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Innovation Network Development Model in Telemedicine: A Change in Participation

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Objectives: This paper introduces a telemedicine innovation network and reports its implementation in Tehran University of Medical Sciences. The required conditions for the development of future projects in the field of telemedicine are also discussed; such projects should be based on the common needs and opportunities in the areas of healthcare, education, and technology. **Methods:** The development of the telemedicine innovation network in Tehran University of Medical Sciences was carried out in two phases: identifying the beneficiaries of telemedicine, and codification of the innovation network memorandum; and brainstorming of three workgroup members, and completion and clustering ideas. The present study employed a qualitative survey by using brain storming method. Thus, the ideas of the innovation network members were gathered, and by using Freeplane software, all of them were clustered and innovation projects were defined. **Results:** In the services workgroup, 87 and 25 ideas were confirmed in phase 1 and phase 2, respectively. In the education workgroup, 8 new programs in the areas of telemedicine, tele-education and teleconsultation were codified. In the technology workgroup, 101 and 11 ideas were registered in phase 1 and phase 2, respectively. **Conclusions:** Today, innovation is considered a major infrastructural element of any change or progress. Thus, the successful implementation of a telemedicine project not only needs funding, human resources, and full equipment. It also requires the use of innovation models to cover several different aspects of change and progress. The results of the study can provide a basis for the implementation of future telemedicine projects using new participatory, creative, and innovative models.

Keywords: Innovation, Idea, Health Care Administration, Technology Transfer, Telemedicine

I. Introduction

Innovations in information technology and the rapid advances of multimedia have made it possible to provide telemedicine services (teleradiology, teleconsultation) to patients suffering from chronic diseases [1]. The purpose of innovation in this area is to allow patients to receive care in their homes freely. The application of new technologies can enable the monitor of patients from long distance and can help develop relationships among various organizations [2]. The diverse applications of telemedicine are implemented

using techniques. Furthermore, new information and communication technologies and video imaging used in medicine are provided by industrial promoters.

Advocates of these new tools are well aware that the quality of patient care in areas such as emergency medicine and surgery, monitoring of high risk pregnancies, hypertension treatment, and so on is unsatisfactory. The low quality of patient care due to delays in diagnostic and therapeutic interventions and unnecessary tests and transfers can all be mitigated to some extent by the use of telemedicine [1,3]. Innovations in healthcare technology make medical services more readily available, improve the quality of patient care, cut costs, and improve medical safety [4]. New technologies are creating novel ways to transfer health care information, which is a critical advantage for the realization of effective telemedicine [5]. Further improvements in the distribution of healthcare can also have an outstanding economic effect on the calculated costs (of more than 1.5 trillion dollars in United States in 2012). Although telemedicine technologies currently make up a small part of healthcare technology, any innovation in this field will bring about significant improvements in efficiency and quality of life [4].

Telemedicine can be defined in the three following areas [6]: direct patient treatment, teleconsultation, and tele-education. In direct patient treatment, patient and physician are geographically distant from each other. Using some communication tools and systems, the physician diagnoses the disease and treats the patient. In teleconsultation, professional knowledge and information is transferred between physicians and other nonprofessional healthcare personnel, and in tele-education, updated information is provided to physicians and/or other personnel who work in various healthcare divisions. These people are separated by geographical distance. Restructuring the healthcare distribution system includes the concept of 'care continuity'. A full shift from hospital-oriented healthcare to patient-oriented care requires technological innovations. These technologies help healthcare providers distribute effective services among patients and healthcare customers. This is the result of important social changes, advancement of science and technology, and improvements in medical knowledge. The studied documents show that despite the clearly rapid growth and promotion of telemedicine in healthcare systems, few patients have been treated under related projects. Also, in some countries that lack infrastructure for the advanced implementation of telemedicine, its application is limited to relationships among hospitals and other healthcare centers [7,8]. In almost every telemedicine project, less than 25% of the system's capacity has been used for teleconsultation. The majority of online activities and system resources have been dedicated to medical management and education [7]. Advances in information and communication technology (ICT) as well as tele medicine applications have positively influenced the delivery of healthcare in India [9].

