



# A Proposed Framework for Developing an Electronic Medical Record System

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## ABSTRACT

The deployment of an electronic medical records (EMR) raises several important issues. Those addressed in this study are the access to such a system, the satisfaction on the security and authorization protocols to follow, the awareness of backup and recovery mechanisms in place, and the appreciation of the training of the IT staff. This qualitative study took place in the natural setting of the medical units' environments. A purposive sample of 40 professionals in Greece and Oman was used. The study underlines that the patients should have access to their records, whereas for the pharmacists the professionals' views are seriously divided. Every other person's access to such a record should be restricted and recorded. The professionals are satisfied with the security level, the ICTs training, and the backup and recovery mechanism in place. They almost all admitted there is an authorization schema followed to access the EMR. The main contribution of the study is the proposal of a framework of policies and procedures for the development of such a system.

## KEYWORDS

Access, Electronic Medical Records (EMR), Framework, Qualitative Study, Security, Stakeholders

## INTRODUCTION

An Electronic Medical Record (EMR from now on) is a patient's record of personal medical information used for the diagnosis and treatment of the medical problem itself. It may be available either on- or offline and used for a variety of purposes even some related purely to research studies (Fritz, Balhorn, Riek, Breil, & Dugas, 2012). The ideal system should be flexible and easy to use for each type of user and different medical environment (Xanthidis & Aleisa, 2012; Yoo et al., 2013).

Since 2004 when the, then, President of the U.S.A. called for the adoption of computer-based medical records, there is a significant progress in the U.S.A. of medical units gradually transitioning from the traditional paper-based to the EMR (Boland et al., 2013; Chiang et al., 2008). Similarly, in Australia since 2012, every resident may opt-in into his Personally Controlled Health Record (PCEHR) (Lehnbom, McLachlan, & Brien E, 2012). In Seoul National University's Bundang Hospital in South Korea, a fully digitalized general hospital with an in-house integrated EMR is in place. In order to develop it they studied for 3 years the issues to be considered in the design process aiming to have a successful next generation EMR system (Yoon, Chang, Kang, Bae, & Park, 2012). There are, also, countries from different cultures, like Iran, with their medical professionals studying other countries' experiences being concerned about the model most suitable to follow to ensure the confidentiality of EMR information (Farzandipour, Ahmadi, Sadoughi, & Karimi irajk, 2011).

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In general, many developed and developing countries either have already or are in the process of formulating policies to follow when adopting such systems. For the development of such a system, it is necessary to identify its stakeholders, i.e., professionals involved with or interested in such a system. They can be at different levels in various positions in the health organizations or the society such as Federal officials, State officials, Hospital & Health Centers Managers, IT staff and not just the patients and the medical practitioners (Hernández-Ávila et al., 2013; Yoo et al., 2013). It seems difficult to find in the bibliography a set of recommendations on policies for the development of a framework for the deployment of such an EMR system.

This study attempts to bridge this gap by providing the model of the association of the stakeholders of such a system as well as suggesting a framework of policies and procedures for its deployment.

## BACKGROUND

The Department of Health and Human Services (HHS) of the U.S.A. defines EMR as “an electronic record of health-related information on an individual that is created, gathered, managed, and consulted by authorized clinicians and staff”. It is a patient’s computer-based record, stored in a database system and transmitted securely, with information about the patient such as demographics, medical and family history (Federal Register, July 28, 2010). It can contain medication information and electronic documentation from previous examinations to help reduce time, cost and mistakes and increase the quality of medical services and it can be accessible by many authorized users (Federal Register, July 28, 2010; Jha, DesRoches, Kralovec, & Joshi, 2010; Saitwal, Feng, Walji, Patel, & Zhang, 2010). The Institute of Medicine reports that medical errors may be responsible for 44,000 to 98,000 deaths per year in the U.S.A. (Chiang et al., 2008). Therefore, there is, also, a need to improve both the quality of healthcare services as well as its security by establishing an EMR free from errors.

Medical practitioners are the most important players in the health sector. They may be regular medical doctors, family doctors, medical consultants or senior doctors (Tan, Phang, & Tan, 2009). They may, also, be physiotherapists because the EMR meant a significant change to their documentation practices (Rojas & Seckman, 2014), or even students of the medical profession as they will be the future users of the EMR (HYGEIANet, 2004). They are the critical users as they can identify and maintain a record, manage the patient’s history, diagnose past and current health problems, prescribe medications and medical examination, receive results of medical examinations from the labs, and after a diagnosis, send electronically to the pharmacy the electronic prescription, therapy treatment and care plans, and guidelines (American Academy of Family Physicians, 2015).

Nurses are the largest group of medical employees and a very important part of the core team. They are the main users of the patient records (Rojas & Seckman, 2014), responsible for finding and recording patient data saving a lot of time for the physicians. They take care of the patient and design care plans, arrange future appointments for medical purposes of all sorts, print special forms with patients’ information and ensure these functions are completed at a satisfactory level with the privacy and security of the patients being always in their focus (Anders & Daly, 2009; Bossen, Jensen, & Udsen, 2013).

