

Telemedicine in Egypt: SWOT analysis and future trends

Telemedizin in Ägypten: SWOT-Analyse und Zukunftstrends

Abstract

Today, many countries have succeeded in integrating telemedicine and advanced technologies into a broad-range of healthcare processes including diagnosis, treatment, disease prevention, and health education & research. Nevertheless, many developing countries are still unable to sustain meaningful telemedicine projects.

Egypt has achieved significant progress in building the Information Society (IS), by providing an enabling legal and regulatory framework, and an adequate Information and Communications Technology (ICT) infrastructure. However, telemedicine projects in Egypt still face common problems and challenges that hinder the wide-scale adoption of eHealth systems.

This study provides a comprehensive Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis of the current telemedicine applications in Egypt. Based on that, four future trends in Telemedicine in Egypt 2020 have been identified from governmental, financial, technological, and medical perspectives. Consequently, these future trends were aligned to the global trends in telemedicine. The main output of this study is that telemedicine should be part of a National eHealth Initiative.

Keywords: eHealth, Information and Communication Technology (ICT), TeleHealth, telemedicine

Zusammenfassung

Bis heute konnten in vielen Ländern erfolgreich Telemedizin und moderne Informationstechnik in vielen medizinischen Prozessen von der Diagnostik über Therapie und Vorsorge bis hin zur Medizinischen Ausbildung und Forschung integriert werden. Aber gerade in Entwicklungsländern ist es oft nicht gelungen, nützliche Telemedizin-Lösungen dauerhaft zu etablieren.

Ägypten hat bereits erhebliche Fortschritte dabei gemacht, sich zu einer Informationsgesellschaft zu entwickeln. Es wurden rechtliche und regulatorische Rahmenbedingungen geschaffen, in deren Rahmen eine leistungsfähige Infrastruktur für Informations- und Kommunikationstechnik aufgebaut werden konnte. Dennoch sehen sich ägyptische Telemedizinprojekte immer noch mit erheblichen Problemen und Herausforderungen konfrontiert, wenn es darum geht, die Ergebnisse flächendeckend und in Routine anzuwenden.

Diese Arbeit berichtet über eine umfassende SWOT-Analyse (Strengths, Weaknesses, Opportunities, and Threats) der Telemedizin in Ägypten. Mit Hilfe der SWOT-Analyse konnten vier Entwicklungstrends identifiziert werden, welche für die Entwicklung der ägyptischen Telemedizin bis 2020 bestimmend sein werden. Diese Trends beschreiben mögliche und notwendige Entwicklungen in den Bereichen der Regierungsverantwortung, der Finanzierung telemedizinischer Vorhaben, der Technik und der Medizin, die eng mit den entsprechenden globalen Trends zusammenhängen. Telemedizin wird in Ägypten aber nur dann erfolgreich sein, wenn sie Teil einer nationalen eHealth-Initiative ist.

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Schlüsselwörter: eHealth, Informations- und Kommunikationstechnik (IKT), Telemedizin, SWOT-Analyse

1 Introduction

Traditionally, telemedicine was utilized in supporting the healthcare services in rural areas using traditional communication technologies such as telephone and videoconferencing. Currently, advances in Information and Communications Technology (ICT) have enabled telemedicine to be integrated into the routine care of patients. In this new model of healthcare, new technologies in health informatics; disease management; and home telehealth will be highly integrated to provide the right care in the right place at the right time. Ultimately, telemedicine applications are also coupled with eLearning technologies to facilitate the exchange of medical knowledge through virtual seminars, lectures, conferences, eBooks, and other online educational and training materials.

Globally, the health sector currently faces several growing challenges that require new strategic approaches and initiatives at national, regional, and international levels. Consequently, there is a strong need to innovate and deploy new eHealth scenarios, including telemedicine, to overcome these challenges.

In Europe, eHealth is intended to play a strategic role in solving many problems in the European Union (EU) health systems as stated in the white paper developed by the European Commission (EC) [1]. In this strategic approach for better health in EU 2008–2013, eHealth is also considered as a tool for better disease prevention and care. Additionally, EC also considers telemedicine as a growing market moving from €4.7 billion at 2007 to reach €11.2 billion by 2012 [1], [2], [3].

Aligning with the United States of America (USA) Government strategy to increase investments in health information infrastructure, telemedicine will be positively affected in USA [4]. This is based on the solid opinion of different American healthcare stakeholders in reshaping healthcare across the country through deploying telemedicine and strengthening the role of ICT in healthcare [5].

eHealth initiatives have also started in Latin America [6], Asia (India [7], China [8], Malaysia [9]), Balkans [10], Africa (Zambia [11], South Africa [12]) and Australia [13], [14]. In these initiatives, telemedicine was recognized as an enabling tool fulfilling national health needs in each country.

Furthermore, the American Telemedicine Association (ATA) performed a survey on the cross-border telemedicine initiatives in 2009 [15]. The preliminary results covered 41 projects implemented in Argentina, Australia, Austria, Brazil, Canada, Egypt, India, Mauritius, Panama, Saudi Arabia, South Africa, Ukraine, United Kingdom, and United States (US). Most of these projects are implemented in US to provide clinical services in different specialties, education, and research domains.

Nevertheless, telemedicine is still facing many challenges worldwide, such as [16], [17]:

- High cost of telemedicine systems and solutions, especially for the poor rural areas.
- Limited reimbursement for telemedicine services. In most cases, medical insurance providers do not cover telemedicine.
- Resistance to change and slow clinical acceptance of telemedicine.
- Unavailability of the required ICT infrastructure for telemedicine (e.g., internet connection, bandwidth for high speed telecommunications, etc.) especially in rural areas.
- Lack of standards, mainly for data exchange security, safety, and privacy.
- Need of regulatory bodies that issue the required laws to manage telemedicine services across the country and beyond the country's borders.
- Lack of accreditation organizations to certify and evaluate telemedicine providers.
- Need of licensed healthcare professionals to avoid malpractice in telemedicine.
- Lack of a well identified business model to ensure the sustainability of telemedicine.

Consequently, many developing countries are still unable to fund and sustain meaningful telemedicine projects [10]. Particularly in Egypt, most of telemedicine projects face common problems and challenges that affect their sustainability in terms of the technical, financial, and human resources aspects. Unfortunately, there are not enough publications on telemedicine in Egypt describing the detailed information about operational infrastructure, funding schemes, as well as the success, inhabitation and sustainability factors. All literature reviews provide only the general overview of the described telemedicine projects or pilots. Some of the publications generally highlight the challenges facing telemedicine in Egypt as well as the leading reasons for unsustainability of such projects. Consequently, this work mainly relies on international organizations studies conducted in Egypt.