Al-Qirim [7] in a comprehensive study presented that telemedicine network activities make up not more than 30% of the overall healthcare activities in the United States.

1. Technologies

Telehealth focuses on patient information transfer beyond networks and the diagnosis, treatment, monitoring, and training of patients via specific technological systems, which provide access to patient information and specialist consultation. In technical terms, telehealth consists of various tools and software solutions that enable healthcare providers to diagnose, consult, monitor, and train patients and customers who are physically inaccessible. In this regard, the efficiency of these tools and software programs as well as the compatibility of technology with healthcare applications and clinical methods are of great importance. Accordingly, there must be some kind of integration between the provided services and the protocols which are value-adding for both providers and patients. The innovation chain can be defined as follows: defining needs, creating demands, making tools, integrating tools with clinical protocols, and planning. Other motives which push forward technological innovation towards the development of third generation telehealth technologies and applications are summarized as follows:

- *Technology-oriented motives*: telecommunication cost reduction and telehealth equipment cost reduction
- *Market-oriented motive*: more emphasis on cutting costs and improving healthcare quality, increasing demand for internal safety and public health technologies, and rapidly increasing demand for home healthcare and treatment
- *Universities*: most of the important and innovative researches in telemedicine are conducted in public and private universities. These researches are specifically done through telemedicine centers affiliated with medical and nursing schools. University studies focus on innovation and technology, while sociological studies emphasize the distribution of healthcare in underserved populations [3].

According to various researches, the main factors creating a demand for telemedicine are the inadequate distribution of medical sources in rural areas, inappropriate quality of medical consultation and patient referral in rural areas, and lack of proper collaboration between healthcare providers in rural areas and hospitals and medical centers [10].

2. Innovation Network

The leaders of future markets will develop their organizations by creating a network of providers, which can add to their innovative capabilities. The acceptance of any participatory and official process requires the development of a sustainable innovation network. The characteristics of an innovation network are defined in five areas including connection, communications, focus, innovative activities, and value [11]. Networks play a critical role in the innovative capacity of organizations. Also, networks are defined as the relationships between companies, universities, and other organizations [12]. Innovation networks create a way for organizations to discuss various aspects of new technologies [13]. In today's competitive world, organizations and business processes must be designed creatively to gain a competitive advantage in the market. Innovation networks enable organizations to meet the global demand for innovation. These networks have provided great opportunities to use new ideas and diverse viewpoints in innovation processes. Innovation networks are intended to create new rules to enable success in international, national, and regional markets. Organizations that participate in innovation networks play their part according to their own creative capabilities. They can be innovators, modifiers, financial sponsors, or mediators [14]. There are several innovation networks around the world. A good example is an ICT network in Portugal. The network aims to develop and strengthen participation and collaboration between partners and their industrial affiliates. The network includes the following [15]: the Innovation Network on Security and Critical Infrastructure Protection, Innovation Network on Future Internet Services and Technologies, Innovation Network on Services and Technologies for Interactive Media, and Innovation Network on Software Engineering (NET-SEI). An innovation network is a rich combination of diverse research, healthcare, medical, educational, and technical capacities, which are used to develop new effective ideas. Technical innovation has created great opportunities in telemedicine; however, technology should be used as a part of the enabling infrastructure. Telemedicine has been considered as an innovation in the area of medicine and healthcare which requires the close collaboration and participation of specialists in various fields of expertise. Some essential infrastructural elements are required for the formation of such a participatory model. In the studied model, the interests of all the beneficiary parties and their intellectual property rights are fully observed. Additionally, all the conditions are provided for the patients, medical groups, and technical groups (virtual communication providers) to play their part in the model and benefit from it. An innovation network in telemedicine requires the development of an innovation process from the ideation phase to the publication phase.

