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Investigating the effective factors on telemedicine in Iran of 2030: A futuristic approach

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Abstract:

BACKGROUND: Telemedicine is influenced by several factors. Increase of recent changes, the emergence of new issues presence of societies in the future world, discontinuous events, and the existence of uncertainties, it seems necessary to plan for the successful. Identifying key effective factors, their role, and mutual relationship can enhance the decision-making and planning process in the country. This study endeavors to find the key effective factors on telemedicine to achieve a better future for the implementation of this technology in Iran.

MATERIALS AND METHODS: In terms of its nature, this research is based on the new methods of futurology is analytical-exploratory, and in terms of purpose it is applied, and in terms of the type of research is descriptive survey. The time horizon of 1410 is the basis of this study. This study was performed in Iran based on STEEP and using MICMAC software (Calculate from matrix of direct influence (MDI) and matrix of indirect influence (MII) include: direct influence/dependence map, direct influence graph, and indirect influence graph).

RESULTS: Data collection was performed through reviewing sources. The prioritization of primary variables was performed through a questionnaire to determine the importance, which led to the identification of 22 important factors. Next, to identify the nature of different factors and explanation the key factors, the matrix of cross-impact and MICMAC software were used. Finally, 13 key factors were defined.

CONCLUSION: Political factors have the greatest contribution as the main key factors and have a greater impact on the future of telemedicine, which highlights the need for authorities to consider this field for the effective implementation of technology in the future.

Keywords:

Digital health, eHealth, forecasting, telemedicine

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Introduction

During recent decades, the rapid progress in information and communication technology has had a significant impact on health systems in developing countries.[1] Technologies such as telemedicine reduce healthcare costs and medical errors and play an important role in universal healthcare coverage.[2-4]

Iran is one of the developing countries with middle income, whose health system is facing many challenges. For example, the aging process is upward in it and predicted that 33% of its population will be over 60 years old by 2050. About 80% of the elderly suffer from chronic diseases, and according to the 2018 report of the World Health Organization, chronic noncommunicable diseases account for 67% of the causes of death in Iran.[5,6] Also, the unequal distribution of physicians, the population dispersion, and large geographical area have caused a decrease in the quality of care and an increase in medical errors, which can be one of the main incentives to implement telemedicine in Iran.[6]

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Although with the emergence of the COVID-19 pandemic, the use of telemedicine expanded and received serious attention, but the continuation of this process in the post-COVID world depends on various factors.[7] Despite the countless benefits of telemedicine, there have always been many obstacles to the implementation of this technology. According to the studies, the main barriers are related to technological infrastructures, laws, national policies, legal and ethical issues, privacy and safety, physicians' resistance, staff training, reimbursement policies, patients' participation and acceptance, and financial issues of system development and diagnosis.[8-13] Also, in developing countries, especially in the Middle East, telemedicine has not been implemented as expected because of the social and cultural diversity and complexities, regional violence, unrest, and instability.[14] Iran is not exempt from this issue and as a developing country has always faced challenges in this field.

To understand the issues related to the implementation of telemedicine, it needs to consider some aspects as follows: The implementation of telemedicine requires changes in both the infrastructure and the organization of affairs because it includes technological and sociotechnological components.[15,16] As such, attention to technical and strategic aspects is necessary, and interdisciplinary studies that consider the dynamic interaction between different components of the system as well as human factors, because it is a complex innovation. This complexity highlights the need for a holistic view to involve all the stakeholders affected by telemedicine. Accordingly, the results of the implementation of telemedicine may vary from one region to another, so the overall design of the study should be well-defined.[17,18]

Telemedicine futurology is a theoretical framework that explores the potential future development and implications of telemedicine. This framework visualizes a future where technological advancement revolutionize healthcare delivery. By leveraging modern information and communication technologies, telemedicine has the potential to improve access to healthcare, enhance diagnostic capabilities, and provide personalized care. In this framework, critical aspects are underscored.[19] Social factors shape the accessibility and utilization of telemedicine. Equitable access to technology and reliable Internet connections should be checked to avoid exacerbating existing healthcare disparities. Cultural attitudes toward healthcare (building trust and addressing privacy concerns) also impact telemedicine acceptance.[14] Correspondingly, Information Technology (IT) has the potential to improve accuracy, efficiency, and decision-making in telemedicine. The integration of IT advancements into telemedicine holds immense promise.[20] To deal with economic barriers such as reimbursement challenges is vital to fully realize the potential benefits of telemedicine on a global scale.[14] Environmental factors take into consideration aspects of the environment that may facilitate or hinder the adoption of a new technology.[21] Furthermore, it is important for policymakers to recognize the potential of telemedicine and create an enabling environment that fosters its growth and widespread adoption.