This work aims at providing an overall roadmap for telemedicine in Egypt. The roadmap was developed based on the following:

1. Assessing the current status of the Egyptian Information Society (IS) in light of Egypt's ICT strategy supporting the national eHealth foundations and applications.
2. Analyzing problems and challenges facing sustainability of the implemented telemedicine projects in Egypt.
3. Developing the Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis of telemedicine in Egypt through conducting workshops with healthcare stakeholders from the Egyptian Ministry of Communications and Information Technology (MCIT) and Ministry of Health (MoH).
4. Identifying the future trends for telemedicine in Egypt and the corresponding required actions that should

be taken to align these trends to the global trends in telemedicine. The future trends are identified using scenario planning techniques as described in the background section.

5. Adopting the recommendations of international organizations to facilitate telemedicine development in Egypt.

As a result of the overall roadmap, the future trends in telemedicine in Egypt are classified as follows:

- Trend # 1: Telemedicine is a part of the Egyptian eGovernment (Governmental Perspective)
- Trend # 2: Telemedicine is driven by the Egyptian private sector (Financial Perspective)
- Trend # 3: Telemedicine is driven by the Egyptian ICT Infrastructure (Technological Perspective)
- Trend # 4: Telemedicine is driven by unexpected circumstances, for instance, due to new trends in medicine (Medical Perspective)

2 Background

2.1 Scenario planning techniques

Scenario planning was first introduced in the early 1970s. A scenario is defined as “a generally understandable description of possible situation in the future, based on a complex network of influence factors” [18]. Peter Schwartz identified the eight-step approach of scenario technique as follows [19]:

1. Identification of the focal issues or decisions
2. Identification of key forces in the local environment
3. Listing driving forces (social, economic, political, environmental, technological forces): ‘What are the macro-environmental and technological forces listed in step 2?’
4. Ranking of key factors and driving forces by importance and uncertainty
 - The degree of importance for the success of the issue in step 1
 - The degree of uncertainty surrounding those factors and trends
 - Identify the two or three factors or trends that are most important and most uncertain
5. Selecting scenario logics (ending up with few scenarios whose differences make a difference to decision-makers)
6. Fleshing out the scenario – the logics give the skeleton of the scenarios and returning to the key factors and trends listed in step 1 and 3
7. Exploring implications
8. Selecting leading indicators and signposts

2.2 Trend and uncertainty analysis

There are several methods for identifying relevant factors and clustering trends and uncertainties, mainly:

- Conducting workshops with scenario and industry experts to identify key factors and relevant future trends [20]
- Using a computerized model in analyzing the weights of each influence factor [18]

Future trends can be analyzed utilizing Impact/Uncertainty Grid in which the influence of the key factors is ranked in 2-dimension matrix as shown in Figure 1 [21]. The degree of impact of the key factor is ranked on the x-axis (low/high) and the level of uncertainty surrounding each factor is ranked on the y-axis (low/high).

2.3 Influence matrix with direct ratings

The influence factors can be also analyzed by using the influence matrix with direct ratings [18] in which the strength of influence of each factor (x-axis) is examined through the rest of factors (y-axis). The strength of influence is scaled from 0 (no influence) to 3 (strong influence). The active sum represents how strong each factor influences the other factors, while the passive sum represents how strong each factor is influenced by the other factors.

3 The Egyptian Information Society

According to the National Profile for the Information Society in Egypt published by the United Nations-Economic and Social Commission for Western Asia (ESCWA) in 2005 [22], Egypt has achieved significant progress in building the Information Society, through providing:

- An enabling legal and regulatory framework: committing to intellectual property rights agreements, creating the National Telecommunications Regulatory Authority (NTRA), adopting progressive legal policies to foster ICT growth, and issuing communications laws for liberalizing the communications sector in Egypt.
- An adequate ICT infrastructure: developing an advanced telecommunications network and providing high quality internet services. According to the ICT indicators released by MCIT in February 2012 [23], there are 91.32 million mobile subscribers in January 2012 while mobile penetration rate is at 112.30%. For the internet, there are 29.53 million internet users while internet penetration rate was 36.31% in January 2012.

Accordingly, the Egyptian Information Society worked on building the ICT sector, developing the ICT human capacities, and providing various socio-economic applications for government, education, commerce & business, healthcare, and digital Arabic content.

3.1 Foundations for eHealth in Egypt

According to the World Health Organization (WHO)-Building Foundations eHealth report published in 2006 [24], Egypt reported that the required actions to establish an enabling environment for ICT in the health sector have

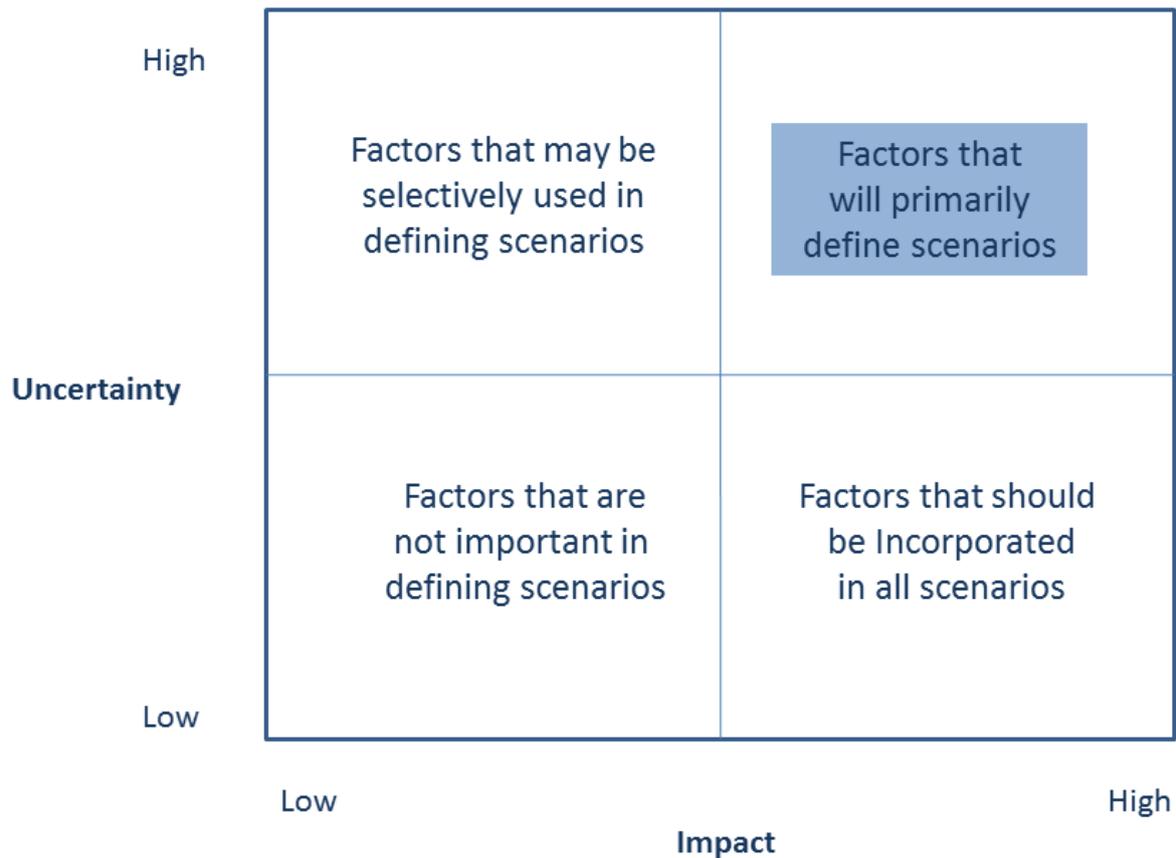


Figure 1: Impact/Uncertainty Grid (Source: Monitor Group) [21]

been achieved between 1998 and 2000. Egypt also reported that the national strategies for enabling this environment were extremely effective and will be continued in the coming years. These initiatives are only funded by the public sector. The private funding and public private partnerships will be started. The infrastructure and access to ICT was also rated to be very effective and will be continued. Localization and adaptation to the culture needs will be started. The capacity building programs are rated from moderately to very effective.