Accordingly, an innovation network in telemedicine has been designed at Tehran University of Medical Sciences. The project's objectives are summarized as follows:

1) Codifying and implementing rapid development projects to design and create the first generation of a product or process,

2) Improving efficiency and flexibility of the innovation chain and saving time,

3) Identifying the distinctions between network members, focusing strategically on common innovation needs and opportunities and integrating and connecting scientific and operational sections to improve efficiency,

4) Developing new projects in the field of connection technology and merging and integrating the projects into medical industries,

5) Providing innovative solutions based on the latest updated technologies and newest scientific advancements and planning to communicate with various national projects to attract and direct current investments in telemedicine,

6) Planning to establish communication between the members, providers, and end consumers,

7) Managing and reducing risks in future telemedicine solutions.

The network includes all the aforementioned requirements. Table 1 shows all the areas of collaboration within the network. The main objective of this article is to publish and share the experiences and useful results of the project within three separate workgroups namely services, education, and technology.

II. Methods

The present study employed a qualitative survey using brain storming method. Brainstorming is a method of idea generation that can facilitate telemedicine projects by creating novel and practical ideas [16,17].

The process of developing the telemedicine innovation network in Tehran University of Medical Sciences is presented in this article. In addition, activities aimed to facilitate implementation of telemedicine projects are discussed. Prior to the formation of the telemedicine innovation network in Tehran University of Medical Sciences in March–April 2012, phase 1 of the project began. In this phase, all the active beneficiaries who had been working in the field of telemedicine in the University were identified. After analyzing the results of the last two conferences on e-hospitals and telemedicine,

Table 1. Workgroups of telemedicine innovation network

| Workgroup	Scope	Goal
Services	Consulting services Radiology services Internal services Phamraceutical services	Enabling tele care and healthcare administration
Education	Launching telemedicine, teleradiology, telenursing, telepathology and telepharmacy programs in universities or other educational centers Virtual medical record Virtual laboratories	Blended learning for any time and any where
Technology	Integrated architecture of software Electronic prescription Virtual pharmacy Intelligent care Intelligence dashboards	Total health technology transfer integration
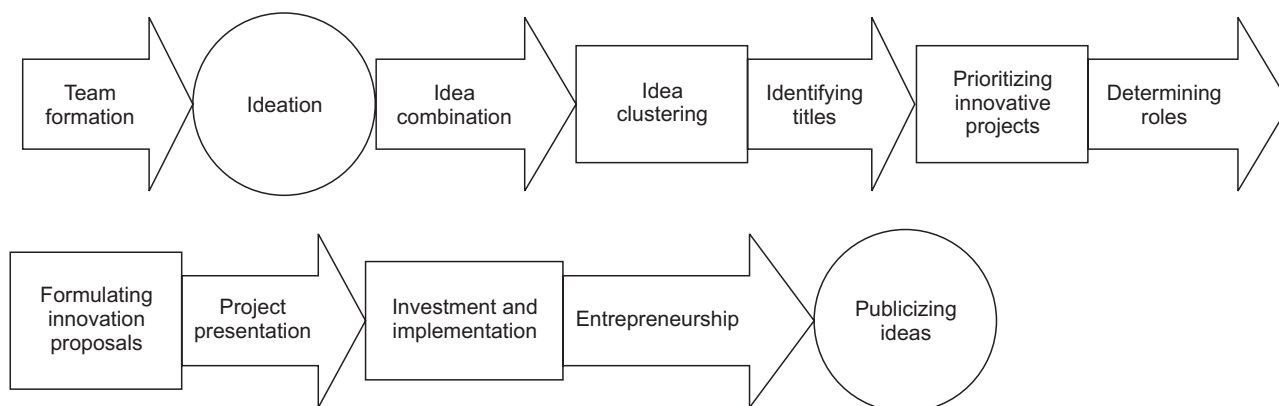
Figure 1. Roadmap of telemedicine network teams.