Based on current trends, the use of telemedicine in Iran is inevitable and requires planning to bolster its infrastructure; such as collaboration and all-round policy planning of Ministry of Health, Ministry of Information and Communications Technology, and Insurance Organizations.[6]

Considering the potential benefits of telemedicine, identifying key effective factors, their role, and interrelation can improve the planning process for implementing telemedicine in Iran in the future. Therefore, this study endeavored to identify key factors affecting telemedicine to improve this technology implementation in Iran.

Materials and Methods

In this applied mixed-methods study, the effective factors on telemedicine were identified through three phases as follows:

Phase 1. Identifying the primary factors affecting telemedicine

To extract the key effective factors, in the first step, comprehensive electronic search was accomplished on books, articles, theses, and upstream documents related to the objectives. PubMed, Scopus, ISI Web of Science, and Cochrane Library databases were searched from database inception up to June of the year 2021. The keywords Factor OR "driving force" OR Trend OR Megatrend OR Driver, AND Telemedicine OR "Mobile health "OR "m-health" OR mHealth OR Telehealth OR "Tele-health" OR "e-health" OR "Electronic health" OR Telecare OR "Tele-care" were looked for in the title/subject sections of the available articles. In the second step, according to PRISMA[1], duplicated, ineligible, unrelated to the aim of the study, non-Persian and non-English, and no full-text available articles were excluded [Figure 1].

In the third step, the upstream documents available in Iran were collected; included the constitution, 20-year national vision document until 2025, national comprehensive academic health road map, national

1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses

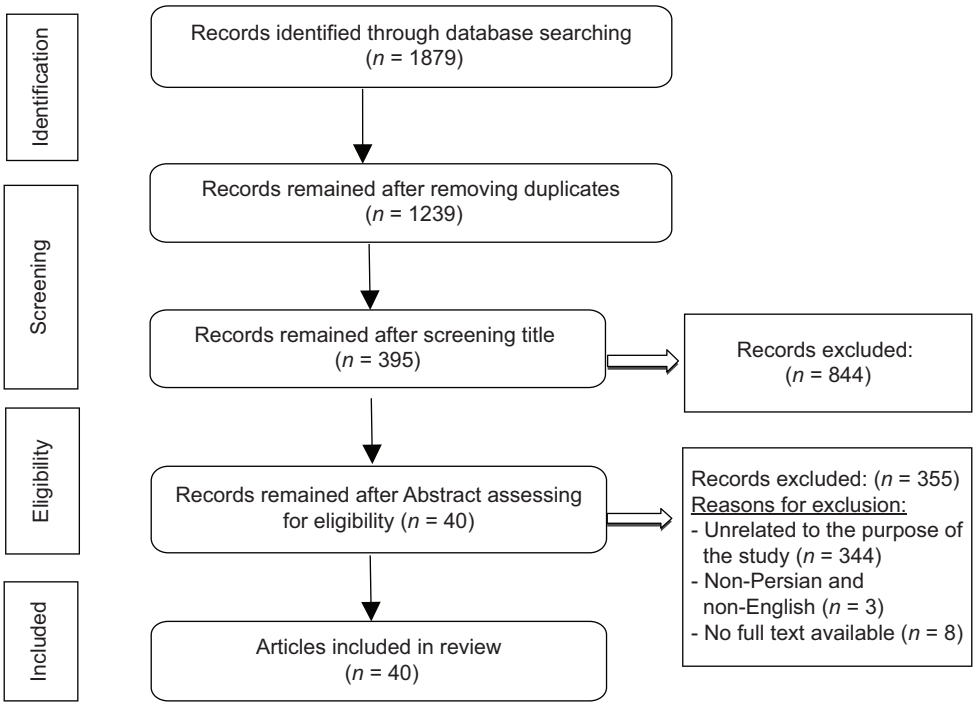

Figure 1: The process of database search and study selection

strategic plan of health insurance organization, the sixth national plan of health development, national health policies, health system reform program, and national macroperspectives, guidelines, laws, by-laws, and circular letters.