Other medical staff like the Paramedical and the ambulance system operators can save time and lives in an emergency case when they have direct access to the patient’s record (HYGEIANet, 2004). The front office staff, like administrators and secretaries, can schedule any kind of appointments, check-in patient, print forms, and send electronic alerts to a physician, to a patient, to labs, to pharmacies or even to the financial department if they have easy access to the patient’s EMR. The financial staff is responsible for generating a list of codes for billing, contact with patient for financial bills and contact the insurance for patient’s coverage (Bossen, Groth Jensen, & Witt, 2012; Bossen et al., 2013; [nyc.gov/health](http://nyc.gov/health), 2015).

The pharmacy system has a major role to play in an EMR system. It includes the pharmacists, their technicians and other staff serving in it (Tan et al., 2009). Through a comprehensive EMR, the

pharmacists can take an order with no mistakes and with their knowledge about medicines, allergies etc. deliver the medicines with safety.

A physician may send an order electronically requiring for some lab tests. The lab receives the order and sends back electronically the results to the physician. These results could be laboratory tests, radiology or cardiology images/results, etc. Thus, the likelihood of missing results is very small. Also, all results are available on screen in front of the medical team for diagnosis or for follow up with the patient, especially in the case of chronic diseases (Kasoff, 2012).

An insurance company covers the patients' costs for medical treatment such as laboratory tests and prescriptions. Insurance looks closely into the patients' care costs. Additionally, with a link to the laboratory tests and the medication prescription, using statistics they can find out which treatment is most effective and hopefully less costly (ICSA Labs, 2010; Safran et al., 2007).

The IT specialists and the hospital administrators are, also, involved. The IT experts have to work as a team to implement a comprehensive EMR system and are responsible for its maintenance. This team usually consists of the systems analysts and programmers, the database administrators and the IT security experts (e.g. network administrators and telecom specialists) (Hernández-Ávila et al., 2013; Shah, 2010; Wager, Lee, & Glaser, 2005).

The International bodies have a very significant role to play as well. They might include such organizations as World Health Organization (WHO), the department of HHS of U.S., the HITECH and the European Commission. WHO has the authority for the coordination within the United Nations of health matters and the responsibility for global health by providing technical support and shaping the health agenda. The organization published, in 2006, a report with a general overview that guides the move towards the implementation of an EMR system (World Health Organization, 2006).

The medical unit administrators and health care providers have invested heavily aiming to offer to their physicians and other users of these systems all their benefits. Sometimes they recommend the purchase of such systems from outside vendors while in other cases they encourage and financially support the in-house development of such systems that will include at least the necessary tasks described under the "umbrella" term "meaningful use" (European Union, 2015). They are the ones appointed to run and monitor the correct application of policies and procedures in the medical units they are responsible for.

Governments and Policy makers are forming policies and guidelines to improve the quality of health, reduce the per capita cost. They are the bodies that encourage the medical units to move forward in adopting EMR systems that will improve the usability of the health system and educate the actors, users, stakeholders to deliver a high quality of healthcare (European Union, 2015).

The above users can be categorized in four groups. The first group includes the medical doctors, the nursing practitioners and other medical staff. The second group includes the pharmacy system, the medical labs and the health insurance system. The various types of IT experts, i.e. the database administrators, network and security experts, and the analysts and computer programmers are parts of the third group whereas the international bodies, the medical unit administrators and the government policy makers belong in the fourth group.

The above are the groups that many professionals in the health sector accept, however, many others argue against these groups and/or their association. There are arguments that say the patients must have access and control over their own medical information to become more responsible and active (Passarani, 2013). Additionally, some believe the pharmacists should have access to these EMRs. Others, from different professions, believe otherwise as to the level of access of patient to their medical record as probably s/he is the one who is going to give any kind of access to the other users of the EMR system.

## METHODS

The aim of this research is to identify the EMR's stakeholders and their associations, and propose a framework for developing such a system. This study follows the qualitative approach since, by its nature, it seeks to reveal and explain the health professionals' viewpoint on the core theme. This is why, as explained later in this section, convenience and snowballing were the sampling methods adopted. A semi-structured interview was the instrument of choice fitting the type of research of this study.

### Data Collection

Forty (40) interviews were conducted for the study. Of those, 32 were in person in the natural setting of the interviewees' health environment, i.e., in the health unit itself (Cooper & Schindler, 2014; Creswell, 2013; Creswell & Poth, 2017; Fink, 2017) and 8 via email (Meho, 2006) because of technical difficulties.

The data collection process was as follows for the in-person interviews:

- First, an introductory letter was given to the interviewees (labeled "UM Confirmation Letter") explaining the study, its purpose and the organization it originated from (the University of Malaya) (Creswell & Poth, 2017),
- Second, the researchers explained the procedure of the study step by step, (through a "Letter of Invitation") (Creswell & Poth, 2017),
- Third, the interviewees were asked (and all of them agreed) to sign the "Letter of Intent – Confirmation" which included their name, position, organization, phone, email, signature, and date (Creswell & Poth, 2017),
- Fourth, the interviewees were asked for permission to record the conversation (Creswell & Poth, 2017),
- Fifth, the transcript of the audio recording was made available to the interviewees to confirm through email. This was done for reliability purposes (Creswell & Poth, 2017).

For the online interviews, the process was the same but was conducted through emails and without audio recordings.

### Instrument

The researchers intended to ask the professionals in the health sector for their personal experience and allow them to freely express it as open and as deep as they wanted. Due to the nature and depth of the research questions it was decided to follow the qualitative research approach. Based on that an in-depth interview was decided to be used (Cooper, Schindler, & Sun, 2014) instead of a public survey that would not offer any new insights on the subject.