According to the WHO-Atlas of countries eHealth profiles published in 2011 [25], the country profile of Egypt describes the current status of using the ICT in the health sector in terms of eHealth foundation actions and the progress of eHealth applications in Egypt.

3.1.1 eHealth foundation actions in Egypt

The main eHealth foundation actions are partly taken in Egypt as follows [25]:

- Developing supportive eHealth policies;
- Establishing legal and ethical frameworks;
- Providing sufficient funding;
- Developing the required ICT infrastructure; and
- Health workforce capacity building in ICT

3.1.2 eHealth applications in Egypt

The WHO survey on eHealth applications conducted in 2009 covers telemedicine, mHealth, and eLearning. In this survey, Egypt reported that telemedicine enabling actions have not been implemented yet [25].

However, the Egyptian government represented by MCIT and MoH have initiated several eHealth programs to afford better diagnostic and health services to a wider segment of the Egyptian society. The MCIT role is facilitating the integration of ICT in health services and building the required ICT capacities in the health sector.

The main projects undertaken under the eHealth programs are [26]:

- Emergency Medical Service Call Center Ambulance Project
- National Network for Citizen Health
- Information System Units in Governmental Hospitals
- Pilot Project for Hospital Automation
- National Cancer Registry Program
- Information Technology (IT) Health Master Plan
- National Picture Archiving and Communication System (PACS) Project
- Integrated Health Record System
- National Healthcare Capacity Building Project
- Women's Health Outreach Program
- Regional Center for Women's Health in Alexandria

4 Telemedicine projects in Egypt

During the past 10 years, some telemedicine projects have been implemented in Egypt, for example:

- *Inter-hospital teleconsulting project between Cairo and Palermo*: established in 2002 between Italian Hospital Umberto I in Cairo and ARNAS-Civic Hospital of Palermo. The main aim of this project was to establish a health network for medical teleconsulting, in order to support diagnosis and treatment of relevant pathologies [27]. In addition, the project facilitates the exchange of the medical and epidemiological data on difficult clinical cases between the two healthcare organizations. This can eventually lead to the development of health data-banks which would be useful to biomedical research. Finally, the project would facilitate the exchange of medical knowledge (diagnostic-therapeutical protocols, guidelines, etc.) that were published at the project website.
In the first phase, the project covered the telepathology and telecardiology activities through the transmission of the medical images and ECG signals as a “second opinion” service. This service was provided in both “real-time” mode through the video-conferences sessions as well as in “off-line” mode by sending clinical information and signals to the project website for referrals and diagnosis.
- *Arab-African Telemedicine Network Initiative*: in 2002, MCIT and MoH asked the International Telecommunication Union (ITU) to lead this project in Egypt [28]. The main purpose of this initiative was to establish a multi-country telemedicine network to share the required knowledge and resources in preventing and treating the common diseases in the participating countries. The expected countries in the first phase of the ArtNet telemedicine network were Egypt, Ethiopia, Jordan, Libya, Mali, Morocco, Sudan, Tunisia, and Uganda. The first phase was also expected to link – at least – two medical centers in Europe and US. The ArtNet telemedicine network was designed to facilitate remote consultations in radiology and pathology as well as distance training and education.
- *Egyptian Telemedicine Network (ETN)*: in 2006, MoH in cooperation with MCIT started in building the Egyptian Telemedicine Network (ETN) [29]. The main plan of this network is to cover all the country (by adding more locations around the country). The first stage of the project included seven telemedicine units, namely, Nasser Institute (Main Site), Luxor International Hospital, Sharm El Sheikh Hospital, Benisoef General Hospital, Mahalla Cardiac center, Kom-Ombo-Aswan General Hospital, and Ambulance car Mobile Unit. These sites were equipped to provide a range of medical services, including radiology, electronic stethoscope use, tele-pathology and ECG. In 2007, two mobile units were set to enter into operation of the ETN and to be used primarily for breast cancer screening. However, ETN faced many problems in financial, legal, technological, capacity building, and sustainability issues after one year of functionality.

- *Saving children through tele-consultation in remote Egypt*: the case study of Siwa Teleconsultation initiative is an effective partnership between MCIT (through Egypt ICT Trust Fund) support, UNDP development knowledge of the country, the technical capacity of the Child and Adolescent Health Unit (CAH) of WHO-EMRO, and the private sector in Egypt [30]. This 1-year pilot project, lunched in 2009–2010, to connect Siwa main hospital with the Pediatric Department of the El Shatby Hospital in Alexandria. The initiative aimed at improving children healthcare services by providing tele-consultation in addition to lifelong professional training of doctors via eLearning techniques. The tele-consultation is effectively conducted between the physicians in Siwa and the experts from the pediatric department of Alexandria El Shatby Hospital via video-conferencing. On the other hand, continued medical education on real cases situations is offered to the students from the faculty of medicine of Alexandria University via eLearning technologies. Currently, 45 children benefited from the tele-medicine service.
- *TeleMedic@Egypt Project*: in 2009, Information Technology Institute (ITI) – MCIT started the TeleMedic@Egypt project funded by the Research, Development and Innovation Programme (RDI). The main aim of this project is to provide teleconsultation services for diagnoses treatment of infectious diseases, like hepatitis, for underserved regions in Egypt [31]. The main partners of this project are the Institute for Biomedical Engineering IBMT (Germany) and the Holding Company for Biological Products and Vaccines-VACSERA (Egypt). The project is mainly implemented in the Family Care Unit of Mahsma in Ismailia. This healthcare unit provides an integrated model for preliminarily preventive and diagnostic healthcare services with high quality as well as public health services.
- *Pan Africa Project*: started in 2009 in partnership of the MCIT, the regional center for health development, Alexandria University and Telecommunications Consultants India Limited (TCIL) [26]. The main aim of this project was providing Teleconsultations services through conducting video-conference sessions between the healthcare organizations in Alexandria and 12 hospitals in India. The project also provides eLearning programs as well as postgraduates’ scholarships opportunities in different specialties like, engineering, IT, and business management.
- *Women HealthCare Mobile Unit Project*: in 2007, MCIT in partnership with MoH launched the Women's Health care Outreach Program [26]. This project aimed to screen ladies above 45 years using fixed and mobile digital mammography imaging units. This service is provided in free of charge basis inside the project mobile vans. The pilot phase started with 4 mobile units and 1 fixed unit. By the end of 2010, the project was expanded to 10 mobile units and 11 fixed units.