a draft consisting of all the innovations that were operable according to the country's current capacities and capabilities was prepared, and a telemedicine innovation network memorandum of understanding was codified. All the beneficiary parties signed the memorandum of understanding and made a commitment to implement all the specified provisions. Three workgroups were then formed with the collaboration of network members (phase 2). The services, education, and technology workgroups recruited their required members and held separate brainstorming meetings. Several ideas were presented during the brainstorming meetings held in each workgroup. The ideas which were similar in content and implementation were combined and clustered using Freeplane software. After the completion of the ideation and clustering phases, similar ideas were combined and presented in a new form. In the next phase, innovation projects were defined. Proposals were formulated and prioritized,

and demand areas were determined. After that, investments were made, and projects were implemented. The process is shown in Figure 1.

III. Results

In the services workgroup, 87 and 25 ideas were confirmed in phase 1 and phase 2, respectively. In the education workgroup, 8 new programs in the areas of telemedicine, tele-education, and teleconsultation were codified. In the technology workgroup, 101 and 11 ideas were registered in the end of process (Table 2). The ideas are those ones that would lead to the creation of necessary infrastructure for making telemedicine projects in Iran. Some of projects which were carried out based on these ideas are presented in Table 3.

Table 2. Number of final ideas

Workgroup	No. of final ideas
Services	25
Education	8
Technology	11

Table 3. Examples of telemedicine projects

Workgroup	Examples
Services	Creation of the reminder site for patients referral
	Teleconsultation in teleradiology services
Education	Creation of telemedical lab disciplinary
	Creation of telenursing disciplinary
Technology	Creation of pharmacy information system
	Cultivation telemedicine services

IV. Discussion

Thematic networks form the intellectual bases of innovation management. The main function of these networks is to encourage experts, university professors, industrialists, and businessmen to explore and discover scientific and technological gaps in medicine and other related fields.

The networks play a significant role in policy making and strategic planning with due regard to the diverse fields of science and technology. A thematic network can bring together those organizations that have common areas of interest. This is very helpful in discovering demands and required technologies in medicine and other related fields.

The studies show that telemedicine has been developed in four areas, namely, teleradiology, telepathology, telepsychology, and teledermatology; however, teleradiology has shown the greatest development so far [8]. The services workgroup was designed to provide teleconsultation, telepharmaceutical, and radiology services in the university's hospitals. As telemedicine provides learning opportunities for healthcare staff through e-learning and by providing high-quality service where qualified experts are needed [8], an education workgroup was established to train and educate telemedicine personnel in healthcare and medical organizations, to familiarize officials and personnel with the organization's plans and objectives, and to hold training lessons in telemedicine at medical universities in Iran as required. Society has an important role in the awareness of telemedicine usage. In addition, telediagnosis can be implemented through specific referral [9]. Some of the main functions of the technology workgroup include the following: utilizing a combination of technologies to provide a wide range of teleservices, designing a unified architecture for telemedicine software programs, utilizing a combination of current equipment and providing the required equipment to improve telemedicine services, establishing electronic prescription and telepharmaceutical system, launching a special virtual system for selling medication to those suffering from chronic diseases, designing and operating an intelligent care program, forming intelligence dashboards as needed, and designing medical software programs and applications for the iPad.

In conclusion, the reported innovation network development model in telemedicine not only synergizes and forms innovation teams in specified areas, but could also pave the way for the implementation of future innovation projects. The model can also be a good example for the development of innovation networks in different areas of medicine and other related fields. By activating the network's process of idea finding, idea making, ideation, and idea clustering, the results were found, and the members who did not primarily have a clear view of the network's performance reached a common understanding of telemedicine through mapping ideas. Afterwards, workgroups were formed based on the combinations of ideas. After the results obtained from the combination of ideas were presented to the investor units, it was possible to form project teams and implement innovation programs.

In every project, a grant application must first be made. Then, the innovation project can be developed based on the required funding and the applicants' priorities. Medical imaging informatics and teleradiology are among the projects which are certainly going to enter the development stage. We will discuss the final phases of the process in future articles.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Acknowledgments

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