The topics and research questions under discussion were carefully chosen in such a way as to ensure triangulation when validating the contents of the instrument (Sousa, 2014):

- The research questions in the interviews came from the deep literature review (Straub, 1989),
- The interview questions were moderated as to their content and structure by 5 academics from different countries and universities,
- After the moderation, 6 pilot interviews took place one from each of the different types of experts in the two countries Greece and Oman. During these pilot interviews (Lewis, Snyder, & Rainer Jr, 1995), after every research question, the interviewee was asked a question on the content validity (following the qualitative research methodology). The question was: "How would you evaluate the question as to its relation to the topic discussed? Not relevant, Important but not essential, and Essential.

- At the end of the pilot interviews, one more point was asked to be clarified by the interviewees, i.e. if the interview missed something from the literature review or their personal experience which they would like to see in the instrument interview questions and further comment on it.

## Sample

The geographic scope of this research are the two countries Greece (developed) and Oman (developing) (World Economic Situation and Prospects, 2012). These countries have dramatically different cultures and religious backgrounds which would make it interesting to see the various approaches on the subject of EMR (CIA Central Intelligence Agency, 2016). Hence, the authors achieved, even though in a limited way, their goal to study a European Union country and a GCC Muslim country.

In order to secure that a balanced sample of the different groups of users are represented, it was decided to select individuals from each of the different groups above. These individuals had to be as highly ranked as possible to be able to provide deep insight and experience on the questions asked. These high-ranking professionals were an administrator, a medical doctor (MD), a nursing practitioner, someone either from the Lab or from the Pharmacy, an ICT expert, and a legal/lawyer or quality assurance.

The sampling process had to follow two different approaches. Initially, it was purposive because it was necessary to seek, find, and approach these professionals (Barbour, 2001; Cooper et al., 2014). For this reason, a number of large medical organizations were contacted, both in Greece and Oman, to try and reach the CEOs or highest administrator officers in these units. The purpose was two-fold, i.e., to get these individuals' permission to conduct the interviews in their hospitals and, if possible, to interview even them. Then, the sampling approach changed to snowballing (Barbour, 2001; Cooper et al., 2014). This means the administrative officials lead the researchers to the most appropriate and highest-ranking officials of the other categories.

An effort was made to conduct a balanced number of interviews from the two different countries, from the public and the private sector and from the different professions. The results, in number of interviews, are detailed in Table 1.

Table 1. The interviews by country, type and profession

By country	By type of the medical unit	By profession
<ul style="list-style-type: none"> <li>• Greece: 26 (4 hospitals)</li> <li>• Oman: 14 (2 hospitals)</li> </ul>	<ul style="list-style-type: none"> <li>• Public: 20</li> <li>• Private: 20</li> </ul>	<ul style="list-style-type: none"> <li>• CEO/Admins: 7</li> <li>• MDs: 7</li> <li>• Nurses: 7</li> <li>• Lab/pharmacists: 7</li> <li>• ICTs: 5</li> <li>• Legal/lawyer: 7.</li> </ul>

## FINDINGS

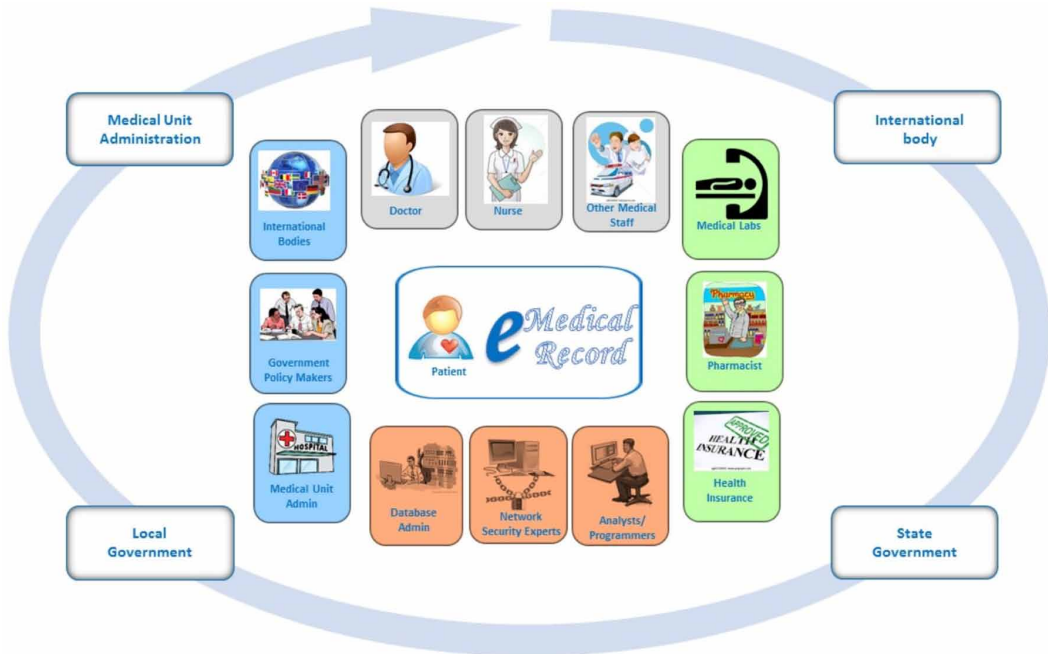
### Stakeholders

The first point of the study was the confirmation, by the professionals, of the users, their groups and their possible level of association with the EMR. Although, it is difficult to have a unanimous verdict, however, Figure 1 (Xanthidis & Koutzampasopoulou Xanthidou, 2019) largely illustrates a common ground that all of them, more or less, agree upon. This figure can be very important for two reasons. One, it can help the hospital management to divide its personnel into these categories and formulate

policies and procedures for each one of them. Two, it can guide the ICTs through the process of developing an EMR system and giving different access rights depending on the type of the user.