The Radiology Information System (RIS) is used for registering the cases demographics before performing the mammography screening. Then, the generated Mammo Images are transmitted via ADSL or Satellite connection to the national radiology center of excellence. The capacity of the project is 50–80 cases per unit per day. Till now, more than 60,000 cases were checked.

The radiology consultants in the Center of Excellency use state of the art Picture Archiving and Communication System (PACS) and RIS system for diagnosing and reporting. The center is equipped with 5 MP workstations that are used to diagnose all the cases transmitted from the fixed and mobile units around Egypt. Reports are sent back to the units through internal private mailing system.

- *Egypt National PACS*: in 2010, the Egypt national PACS-RIS project was launched [26]. The system consists of the centralized PACS and RIS system in Fum El-Khalij ‘the main Center of Excellence’ and the participated hospitals, namely: El Khalifa general hospital, El Alameen emergency hospital in Marsa Matroh, Shark El Madina specialized hospital in Alexandria, Sharm Elshiekh hospital, Luxor General Hospital, and Hurgada General Hospital.

4.1 Problems and challenges facing telemedicine in Egypt

However, the majority of telemedicine projects in Egypt face many problems and challenges such as [29], [30]:

- Lack of patients’ awareness and acceptance of receiving healthcare services via telemedicine networks and applications
- Inability to sustain the functionality of the project due to shortage of both financial and legalization frameworks
- Lack of professional calibers as well as capacity building programs

These findings also match with the ITU study entitled “Implementing e-Health in Developing Countries: Guidance and Principles” published in 2008 [32]. This study summarizes the lessons learned in implementing telemedicine projects in the developing countries over 40 years (from 1960 to 2000). The overall results of such projects are very disappointing. See particularly section 7.1 of [32] on the traditional cycle of telemedicine projects, which in many ways seems to reflect the situation in Egypt.

5 SWOT analysis and future trends in telemedicine in Egypt

The methodology of developing the SWOT analysis and future trends in telemedicine in Egypt is summarized as follows (see Figure 2):

1. Analyzing the overall telemedicine opportunities and barriers in Egypt in light of the published reports of international organizations such as WHO and ITU (section 5.1).
2. Developing the SWOT analysis of telemedicine in Egypt through conducting workshops with experts in strategic management as well as healthcare stakeholders in Egypt from MCIT and MoH (section 5.2).
3. Identifying the future trends in telemedicine in Egypt using scenario planning techniques as described in the background section. Consequently, identifying the actions to be taken to align the developed trends in this study to the global trends in telemedicine (section 5.2 and section 5.3).

5.1 Telemedicine opportunities and barriers in developing countries

In 2010, WHO published a report on a systematic literature review of current state of telemedicine in developing countries [33]. According to this report, telemedicine offers many opportunities to developing countries which can be summarized as follows:

- Meeting the needs to deliver a better healthcare service in the underserved areas
- Reducing the expenses of travel costs (for both patients and specialists), time and effort
- Creating telemedicine networks to facilitate communications between rural areas and healthcare professionals worldwide
- Providing opportunities for professional development via eLearning
- Addressing the ‘neglected’ diseases in the developing countries by the international healthcare experts

However, there are many barriers that minimize the benefits of telemedicine in developing countries [29], such as:

- Insufficient infrastructure with an adequate bandwidth for telemedicine
- Unavailability of Internet connectivity outside large cities
- High cost of telemedicine solutions including equipments, transportation, maintenance and training
- Lack of skills, knowledge and recourses
- Socio-cultural barriers between industrialized world and developing countries

5.2 TeleMedic@Egypt workshops

The authors conducted three workshops during TeleMedic@Egypt project (described in section 4) to create the roadmap of telemedicine in Egypt 2010 including SWOT analysis and future trends.

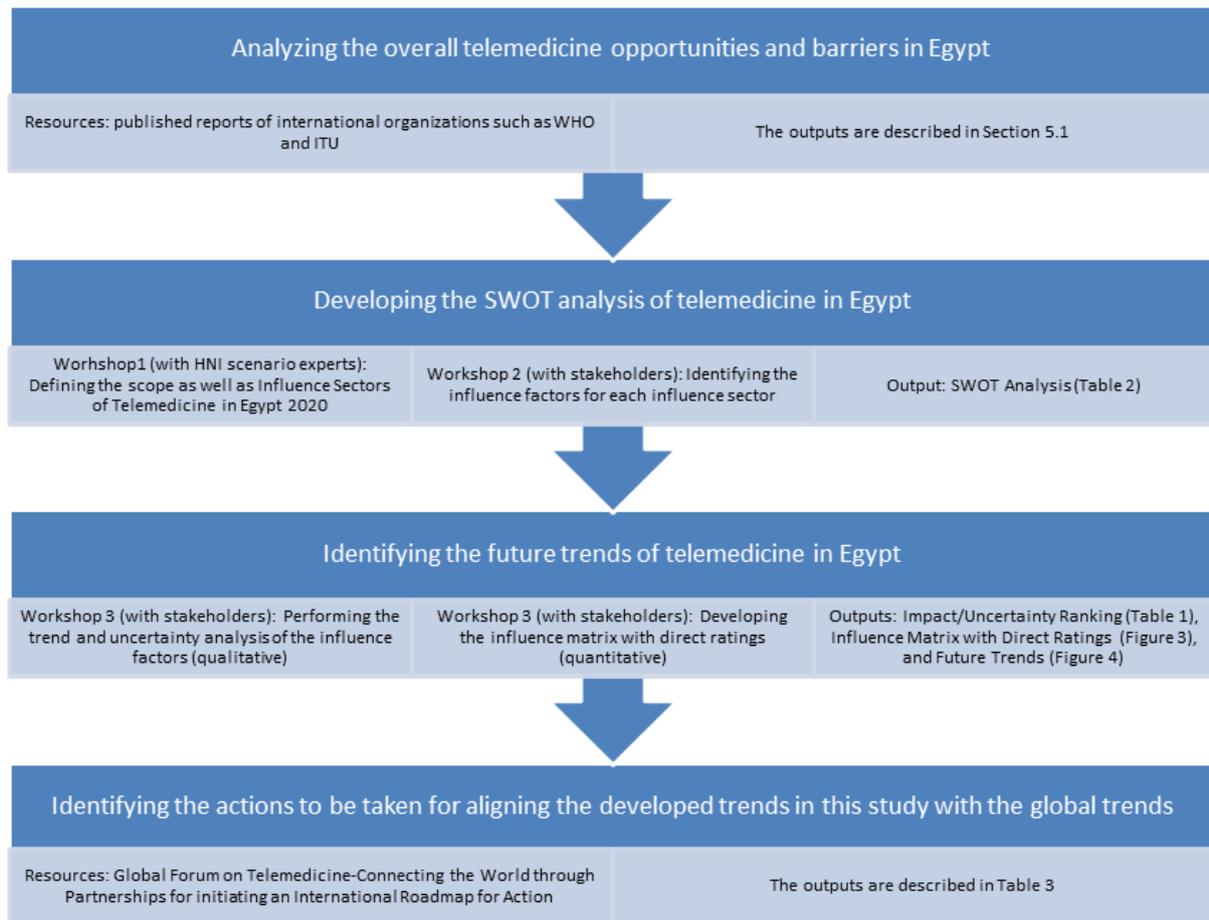


Figure 2: Methodology of developing the SWOT analysis and future trends in telemedicine in Egypt

