal setting and implementing robust strategies. Additionally, universities can select a preferable scenario and create a corresponding roadmap that incorporates exclusive strategies to effectively work toward that particular outcome.

Abbreviations

MSUI	Medical Sciences Universities in Iran
PRISMA-ScR	Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for scoping review checklist

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Data availability
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Ethical approval was granted by the Ethics Committee of the Tehran University of Medical Sciences (Reference number: IR.TUMS.SPH.REC.1401.075). Informed consent to participate in the study was obtained from all of the subjects.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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