In the fourth step, for all the articles, initially, the following data were independently extracted through Directed Content Analysis by MAXQDA 2020: author (s)' name, Country, year of publication, methodology, purpose, sample size, and the key effective factors on telemedicine. Similarly, the factors affecting telemedicine were extracted from the upstream documents. In the fifth step, the key effective factors were categorized based on the five classes of STEEP (social, technological, economic, environmental, and political). The reason for choosing this classification is the division of the most important macroareas of a national or transnational system, each of which includes key factors that affect the investigated system through the lens of that area.[22] We attempted to resolve disagreement of researchers by discussing, reviewing, and reconciling the factors; this way, an agreement was reached.

Phase 2. Prioritizing the importance of the effective factors

In the first step, a researcher-made questionnaire was developed consisting extracted effective factors (social = 29, technological = 25, economic = 12, environmental = 3, and political = 27 items). The reliability of the questionnaire was confirmed by test-retest method (Cronbach's Alpha = 0.982), and its content validity were confirmed by experts of STEEP area[2]. In the second step, 38 academic members in STEEP area who contributed to publish 4 or more articles related to telemedicine (indexed in Scopus) filled the questionnaire. In the third step, the average importance and the average uncertainty score of each factor were calculated, and factors with medium to high importance were identified.

Phase 3. Investigating cross-impact of the factors

To collect the experts' opinions about the cross impacts of different key factors, a researcher-made questionnaire was developed, including the matrix of factors with medium to high importance (social = 4, technological = 4, economic = 4, environmental = 2, and political = 8 items). The content validity was confirmed by experts of STEEP area, and the reliability was confirmed. According to the nature of the study, matrix of cross-impact multiplications and MICMAC[3] software were used to check the factors cross-impact. By using MICMAC software, the table of the factors' cross-impacts was analyzed. As such, the direct and indirect impacts matrix and graphs were obtained.

2 Including medical informatics, health information management, health policy, health promotion, health sciences, health services management, information technology, future study, health education, and promotion, technology and innovation management and policy planning, and preventive medicine

3 Matrix of cross-impact multiplications applied to a classification

Ethical code and ethical considerations

Ethical issues (plagiarism, misconduct, data fabrication, and falsification, double publication and submission, redundancy) were considered. Besides, this study received the required ethics approval from Isfahan University of Medical Sciences Research Ethics Committee, Isfahan, Iran with ethical code number: IR.MUI.NUREMA.REC.1400.39.

Results

In the first phase, 96 primary factors (including: 29 social, 25 technological, 12 economic, 3 environmental, and 27 political) were identified. In the second phase, according to opinions of the experts, the factors were scored, and the average of importance and uncertainty for each factor was specified. Finally, 22 factors with an upward average score were identified to be entered into the MICMAC software. These factors are displayed in Table 1, along with their codes, and were classified according to STEEP.

In the third phase, the 22 factors were scored by experts and entered into the MICMAC software in square matrix that was determined intensity of direct communication between the effective factors. Table 2 shows the general features of the studied matrix. The dimensions of the matrix are 22 × 22, and there are 484 relationships in this matrix; 462 relationships had an influence on each other. The matrix based on statistical indicators with 3repetitions of data has 100% desirability and optimization, which indicates the high validity of the questionnaire. The filling rate of the matrix is 95.45%, which shows that the selected factors have a large effect on each other, and in fact, the system is unstable. The distribution of variables around the diagonal axis in the dispersion plane shows the type of stability of the system in this study, considering that the variables are scattered around the diagonal axis [according to Figure 2], the system can be considered unstable. In these systems, the lack of influential variables threatens the system, and most of the variables show an intermediate state of influencing and depending, which emphasizes the evaluation and identification of key factors. According to the position of the variables in the scatter plane, the nature of different factors can be determined. Based on this, each variable is placed in one of a category as follows:

1) Influential variables (located in north-west part). These are very influent factors, have little dependence, and cannot be controlled by the system and include service delivery guidelines, laws and regulations governing the country, privacy protection, and the economic situation of the country.