5.2.1 Workshop 1: How to define telemedicine future trends and scenarios?

The first workshop was conducted in April 2011 with the innovation management academic staff of Heinz Nixdorf Institute (HNI) – Paderborn University, Germany. The main aim of this workshop was to share the HNI expertise on utilizing futures scenario techniques in telemedicine. This workshop was also based on Monitor Group’s white paper entitled “Telemedicine Scenarios and Implications” [21]. The output of this workshop was defining the influence sectors of telemedicine in Egypt 2020 as follows: economy, health, education & research, legalization, ICT, cultural and social aspects, human resources, and governmental policies.

5.2.2 Workshop 2: Identifying the influence factors for each influence sector

The second workshop was conducted in May 2011 with ten of the healthcare stakeholders. The output of this workshop was identifying 60 influence factors associated with the defined influence sectors. Then, the authors created the definitions of each influence factor. According to these definitions, the similar factors have been clustered into the final 26 influence factors as listed in the ‘Influence Factors’ column of Table 1 and the corres-

ponding associated influence sectors are listed in the ‘Influence Sector’ column.

Accordingly, the SWOT analysis was created based on those 26 affecting factors and grouped by the associated influence sector as listed in Table 2. In this analysis, the strengths and weakness of the current situation of telemedicine were analyzed versus the opportunities and threats of the future implementation of telemedicine in Egypt.

5.2.3 Workshop 3: Identifying telemedicine future trends in Egypt

The third workshop was conducted on June 2011. In this workshop, the definitions of the final 26 influence factors have been revised with the stakeholders. Then, the authors and stakeholders analyzed the impact and uncertainty of each influence factor. Each factor has been ranked in terms of [21]:

- its degree of impact on telemedicine (low/high), and
- the level of uncertainty surrounding it (low/ high).

The analysis results are indicated in Table 1. In addition, all influence factors are quantitatively analyzed using the influence matrix with direct rating to measure the impact of each factor on the other factors [18]. The results are shown in Figure 3. The factors with highest active sum values and highest passive sum values

Table 1: Influence factors impact/uncertainty ranking

Influence Sector	Influence Factors	Impact		Uncertainty	
		Low	High	Low	High
I. Economy	F1. Income per capita (patient, physician, nurse, technician, etc.)	X		X	
	F2. Cost of service (equipment, maintenance, SW, etc.)		X	X	
	F3. Funding Schemes & sponsorships		X		X
	F4. Currency flow worldwide	X		X	
	F5. Medical insurance, reimbursement, and National Medical ID	X			X
	F6. Disease profiles 2020	X		X	
II. Health	F7. Healthcare sectors (primary, secondary, etc.)	X		X	
	F8. New trends in medicine	X			X
	F9. Medical links (associations, hospitals, academics, individuals, etc.)		X	X	
	F10. Social education and awareness (patient empowerment)		X	X	
III. Education and Research	F11. Shortage of the trained staff		X	X	
	F12. Medical practice law (for eHealth)		X		X
IV. Legalization	F13. Commitment to Telemedicine (eGovernment)		X		X
	F14. Security, privacy and safety		X		X
V. Information and Communication Technology (ICT)	F15. Cloud computing		X		X
	F16. Infrastructure of networks		X	X	
	F17. Mobile technology		X		X
	F18. Interoperability and standards		X	X	
	F19. Medical devices technologies		X		X
	F20. Application: cross-platform, multilingual and user friendly		X		X
VI. Cultural and Social	F21. Social networks (Facebook, twitter, etc.)		X	X	
	F22. Millennial Generation (Generation Y): patients and physicians		X	X	
	F23. Social barriers	X		X	
	F24. Career changes		X		X
	F25. Certification and accreditation bodies	X			X
	F26. Telemedicine syndicate	X		X	
VII. Human Resources					
VIII. Governmental Policies					

Table 2: SWOT analysis for telemedicine in Egypt

Sectors	Strengths	Weaknesses	Opportunities	Threats
1. Economy	Cheap cost service provided at the governmental healthcare enterprises	Low income per capita affects access to telemedicine networks (Internet, iPhone, etc.)	Availability of international funding schemes (like EU, US aids)	Limited support from the government
		No national coverage of the medical insurance	Telemedicine business models & initiatives taken by the private sector, mainly, mobile operators	No sustainable business models for telemedicine
2. Health	Highly developed medical knowledge and practice	Lack of patient empowerment (through education, awareness, etc.)	Starting the reorganization "restructuring" of the healthcare sector	New disease profile for 2020
		Moderate medical links with international (associations, hospitals, academics, individuals, etc.)	New trends in medicine, e.g., preventative medicine, personalized medicine, etc. heavily utilize mobile applications	
3. Education and Research	Increased motivation for education and training on Biomedical Informatics	Lack of patient/social awareness and education programs	Availability of international research funding schemes	Unavailability of strategic plan to incorporate the Biomedical Informatics programs in the medical educational system
	Availability of some educational and life-long learning programs	Lack of specialized training of the medical staff	Availability of staff exchange programs	
4. Legalization	The Ministry of Health established regularly bodies, like: the Egyptian Drug Authority (EDA), hospitals auditing, etc	No laws of eHealth practice	Availability of many international experiences and case studies in telemedicine	No stakeholders' commitment to take responsibilities in utilizing telemedicine according to the regulations
		No regulatory framework for information security, privacy, and safety	Telemedicine could be a part of the eGovernment	
5. Information and Communication Technology (ICT)	An efficient ICT infrastructure in Egypt	Lack of adopting the international industrial standards for interoperability	Utilizing the Egyptian Cloud Computing Center of Excellence to launch telemedicine applications as services	Unavailability of the advanced medical devices "incorporated in TeleHealth networks" in the Egyptian market
	Highly competent calipers in ICT and mobile applications		Incorporating many initiatives for eHealth open source applications	Unavailability of cross-platform, multilingual and user friendly applications
	Availability of three mobile operators in Egypt		The Social networks (Facebook, twitter, etc.) can be highly utilized in the social awareness programs	
	Many Egyptian companies provide healthcare applications			

(Continued)