Figure 1 does not illustrate, though, the minor dispute between several professionals from different categories that the medical doctors should be separated as a distinct category apart from the others. Also, it cannot show the view of some of them that the medical labs experts should be included in the same category with the medical doctors and the nurses.

Figure 1. Model of the stakeholders of the EMR



The circle shows that for some professionals the international bodies, the government policy makers and the medical unit administrators should be the first, since everything starts from them. On the other hand, many others place them as last and they observed the first are the medical doctors and the nursing practitioners, since they are the first who are involved with the EMR and the patient. In any case, it is important to note that the association between the professionals related to the EMR follows a cyclical model.

The study showed that almost all the professionals believe the patients should have access to their medical records, one way or another, either directly or through their personal MD. It is simply their legal right. On the other side, the opinions about the pharmacists having full, or restricted, or no access are, seriously divided. This is a very serious, sensitive and complicated issue. The general public is not educated and experienced enough to understand the consequences of one decision or another on the matter. This is why there must be a legal framework of clear policies and procedures that everyone, ideally worldwide, adheres to. At least, it is important that the hospitals have such policies that the management formulated and, hence, when the ICTs develop the electronic medical record information system, they should keep in mind these policies.

## Contents and Structure of The EMR

This study resulted in several interesting conclusions regarding the contents and structure of the EMR. First, as far as the demographics are concerned, they should be divided into different categories not all of them accessible and/or visible by all users of the EMR. The most sensitive information would not appear in the first level and the users would not have to spend time to go through all of it. Not all the stakeholders can have the same level of access in the system. The elements race, religion, income level and education level, which are sensitive information and usually more useful for statistic reasons, should be in the sensitive information category, or not appear at all (Koutzampasopoulou Xanthidou, Shuib, Xanthidis, & Nicholas, 2018).

A particular category like 'eating habits' or 'life style' should be included in the system, as some of the professionals insist. This kind of information, i.e., smoking, night life, special nutrition, vitamins, etc., sometimes, is very important since these 'habits' have different interactions with some treatments. Given these the MD could provide better health care to the patients and avoid mistakes that are related to the elimination of the effects of a medicine because of these behaviors.

All the interviewees agreed it would be better if the implementation of such a structure is following an open architecture. This means that the medical units can start with something at a small scale, probably at a basic level, review it, experience it in real life and gradually develop it to a larger scale system. Furthermore, an open architecture allows changes depending on the needs of each medical department even in the same hospital.

All professionals agreed with the implementation of such a system. Since it needs a serious budget to implement, the management people cannot overlook or underestimate the financial issues. On one hand, the main argument is that money is not everything, human health is. On the other hand, money is not limitless. When, almost always, there are budgetary constraints for running a medical unit, there is an unfortunate demand to limit spending in certain categories of expenses as much as that is possible. As some professionals said, you cannot spend all you have in just one category but have to balance it horizontally among all categories of needs. This is especially so in the case of public units supported by the government and gets tighter if the country is in economic recession, like in the case of both Greece and Oman.

Finally, concerning the concept of sharing the medical records, most of the professionals agreed it should be done either under authorization or even without. The idea of sharing would help not only the patient but the international research efforts since it could provide very valuable statistics. Special attention should be given, though, so that there is no sharing of patients' personal information but just their medical data. However, it should be noted that there is a very thin line, difficult to see, that separates one from the other and, often, it is a matter of interpretations. Eventually, no matter if the patient's medical record is in a medical unit system or in a national one, it always belongs to the patient him/herself and s/he is responsible to make these decisions.

## Security Issues

All the professionals, although feeling somewhat insecure, recognized that access to the EMR from different stakeholders should be either restricted or full and agreed it should be recorded. The medical record is very sensitive and must be confidential. Therefore, the health information systems that implement it should have provisions that ensure the different levels of access and record the history of that access. In open societies, like Greece, this is important since it helps safeguard the personal information of the patients despite the tendency of the society towards less privacy and more efficiency and comfort. In developing countries, where education is still a target, it would be probably more preferable to apply strict rules to secure the privacy of a patient. In countries like Oman, the conservative character of the society assists towards achieving this goal.

Almost all the medical organizations, where a health information system is implemented, follow some kind of authorization schema, either personalized, or general or mixed. This is necessary to

protect the medical record from unauthorized access even amongst health professionals. There are two issues raised at this point that must be addressed.