Table 1: Variables entered into MICMAC

Code	Classification	Factor
S9	Social	Users' resistance to technological changes
S10		The level of trust of doctors and patients in technology
S12		Acceptance of telemedicine technology
S25		increased sharing of integrated data
T4	Technological	How to implement telemedicine
T16		Establishment of EHR
T23		Development of new sciences and technologies
T24		Increasing the influence of information technologies in providing services
E1	Economical	The economic situation of the country
E3		The cost of effectiveness of telemedicine services
E6		The level of support of the beneficiaries
E8		Reimbursement coverage of telemedicine services
En1	Environmental	Geographic context
En2		Deprivation caused by the limitations of the geographical environment
P2	Political	Laws and regulations governing the country
P3		Government support infrastructure
P4		Service delivery guidelines
P8		Privacy protection
P9		Ensuring confidentiality of patient information
P13		Development of insurance services
P14		The approach of governments to the expansion of telemedicine
P16		Legal protections

Table 2: General characteristics of the studied matrix

Indicator	Matrix size	Number of iterations	Number of zeros	Number of ones	Number of twos	Number of threes	Total	Filling rate
Value	22	3	22	51	354	57	462	95.45%

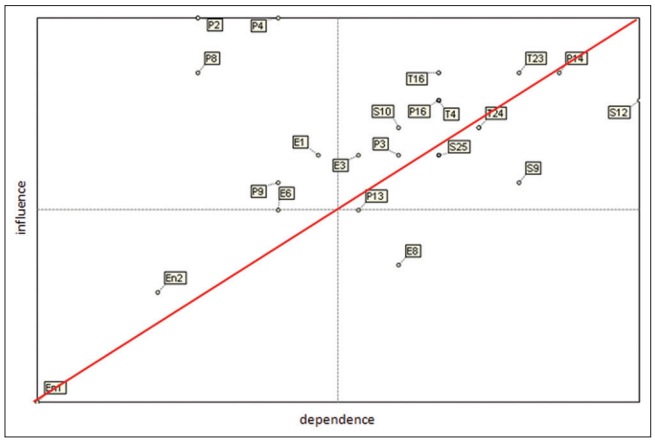

Figure 2: Distribution of variables based on direct influence and dependence

2) Relay variables (located in north-east part). These are both very influent and very dependent such as this: government support infrastructure, increased sharing of integrated data, development of new science and technologies, increasing the influence of information technologies in providing services, the government's approach to the expansion of telemedicine, establishment of EHR, legal protections, how to implement telemedicine, the level of trust of doctors and patients in technology, the cost-effectiveness of telemedicine services, users' resistance to technological changes, and acceptance of telemedicine technology.
3) Depending variables (located in south-east part). These variables have high dependence, little influence, and can be introduced as result variables. Reimbursement coverage of telemedicine services is one of the important indicators of the result group.
4) Excluded variables (located in south-west part). These are variables with little influence and little dependence. The variables related to environmental issues, such as geographical context and deprivation caused by the limitations of the geographical environment, are included in this category.
5) Regulating variables (located in center of gravity). These variables may play alternatively the role of secondary levers, weak objectives, and secondary stakes. These variables are as follows: the development of insurance services, ensuring confidentiality of patient information, and the level of support of the beneficiaries.

Levels of relationships between variables

Examining the relationships the variables affecting telemedicine shows a strong direct and indirect effect of some variables. In Figure 3 (a), the lines drawn from each variable express the degree of influence, that variables such as laws and regulations governing the country (P2), service delivery guidelines (P4), and privacy protection (P8) have the greatest influence on other variables, and some variables such as increased sharing of integrated data (S25), acceptance of telemedicine technology (S12) and establishment of EHR (T16) are affected by other variables.

Examining the effect of indirect relationships will provide planners with useful information that is needed for proper system management. Indirect relationships discover and confirm the importance of specific variables and their potential, as well as identify other variables that cannot be recognized in direct classification because of their indirect role. Figure 3 (b) shows the variables with strong indirect influence such as laws and regulations governing the country (P2) and service delivery guidelines (P4). Acceptance of telemedicine technology (S12) and the approach of governments to the expansion of telemedicine (P14) have indirect dependence.

After entering the indirect factor in the calculations, 11 influencing variables did not change their position, which indicates the importance of the variables in the system management in the future.

These variables include privacy protection, Development of new sciences and technologies, the approach of governments to the expansion of telemedicine, establishment of EHR, acceptance of telemedicine technology, the economic situation of the country, ensuring confidentiality of patient information, users' resistance to technological changes, reimbursement coverage of telemedicine services, geographical context, and deprivation caused by the limitations of the geographical environment.

The increase in the influence rank of the variables after the application of the indirect factor indicates the increase in the indirect influence of the variables, and they have the potential to be considered in future scenarios. These variables include Laws and regulations governing the country, service delivery guidelines, the level of trust of doctors and patients in technology, increasing sharing of integrated data, and the development of insurance services.