Table 2: SWOT analysis for telemedicine in Egypt

Sectors	Strengths	Weaknesses	Opportunities	Threats
6. Cultural and Social aspects	No cultural or social barriers towards ICT utilization (Internet, mobile technologies)	Fears of losing certain jobs when eHealth system will be deployed	The new generation of physicians and patients is very eager to utilize the new technologies	The old generations relatively resist the automation process
7. Human Resources	Availability of healthcare experts in all healthcare sectors	No initiatives for workflow reengineering to cope with telemedicine network and applications	Telemedicine provides new careers requiring professional skills	No experts' commitment to participate in telemedicine networks
8. Governmental Policies	Utilizing the eHealth programs undertaken by the MCIT and MoH for capacity building and applications development	Lack of benchmarking and evaluation schemes for telemedicine	Many governmental initiatives for ICT literacy, such as the IT clubs	No strategies for implementing eHealth at the national scale No commitment to adopt telemedicine

Influence Matrix [18]																											
Question: How Strong does the influence factor i (line) influence the influence factor j (column)?																											
Assessment Criterion: 0 = no influence, 1 = low influence, 2 =medium influence, 3 = strong influence																											
Influence Factors	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25	F26	Active Sum
F1	0	1	0	2	1	2	1	0	2	2	2	1	2	0	2	0	3	0	2	1	2	0	1	2	0	1	30
F2	3	0	2	2	2	1	2	2	2	2	3	0	2	2	2	3	2	3	3	3	1	1	1	1	3	1	49
F3	2	3	0	2	3	3	2	2	3	1	3	2	2	3	3	3	3	3	3	3	2	1	2	3	3	2	62
F4	2	2	2	0	2	1	1	0	2	1	1	0	3	1	2	1	1	1	1	2	2	1	0	0	0	1	30
F5	2	2	3	3	0	2	3	2	3	2	1	2	3	2	1	0	1	2	1	2	1	0	0	1	1	2	43
F6	2	1	3	0	3	0	3	3	3	3	1	1	2	1	1	0	1	1	1	1	1	0	1	1	1	1	36
F7	1	2	2	1	2	3	0	1	1	3	3	1	2	1	0	2	2	1	2	1	2	0	2	1	2	2	40
F8	2	1	3	0	1	3	0	0	3	3	2	3	2	2	3	1	1	2	2	2	1	0	1	1	1	1	41
F9	0	0	3	3	1	2	3	3	0	3	3	2	3	3	3	3	3	3	3	3	3	3	3	2	3	1	62
F10	1	1	3	0	1	3	3	3	1	0	2	1	3	3	3	1	1	1	1	1	3	3	3	2	0	0	44
F11	1	1	3	2	3	1	2	3	2	1	0	1	3	2	3	1	2	2	2	2	3	3	3	3	3	2	54
F12	0	1	3	0	2	2	2	3	2	1	3	0	3	3	3	2	1	3	3	3	1	0	0	1	3	3	48
F13	1	1	2	3	2	1	2	2	2	2	3	3	0	3	3	3	3	3	3	3	1	1	1	3	3	3	57
F14	0	1	3	3	3	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	1	0	1	2	3	0	51
F15	3	2	3	1	1	1	1	3	0	1	0	2	2	3	0	3	3	2	1	3	3	3	1	2	1	0	45
F16	2	3	3	2	2	0	1	1	1	1	0	2	2	3	3	0	3	2	2	2	3	3	1	1	1	0	44
F17	2	3	3	1	1	1	1	2	1	1	1	1	2	3	3	2	0	2	3	2	2	3	3	1	1	0	45
F18	0	2	2	2	3	0	0	3	3	2	0	3	3	3	3	3	2	0	3	3	2	1	0	1	3	1	48
F19	2	2	3	2	1	3	0	3	1	2	1	2	2	2	3	2	3	3	0	3	0	1	1	2	2	1	47
F20	2	2	3	2	3	1	1	3	1	3	2	3	3	3	3	3	3	2	3	0	1	3	2	3	3	1	59
F21	3	1	2	1	1	1	1	2	1	3	1	2	2	2	3	1	3	1	2	1	0	3	3	2	1	1	44
F22	2	2	1	0	1	1	1	3	1	1	1	3	3	1	3	1	3	1	3	3	3	0	3	3	3	3	50
F23	2	1	1	0	1	2	2	2	1	1	1	1	2	1	3	1	3	0	3	3	3	3	0	1	0	0	38
F24	1	2	3	2	2	3	3	2	1	3	3	3	2	3	0	3	0	3	2	3	1	0	0	2	2	2	54
F25	0	2	2	2	3	1	2	2	2	1	1	3	2	2	0	0	0	2	2	2	0	3	0	3	0	2	39
F26	1	0	1	1	0	0	3	1	1	0	1	2	1	0	0	0	0	1	0	0	1	3	0	3	3	0	23
Passive Sum	37	39	59	37	45	39	41	54	43	43	41	47	60	51	59	39	53	44	56	54	42	41	35	45	48	31	

Figure 3: Influence matrix with direct ratings

of this analysis are examined with the factors with highest degree of impact and highest degree of uncertainty obtained from the trend and uncertainty analysis. The results of both techniques are matched with each other.

As described in Figure 1, the factors located in the upper right corner of the impact and uncertainty grid primarily define the futures trends. Accordingly, these factors are clustered into four different future trends for implementing telemedicine in Egypt (see Figure 4). Each future trend can be driven by one of the main Egyptian sectors, such as, the government, private sector, ICT sector, or medical sector. Meanwhile, the other affecting factors are also incorporated in these trends as follows:

Trend #1: Telemedicine is a part of the Egyptian eGovernment (governmental perspective)

In this future trend, the government will adopt a plan for the national medical insurance to generalize the national medical identifiers as well as telemedicine reimbursement policy. Accordingly, the laws of eHealth practice will be issued. The Ministry of Health will work on restructuring the healthcare system as well as developing the required regulations to guarantee the commitment to adopt telemedicine. Above all, certification and accreditation bodies for telemedicine should be established.

Trend #2: Telemedicine is driven by the Egyptian private sector (financial perspective)

In this future trend, the Egyptian industry will create an innovative telemedicine business model. This model will be mainly supported by the national income and the available funds & sponsorships. Public Private Partnership (PPP) models can be also supported in this trend.

Trend #3: Telemedicine is driven by the Egyptian ICT Infrastructure (technological perspective)

In this future trend, the powerful ICT infrastructure as well as the national cloud computing initiative in Egypt will be efficiently utilized in telemedicine networks. The Ministry of Communications and Information Technology will work in adopting the international industrial standards to guarantee the required interoperability within the eHealth systems.

Trend #4: Telemedicine is driven by unexpected circumstances (medical perspective)

In this future trend, telemedicine will be driven by unexpected diseases profile as well as new trends in medicine that necessitate using telemedicine as an efficient tool for experts networking. This trend can be also driven by emerging new careers and/or career changes due to deploying eHealth systems.

In all trends, the following factors will play an essential role in adopting telemedicine:

- Overall cost of the provided service including, equipment, maintenance, software, etc.
- ICT infrastructure: networks, Internet, mobile, etc.