First, there are still organizations that either don't follow an authorization schema or it is very weak. Second, there are cases where the medical doctors are indifferent and careless about this very important issue and easily share their authorization details with others, especially the nurses of their departments, in an effort to avoid unnecessary, as they see it, clerical work. The administrations should make every effort to raise their level of awareness of the great risks that such a practice entails for their patients' privacy. Their opinions as to the "feeling of security" of the professionals are almost equally divided between those who "feel protected" and those who "need more protection". The closer to technology the more insecure a health professional feels on security matters.

Generally, there is the feeling that one can never feel completely safe when s/he has data on the Internet no matter how many security measures s/he takes. The only way is to not put the data online but this would mean less efficient medical record systems. It is a big trade-off between efficiency and security. It is not possible to have both to a level of perfection. The biggest issue, in the developing countries like Oman, is that the organizations have so many more problems to solve, in terms of their technical and other infrastructure, that security issues are a second priority. The administrative people must balance between infrastructure costs, education and training of their employees and medical practice related costs. All of these are equally important and should be equally addressed.

It looks like the more developed the environment, the more confident the professionals are about the level of training the ICT experts have. Nevertheless, things are not negative in the case of the developing environments either but just less advanced and secured. Technical personnel, i.e., ICTs, lab/pharmacist supervisors, and even lawyers feel less confident whereas those not as close to technology feel more confident about the ICTs level of expertise in security matters. It is important to note that all these professionals have slightly or even heavily different viewpoints as to how the EMR should be implemented and used. It is, therefore, rather necessary to involve all these types of professionals to ensure efficient deployment of such a very sensitive, sophisticated and complex system. This is not the norm in all organizations especially in developing countries like Oman.

As the years of experience increase the stronger is the feeling that the problems related to the technology need more time to be solved. A few minutes are usually not enough for big problems but it takes hours or days. A good strategy would be to have the IT departments store enough technology equipment to replace immediately in case of a major failure. Also, it should be decided what part of the system should be exposed to the general public online and what part should not. What is worth to note is that the study revealed there are no particular policies and procedures formulated and applied in different problem scenarios but everything is done in an ad hoc basis. This is acceptable for newly formed organizations, perhaps in developing countries, but not in well-established organizations, especially in developed countries.

## Privacy Concerns

This study shed light in the question whether the patients have the intention, or not, to upload their personal medical information on an Online health platform. Moreover, it offered the professionals' insight about how the education level, the cultural and the religious issues possibly affect their decision to include their medical data in an Online database.

The majority of the health experts believed that the patients will not feel comfortable with the idea of uploading their personal medical data on an Online platform. Regardless of the reality that most people share many personal moments, photos, feelings, etc., on the social platforms, however, when it comes to health issues, they would be very reluctant. In social media, they can hide behind aliases but in a real health Online database they should provide only actual data.

The patients' level of education, most likely, will have a negative effect on their willingness to include their personal information in an Online health platform. The higher the patients' education the more comfortable and knowledgeable about the technology they are and the lower their intention



to share their medical data online. There are those professionals, though, that believe the education does not affect as much as their personal mentality and temperament.

People in different cultures, whether liberal or conservative, have different influences on such sensitive matters. It can be said, however, that despite these differences, in general, the culture affects such behavior in a negative way, i.e., leading the society away from such practices. Both the Greek and the Omani professionals believe that their societies share this feeling. The only difference is that the Omani society is somewhat more conservative than the Greek.

The main religion in Greece is Christianity whereas in Oman is Islam, two different religions with different ideas and systems. In both cases, however, it looks like the majority of the health professionals, regardless of field or type (i.e., public or private) believed the religion does not affect the patients' decision to "give" their personal medical data. It is worth quoting the view of a Muslim that, probably, expresses the Christian societies as well: "Islam is a very open religion here in Oman and whatever is good for the humanity is accepted by Islam. It is not necessary if a study helps directly Omani society because if it helps the rest of the world, then indirectly but certainly it will help also Oman".

Finally, it appears that the majority of the health professionals are in favor of the deployment of the medical card concept in their societies since they either see only benefits in its application or at least they see more benefits than security concerns and threats. Most of the doubt and hesitation comes from the Greek society whereas in the case of Oman a serious number of the professionals are not informed on the subject and, hence, don't have an opinion on it.

These conclusions are very important not only for the local governments in their quest to develop relevant policies and apply them but also for the health and technology professionals who should aim to plan and build an appropriate infrastructure to facilitate the proper function of these mechanisms, i.e., the Online health systems and/or the medical cards. Furthermore, the governments should make every provision to ensure that their citizens are aware of both the functionality of these mechanism but, also, of the issues related to it.

## The Proposed Framework For A Centralized EMR Environment

The above findings could result in a comprehensive proposed framework for a centralized EMR environment shown in figure 2.

In Step 1, the management identifies the stakeholders of the EMR system as well as their roles and privileges as follows:

- **Patients:** It is their legal right to have access to their personal medical record.
- **Pharmacists:** Most believe they should not have access while others that it would help and improve the system to protect the patient
- **Others:** There should be different levels of access depending on the category of the stakeholder; this access should be recorded and monitored.