The decrease in the rank of the variables also shows the less influence of the variable compared with other variables, and these variables include service delivery guidelines, legal protections, increasing the influence of information technologies in providing services, government support infrastructure, and cost-effectiveness of telemedicine services and the level of support of the beneficiaries.

Identification of Key Variables

By analyzing the graphs, the score of direct and indirect influence, and the maps obtained from MICMAC software, finally, it should be possible to identify the

key and strategic factors affecting telemedicine. Strategic variables are among the key variables in the system that have some characteristics: manipulable, controllable, affect the dynamics and change of the system and are also important in scenario. Variables above the diagonal line are strategic variables because they can be controlled by the management system and have an acceptable influence on the system. These factors are listed in Table 3.

Analysis of the results of MICMAC software can be used as a reference to identifying key factors for interventions or improving performance through 1. analyzing some selected variables to improve and strengthen capacity and effectiveness. 2. Improving the performance of the influential determining variables of the first area to increase their positive effect on other variables, including the variables of the second area. 3. Special attention to discover the hidden potential of influential and indirect dependent variables for their essential participation in the future. 4. More focus on critical variables that have a high influence and dependence.

Discussion

Hosam *et al*.[14] reviewed 43 studies on the use of telemedicine in Middle Eastern countries. In countries such as Saudi Arabia, Iran, and Egypt, cultural issues (e.g. religious and social restrictions, resistance to change, traditional beliefs, literacy level, and linguistic distinction) were found to influence individuals' perceptions and attitudes toward accepting telemedicine. It is also necessary to adopt standard training methods to familiarize healthcare workers in countries such as Palestine, Syria, and Egypt with the functions and interfaces of telemedicine applications. Other privacy and legal issues in countries such as Turkey, Iran, Jordan, and Yemen play a role in convincing practitioners and patients of the value of telemedicine. In addition, the lack of knowledge, skills, and experience in the use of technology affects the perception, trust, and motivation to use telemedicine applications, mainly in the GCC and Jordan.[14] In similar studies conducted in Iran, social factors including training, awareness, knowledge and perception, traditional beliefs, resistance to change, linguistic distinction, and culture of people; technological factors including infrastructure and technical support, quality and system maintenance; economic factors such as equipment cost, economic strains, insurance problems, and reimbursements; and political factors such as security, confidentiality, privacy, ethical and political issues, and patient satisfaction are most important factors and obstacles to the implementation of telemedicine.[23-31]

Table 3: List of final key factors affecting the future of telemedicine

Row	Classification	Key factors
1	Political	Service delivery guidelines
2		Laws and regulations governing the country
3		Privacy protection
4		Legal protections
5		Government support infrastructure
6		Ensuring confidentiality of patient information
7	Technological	Establishment of EHR
8		How to implement telemedicine
9		Development of new sciences and technologies
10	Economical	The economic situation of the country
11		The cost of effectiveness of telemedicine services
12		The level of support of the beneficiaries
13	Social	The level of trust of doctors and patients in technology

Thirteen important factors affecting the future of telemedicine. Among these, the political factors have the greatest effects on telemedicine. This is in line with the findings of Abdalla, Fouquet, Rangachari, and Maleki. According to Abdalla, technological factors (such as requirements, infrastructure, and supporting), and political factors (such as policies, regulations, and laws) are the vital determining factors in telemedicine.[32] Fouquet *et al*.[33] believe that patient access, system integration, environmental restrictions, training, and audio-visual communication are effective factors. According to Maleki *et al*.,[34] national and organizational culture, formal training programs, and clinicians acceptance affect telemedicine. Rangachari *et al*.[35] state that the reimbursement, telehealth coverage, patient training, and synchronous audio-visual technology affect telemedicine.