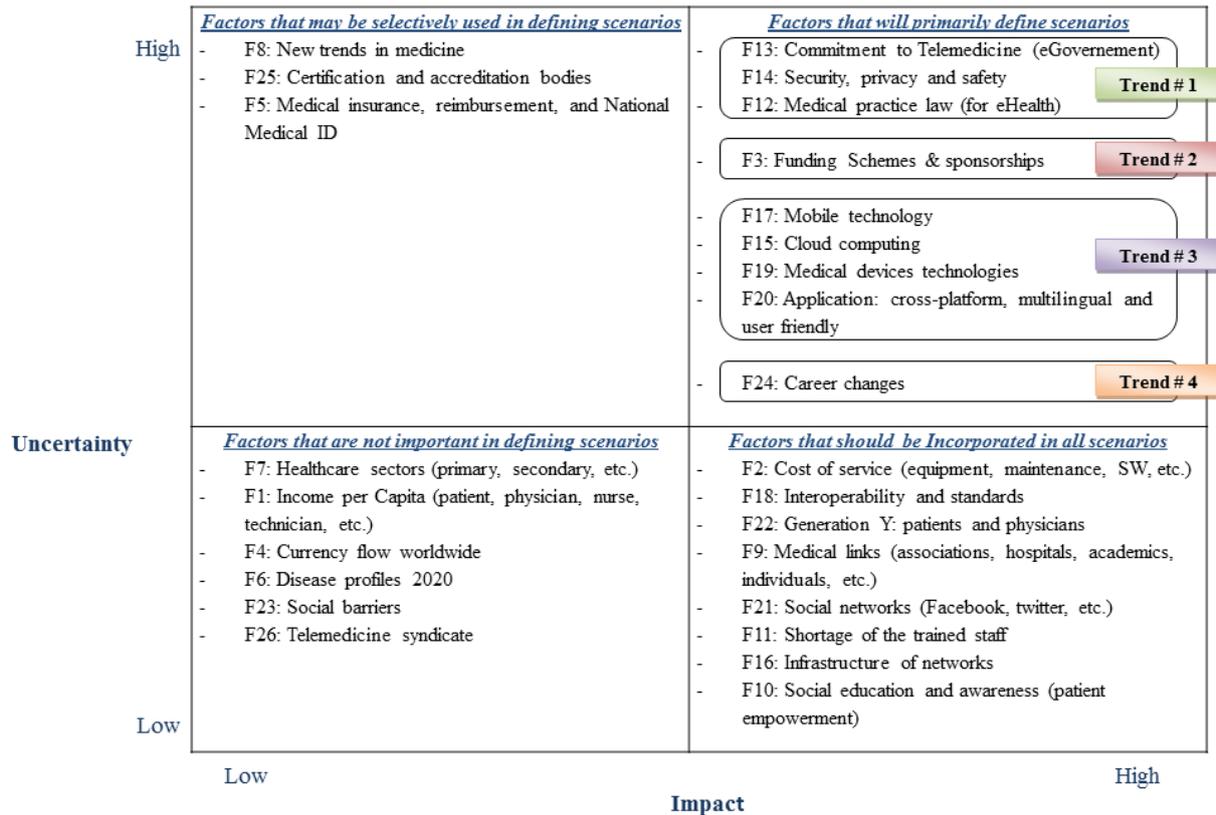


Figure 4: Influence factors ranking – future trends

- Interoperability of the Egyptian Telemedicine Networks with the international eHealth Systems.
- New generation – of patients and physicians – who is familiar with Internet, mobile technologies, and social networks.
- Availability of strong medical links (associations, hospitals, academics, individuals, etc) for providing consultation and sharing second opinion in addition to clinical expertise.
- Patient empowerment: public eHealth education and awareness.
- Social networks (Facebook, Twitter, etc.) as an effective tool for telemedicine awareness campaigns.
- Availability of professional calibers and trained staff.

5.3 Aligning telemedicine in Egypt to the global trends

In 2008, ATA organized the Global Forum on Telemedicine: Connecting the World through Partnerships for initiating an International Roadmap for Action [34]. This was achieved through bringing together the key stakeholders in global healthcare outreach. The main goal was to define a framework and a sustainable business model in order to leverage telemedicine through governmental and Non-Governmental Organizations (NGOs). This forum included five panels, namely:

- Panel 1 – Component framework: The NGO perspective: understanding the mission, challenges and opportunities for international outreach.
 - Panel 2 – Financial sustainability: funding, financial models, reimbursement, and grants – opportunities and challenges in international outreach.
 - Panel 3 – Government/military perspectives: challenges and opportunities for humanitarian missions.
 - Panel 4 – Disaster Relief: Outreach for health emergencies and disaster response.
 - Panel 5 – The co-creation environment: current and emerging opportunities for development and partnership in international telemedicine outreach programs.
- Table 3 lists the suggested actions to be taken to align the future trends in telemedicine in Egypt to the global trends identified during the ATA global forum.

6 Discussion and Recommendations

Fortunately, there is a great opportunity for the provision of telemedicine in Egypt according to these enabling factors:

- An effective ICT infrastructure all over the country
- The concept of telemedicine has been proven through MCIT/MoH cooperation in various eHealth projects
- Wide use of mobile technologies and applications
- Availability of both ICT and healthcare capacities

Table 3: Aligning telemedicine in Egypt to the international trends

International Trend [34]	Actions to be Taken
1- Component framework: The NGO perspective: understanding the mission, challenges and opportunities for international outreach	<ul style="list-style-type: none"> - Emphasize the role of the Egyptian NGO community in leverage the potential of telemedicine - Establish partnerships with the Egyptian NGO to adopt telemedicine and develop a framework for incorporating telemedicine applications into the respective programs - Participate in the international telemedicine forums
2- Financial sustainability: funding, financial models, reimbursement, and grants: opportunities and challenges in international outreach	<ul style="list-style-type: none"> - Map activities with Trend #2: Telemedicine is driven by the Egyptian private sector (Financial Perspective) - Develop new funding models to facilitate the public and private partnerships in Egypt - Encourage more participation in EU funding schemes for research and innovation, especially in the public health domain
3- Government/military perspectives: challenges and opportunities for humanitarian missions	<ul style="list-style-type: none"> - Map activities with Trend #1: Telemedicine is a part of the Egyptian eGovernment (Governmental Perspective) - Develop national surveillance portals for public health utilizing the ICT infrastructure in addition to Geographical Information Systems (GIS) applications - Establish a dialogue and cooperation mechanisms between Public Private partnerships and NGO - Establish more cooperation with international agencies like WHO - Conduct more human capacity building programs and awareness campaigns
4- Outreach for health emergencies and disaster response	<ul style="list-style-type: none"> - Map activities with Trend #4: Telemedicine is driven by unexpected circumstances (Medical Perspective) - Develop integrated eHealth initiative involving all healthcare stakeholders - Integrate the international telemedicine initiatives, networks and projects
5- The co-creation environment: current and emerging opportunities for development and partnership in international telemedicine outreach programs	<ul style="list-style-type: none"> - Map activities with Trend #3: Telemedicine is driven by the Egyptian ICT Infrastructure (Technological Perspective) - Develop a national regulatory system of telemedicine in accordance to the international standards - Develop an evaluation framework for telemedicine initiative in Egypt

This work utilizes scenario planning techniques to provide a roadmap for the future telemedicine in Egypt. The main advantages of the used methodology are: identifying the scope of telemedicine in Egypt 2020 covering multiple sectors and facilitating the development of the telemedicine future scenarios. This will eventually encourage the governmental to adopt an national eHealth initiative based on a methodological strategy as well as a robust monitoring/evaluation framework.