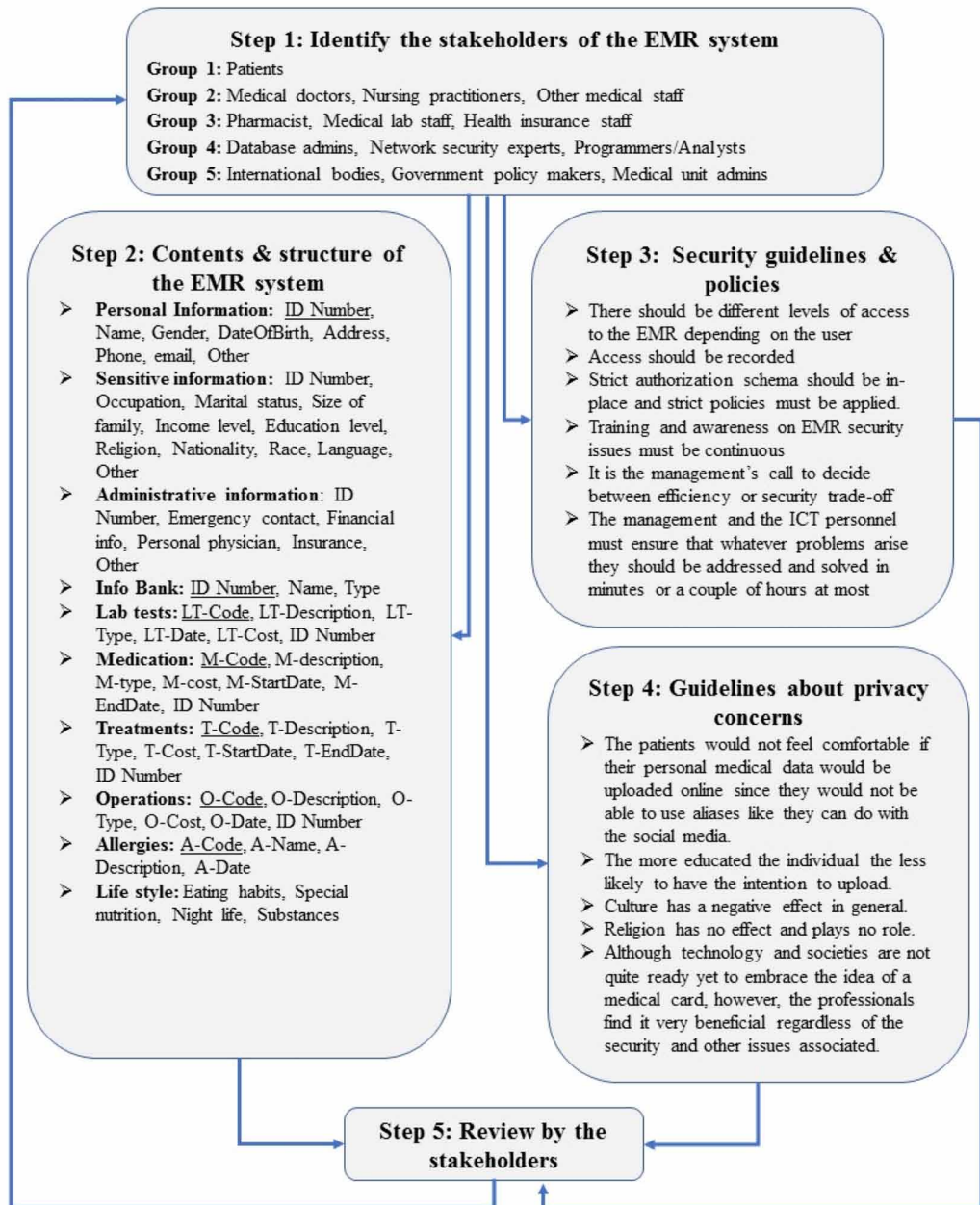
In Step 2, Contents and Structure of the EMR system, the management is to decide the elements to include in the system, possible levels of visibility, and accessibility rights. It can follow the suggestion in a form of database tables and, possibly as needed, scale it from smaller to full scale.

In Step 3, a number of security issues are suggested that have to be addressed through clear policies and procedures. Finally, in Step 4, the management decides the policies necessary in order to follow the local societies' educational level, as well as cultural and religious concerns.

It is, once again, at the managements' discretion to decide, like in a strategic plan, how often it will review the outcomes of such an environment, evaluate it and proceed to necessary amendments (Step 5).

Figure 2. Proposed Framework of an EMR environment

### Proposed Framework of a centralized Electronic Medical Record (EMR) environment



If such a framework is, more or less, adopted by the local and international health organizations and closely monitored by relevant government bodies, the author believes, it will lead to an efficient and centralized EMR environment.

## CONCLUSION

This research study investigated issues for a centralized EMR system from the professionals' viewpoint and proposed a framework of 5 steps of what such an ecosystem should include and its model of operation. In addition to the main findings described and explained in the previous sections, and the proposed framework, there are a number of other interesting points to note.

The application of such a framework (ecosystem rather) will reduce the repetition, save time and cut costs in the process of providing quality healthcare. However, some professionals feel it is necessary to have an economic feasibility of such a plan since it must be shown that the economic benefits outweigh the costs. Also, there are some medical doctors and some nursing practitioners that don't like the idea of taking time in front of a monitor instead of actually practicing their duties.

The size and depth of the data in the EMR may affect seriously the cost of implementing and supporting such a system. This is the reason that mainly admins believe such a plan should not be deployed full scale immediately but in a scalable manner, i.e., start small and gradually grow to full scale. Moreover, health professionals see it appropriate to share such a medical record between medical doctors and certified medical organizations worldwide to save patients' lives.