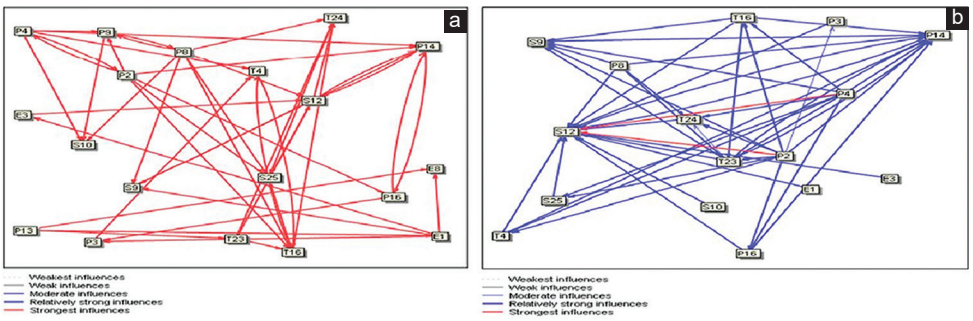

Figure 3: (a) Relationships between variables based on direct effects, (b) Relationships between variables based on indirect effects

In these studies, only the factors affecting telemedicine have been extracted but has not been paid the degree of importance, intensity of influence and dependence, and direct and indirect influence of the factors on each other. The distinguishing feature of this study with other telemedicine studies is structural analysis by MICMAC software to determine the key factors affecting the future of telemedicine. In other words, in the absence of important statistical indicators to monitor trends, structural analysis helps us gain insight into the future of telemedicine, illuminates the global dynamics of telemedicine, and helps to create a network of mutual complex relationships between various factors. This can be ways to shape the future of telemedicine in Iran. Notably, in the absence of reliable databases, which is a common challenge for researchers in some countries such as Iran.

The factors of areas 1 and 2, most of which are political, social, economic, and technical, affect other factors and the whole system. This means that several factors affect telemedicine as a technology; hence, different aspects should be considered for its implementation. By focusing on strategic factors (areas 1 and 2) and improving the performance of these factors, it is possible to help manage this technology.

Conclusion

The variables of areas 1 and 2 affect other variables and the whole system (all areas). Most of them are political, social, economic, and technological variables, which indicate that telemedicine is a technology that affects different dimensions and different aspects should be considered for its implementation. By focusing on strategic variables (areas 1 and 2) and improving the performance of these variables, it is possible to help manage this technology.

The 13 key factors affecting the future of telemedicine include political, technical, economic, and social factors (listed in Table 3. These factors not only affect telemedicine, but also they affect other factors. Considering these factors, it is clear that political factors have great effect on telemedicine.

Because of the existence of internal dependence between key factors, the change of each factor can affect other factors and change the future of medicine. Therefore, it seems necessary to consider the relationships between the factors affecting the future of telemedicine and their levels of influence and dependence in the calculations and analyses. Knowing about the influential factors can attracted the attention and energy of officials to those indicators and improving the organization's performance and can help achieve a clear future regarding the use of telemedicine in Iran. Analysis of graphs and matrix influence-dependence showed that the factors "Laws and regulations governing the country" and "Service delivery guidelines" have the highest level of influence and the lowest level of dependence in the system and the lack of attention of the organization's officials to this factors can affect an important part of the processes related to telemedicine. Therefore, basic attention to these factors can play a significant role in improving the implementation of this technology and thus benefiting from the advantages of this technology. Besides, it seems indispensable to consider other key factors, including risk factors given that they have the highest level of interaction with other factors affecting the future of telemedicine and connect these factors together like a chain link.

The design, implementation, and control of information technology projects in organizations without considering the key factors derived from the opinions and experiences of experts in this field can lead to project failure. Therefore, paying attention to these factors in design, implementation, and control of information technology projects, especially telemedicine, can play a significant role in completing these projects in a short time, with the lowest cost and the highest quality.

National policies play a crucial role in successful implementation of telemedicine. These policies may encompass a wide range of aspects, including legal frameworks, reimbursement mechanisms, and guidelines for healthcare providers. The main objective of national policies is to ensure that accessibility and affordability of telemedicine services, irrespective of individuals' geographical location or socioeconomic background. These policies also aim to establish standards for data privacy and security, ensuring the confidentiality and integrity of patient information during remote consultations. Moreover, national policies are concerned with licensing and credentialing of healthcare professionals practicing telemedicine, thereby ensuring proper care delivery. By establishing clear guidelines and regulations, national policies create a suitable ambiance for the effective deployment of telemedicine, which in turn, improves healthcare access and outcomes throughout the nation.

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Ethics approval and informed consent to participate

In the second and third phases of the research, a researcher-made questionnaire was used, which has been sent as a supplementary file. All the participants expressed their informed consent, aware of the study

purpose, risks, and benefits before completing the questionnaire. The researchers also committed that the information and answers of the participants will remain confidential, and the results will be published as a group.

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Conflicts of interest
There are no conflicts of interest.

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