From national and international experiences, the most efficient future trend will be Trend #1: Telemedicine is a part of the Egyptian eGovernment (Governmental Perspective). This is because; the governmental support will facilitate the following:

- Establishment of the required technical and legal framework of telemedicine in Egypt
- Establishment of a well defined business model based on Public Private Partnership (PPP) models
- Participation in eHealth international projects and initiatives

Furthermore, this section summarizes the recommendations to facilitate telemedicine development in Egypt based on the ITU studies performed in 2008 [32], and WHO studies performed in 2010 [33]. These recommendations are grouped in two categories:

- Recommendations to facilitate telemedicine development in Egypt in terms of: governance; policies and strategies; and scientific development and evaluation. These recommendations will have a high impact in establishing an enabling environment of eHealth in Egypt, especially when adopting Trend #1: Telemedicine is a part of the Egyptian eGovernment (Governmental Perspective).
- Recommendations to overcome barriers to telemedicine development in terms of: cost and infrastructure; and information needs. These recommendations will

Table 4: Suggested performance indicators to monitor the telemedicine development in Egypt

Influence Factors	Proposed Performance Indicators
F2: Cost of service (equipment, maintenance, SW, etc.)	Total cost of the provided service
F9: Medical links (associations, hospitals, academics, individuals, etc.)	Number of medical links incorporated in the national telemedicine network
F10: Social education and awareness (patient empowerment)	Extent of patients' acceptance
F11: Shortage of the trained staff	Availability of professional staff (number of trained staff and available training programs per governorate)
F13: Commitment to Telemedicine (eGovernment)	Degree of commitment to telemedicine
F15: Cloud computing	Extent of service availability across Egypt
F20: Application: cross-platform, multilingual and user friendly	Availability of various applications covering different specialties
F25: Certification and accreditation bodies	Number of the certified health organization and their distribution among the Egyptian governorates

have a high impact in establishing a clear practice model for telemedicine in Egypt, especially when adopting Trend #3: Telemedicine is driven by the Egyptian ICT Infrastructure (Technological Perspective).

Moreover, some of the influence factors can be also utilized in identifying potential key performance indicators to monitor the telemedicine development in Egypt as suggested in Table 4.

6.1 Recommendations to facilitate telemedicine development

A. Governance

- Establish a national-level body of eHealth to coordinate the national eHealth initiatives in Egypt in context of: interoperability, cost-effectiveness, performance, monitoring and evaluation framework (including output indicators as well as measures timeframes), and integration to the national health system.
- Promote an enabling eHealth legal environment through developing the required legislative frameworks and administrative rules.
- Consider long-term strategic plans to develop and implement eHealth services (including telemedicine).

B. Policies and strategies

- Adapt a national policy for eHealth according to the local context in which all stakeholders are engaged at all levels: government, private sector, community, health professionals, academic institutions, health administrators, and policymakers.
- Ensure responsiveness to local demand by implementing a national eHealth system to solve health problems

and improve the local healthcare services and medical priorities.

C. Scientific development and evaluation

- Support and fund research projects in telemedicine with international partners covering telemedicine methodologies, technologies and overall system evaluation.
 - These projects must be aligned to the national eHealth strategies rather than developing ad hoc solutions.
 - The size and scope of all eHealth projects should be strongly related to their objectives and resources.
 - All eHealth projects should have an alternative backup plans 'Plan B' to guarantee the continuity of providing the healthcare service in case of projects failure.

6.2 Recommendations to overcome barriers to telemedicine development

A. Cost and infrastructure

- Invest in cost-effective multipurpose telemedicine projects and applications utilizing the Egyptian ICT infrastructure.
- Develop professional business plans and allocating financial resources through Public Private Partnership (PPP) models in cooperation with NGOs and international bodies. In this way, all required expertise is shared to successfully implement and run the eHealth projects.

B. Information needs

- Ensure the engagement of all stakeholders from ICT and health sector to discuss how telemedicine can improve health care delivery and how to sustain the eHealth initiatives.
- Establish national programs for capacity building of healthcare professionals on eHealth and telemedicine solutions.
- Strengthen the role of new generation, international bodies, and the NGOs in guiding the healthcare staff during the change process.

7 Conclusion

Telemedicine can play an essential role in solving the global challenges facing the health systems. Particularly, when telemedicine is being a part of the national health strategy.

In Egypt, various socio-economic applications in eGovernment, eBusinesses, and eLearning have been developed. However, telemedicine and eHealth applications are still not optimally deployed due to many common reasons, such as:

- resistance to change (which faces many of health informatics applications);
- unclear business model for telemedicine i.e., which services could be provided, who will pay and how much will be paid;
- unavailability of an efficient infrastructure for telemedicine (high bandwidth and the special equipment) in the rural areas; and
- unavailability of regulatory bodies for: accrediting telemedicine eHealth systems and healthcare organization, issuing best practices and guidelines, certifying the medical staff, etc.

Accordingly, telemedicine involves many advantages along with great challenges. Therefore, this work provides an overall roadmap for telemedicine in Egypt in terms of four different trends, representing four different perspectives, namely, governmental, financial, technological, and medical perspectives. These trends are also strongly aligned to the global trends in telemedicine. Lastly, the main recommendation of this work is to incorporate telemedicine into a national eHealth initiative to guarantee success and sustainability.

Notes

Acknowledgement

This work is a result of the research project "Tele-Medic@Egypt" funded by the Research, Development and Innovation Programme (RDI), Grant Contract Number: C2/S1/95 – MED/2009/213-554.

The authors gratefully acknowledge Heinz Nixdorf Institute (HNI) team, University of Paderborn for their valuable lectures on scenario techniques. Special thanks to Mr. Christoph Peitz and Mr. Niklas Echterhoff for their guidance regarding creating the influence matrix with direct rating. The authors also acknowledge Prof. Dr.-Ing. Jürgen Gausemeier, HNI, for his remarkable contributions in strategic planning and innovation management. Special thanks to Dr. Tarek Kamel, the Former Minister of Communications and Information Technology, for his remarkable contributions in building the Egyptian information society.

Competing interests

The authors declare that they have no competing interests.

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Please cite as

Hussein R, Khalifa A. *Telemedicine in Egypt: SWOT analysis and future trends*. *GMS Med Inform Biom Epidemiol*. 2012;8(1):Doc01. DOI: 10.3205/mibe000125, URN: urn:nbn:de:0183-mibe0001256

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Published: 2012-06-19

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