Concerning the various backup and recovery mechanisms available through their information systems, most professionals are aware of both their existence and the process to activate them as well as the time it takes for these mechanisms to process the requests.

Except from the ICT experts, who are usually modest and deeply conscious of the security problems, keeping low profile, the rest are, generally, happy about the security of their system. Additionally, they all feel the ICT's training level is satisfactory but they all feel it is always necessary to have the ICTs constantly trained.

In terms of whether the professionals feel patients are willing to share their medical information on the network platforms similar to Facebook, Twitter, etc., the vast majority believe the patients are not comfortable with this practice. They feel the more educated a patient is the less comfortable and willing that person is to share his/her data. However, the verdict is far from unanimous. Additionally, most of them believe that the culture has a negative effect but there are many who believe it doesn't have any effect at all. On the other hand, they don't see any effects of religion on the patient's decision although some see a negative effect.

Finally, the pattern is that the professionals approve the idea of institutionalizing the patient's card. They feel the technology to achieve this is available and that it will help improve the health system both locally and at the international level. They understand the potential security risks of such a concept and they have different opinions on how to address these risks ranging from having the patient control the card to having a central governmental body control. In general, they believe that the financial and health benefits deriving from its application far outweigh the possible risks.

## Contribution of The study

The main contribution of this study is that it provides "in a nutshell":

- the stakeholders and their association with the EMR, and
- the actual proposed framework itself which includes procedures and policies to address various concerns and issues including security and privacy.

The significance of the work is that it provides a "handy" and easy to understand framework of how the environment should be developed for the health organization management to look upon. This proposed framework could facilitate the identification of the various stakeholders of the system, the different levels of access to that, and suggest a possible structure and contents of such a system based on the particular health unit needs. Additionally, it could project security policies and ensure privacy

and cultural concerns are addressed. As mentioned before, it is hard to find such a framework in the international bibliography and, hence, the value of this study is its potential use by the hospital management, development team, and medical and/or nursing practitioners, although each one of them has different viewpoints and, therefore, would value it in a different way.

## **Limitations**

The main limitations of the study are related to the countries this study took place, the language used, and the fact that only medical unit professionals were interviewed and not those from higher organizations e.g. ministries, health insurance companies. The study took place in Greece and Oman. Ideally, it should take place in the U.S.A., E.U., China, India, and Arab World. In this case, Greece and Oman would also be included. However, given the time constraints and budget available, this would be practically infeasible. The study would benefit from interviewing, also, high-ranking professionals from the countries' ministries of health but this was simply impossible given the constraints explained. New research efforts could cover this issue.

One of the problems faced, especially in Oman, was that either many professionals could not speak English or their language command was really poor. This may have resulted into problems of understanding completely the questions of the interviews which, by nature, were difficult and deep. Hence, it would be more appropriate to have Arab translators to help during the interviews or well-trained Arabs to conduct them. If a new research targeting only the Arab world is made this problem would be addressed. Additionally, ICTs were difficult to reach and, hence, difficult to interview. Same with the lawyers who did not want to participate and, when they did, they were not very open to describe their views as they were worried about the confidentiality of their interviews.

## **Future Research Directions**

There are a number of very interesting topics that could be studied as the technology is developed further to serve the health sector better. Some of them include the topics of "Clinical Decision Support (CDS)", the "Medical Card", "the prospects of interoperability", and, of course the effects of the emerging technologies of Sensors/wearables, blockchain, cloud services, Big Data (analytics), and virtual/augmented reality. These new technologies will, no doubt, bring the health sector (they already started) at the frontier of the new health paradigm that many professionals, widely nowadays, refer to as Smart Health. The Corona Pandemic has brought this paradigm shift much closer and much faster than many were expecting just a few months ago.

## REFERENCES

- nyc.gov/health. (2015). *What Do Electronic Health Records Mean for Our Practice?* Retrieved from <http://www.nyc.gov/html/doh/html/pcip/pcip.shtml>
- American Academy of Family Physicians. (2015). *Understanding Features & Functions of an EHR*. AAFP.
- Anders, J., & Daly, T. (2009). *The Crucial Role of the Nurse in EHR Implementation*. Whitepapers. <http://bl.healthleadersmedia.com/content/242945.pdf>
- Barbour, R. S. (2001). Checklists for improving rigour in qualitative research: A case of the tail wagging the dog? *British Medical Journal*, 322(7294), 1115–1117. doi:10.1136/bmj.322.7294.1115 PMID:11337448
- Boland, M. V., Chiang, M. F., Lim, M. C., Wedemeyer, L., Epley, K. D., McCannel, C. A., Silverstone, D. E., & Lum, F. (2013). Adoption of Electronic Health Records and Preparations for Demonstrating Meaningful Use: An American Academy of Ophthalmology Survey. *Ophthalmology*, 120(8), 1702–1710. doi:10.1016/j.opthta.2013.04.029 PMID:23806425
- Bossen, C., Groth Jensen, L., & Witt, F. (2012). Medical secretaries' care of records: the cooperative work of a non-clinical group. *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*. doi:10.1145/2145204.2145341
- Bossen, C., Jensen, L. G., & Udsen, F. W. (2013). Evaluation of a comprehensive EHR based on the DeLone and McLean model for IS success: Approach, results, and success factors. *International Journal of Medical Informatics*, 82(10), 940-953. 10.1016/j.ijmedinf.2013.05.010
- Chiang, M. F., Boland, M. V., Margolis, J. W., Lum, F., Abramoff, M. D., & Hildebrand, P. L. (2008). Adoption and Perceptions of Electronic Health Record Systems by Ophthalmologists: An American Academy of Ophthalmology Survey. *Ophthalmology*, 115(9), 1591-1597. 10.1016/j.opthta.2008.03.024
- CIA Central Intelligence Agency. (2016). *The World Factbook*. Retrieved from [retrieved from https://www.cia.gov/library/publications/the-world-factbook/fields/2122.html](https://www.cia.gov/library/publications/the-world-factbook/fields/2122.html)
- Cooper, D. R., & Schindler, P. S. (2014). *Business Research Methods* (12th ed.). McGraw-Hill.
- Cooper, D. R., Schindler, P. S., & Sun, J. (2014). *Business research methods*. Irwin Series. McGraw-Hill.
- Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage Publications.
- Creswell, J. W., & Poth, C. N. (2017). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Sage Publications.
- European Union. (2015). *EUROPA - European Union Website, the official EU website*. Retrieved from <https://www.europarl.europa.eu/aboutparliament/en/0081f4b3c7/Law-making-procedures-in-detail.html>
- Farzandipour, M., Ahmadi, M., Sadoughi, F., & Karimi irajk, I. (2011). Adopting Confidentiality Principles for Electronic Health Records in Iran: A Delphi Study. *Journal of Medical Systems*, 35(3), 333–343. doi:10.1007/s10916-009-9370-x PMID:20703556
- Federal Register. (2010). *Health Information Technology: Initial Set of Standards, Implementation Specifications, and Certification Criteria for Electronic Health Record Technology; Final Rule*. United States Government Printing Office.
- Fink, A. (2017). *How to conduct surveys. A step by step guide* (6th ed.). SAGE.
- Fritz, F., Balhorn, S., Riek, M., Breil, B., & Dugas, M. (2012). Qualitative and quantitative evaluation of EHR-integrated mobile patient questionnaires regarding usability and cost-efficiency. *International Journal of Medical Informatics*, 81(5), 303-313.
- Hernández-Ávila, J. E., Palacio-Mejía, L. S., Lara-Esqueda, A., Silvestre, E., Agudelo-Botero, M., Diana, M. L., & Parbul, A. S. et al. (2013). Assessing the process of designing and implementing electronic health records in a statewide public health system: The case of Colima, Mexico. *Journal of the American Medical Informatics Association: JAMIA*, 20(2), 238–244. doi:10.1136/amiajnl-2012-000907 PMID:23019239

HYGEIAnet. (2004). Description of eHealth Solution. *Regional Health Information Network of Crete*, 1-4. Retrieved from [https://www.ics.forth.gr/publicity/ics\\_representation/hygeia-net.pdf](https://www.ics.forth.gr/publicity/ics_representation/hygeia-net.pdf)

ICSA Labs. (2010). *Advanced Data Systems Corporation*. Retrieved from <https://healthcare.adsc.com/blog/bid/178697/The-Role-of-Insurance-Companies-in-EHR-Medical-Billing-Software>

Jha, A. K., DesRoches, C. M., Kralovec, P. D., & Joshi, M. S. (2010). A progress report on electronic health records in US hospitals. *Health Affairs*, 29(10), 1951–1957. doi:10.1377/hlthaff.2010.0502 PMID:20798168

Kasoff, J. (2012). Connecting your LIS and EHR. *Medical Laboratory Observer*. <http://www.mlo-online.com/articles/201202/connecting-your-lis-and-ehr.php>

Koutzampasopoulou Xanthidou, O., Shuib, L., Xanthidis, D., & Nicholas, D. (2018). Electronic Medical Records in Greece and Oman: A Professional's Evaluation of Structure and Value. *International Journal of Environmental Research and Public Health*, 15(6), 1137. doi:10.3390/ijerph15061137 PMID:29857585

Lehnbom, E. C., McLachlan, A. J., & Brien E, J.-a. (2012). A qualitative study of Australians' opinions about personally controlled electronic health records. *HIC*, 105-110. 10.3233/978-1-61499-078-9-105

Lewis, B. R., Snyder, C. A., & Rainer, R. K. Jr. (1995). An empirical assessment of the information resource management construct. *Journal of Management Information Systems*, 12(1), 199–223. doi:10.1080/07421222.1995.11518075

Meho, L. I. (2006). E-mail interviewing in qualitative research: A methodological discussion. *Journal of the American Society for Information Science and Technology*, 57(10), 1284–1295. doi:10.1002/asi.20416

Passarani, I. (2013). *Patient access to Electronic Health Records*. Report of the eHealth Stakeholder Group.

Rojas, C. L., & Seckman, C. A. (2014). The Informatics Nurse Specialist Role in Electronic Health Record Usability Evaluation. *CIN: Computers, Informatics, Nursing*, 32(5), 214–220. doi:10.1097/cin.0000000000000042

Safran, C., Bloomrosen, M., Hammond, W. E., Labkoff, S., Markel-Fox, S., Tang, P. C., & Detmer, D. E. (2007). Toward a National Framework for the Secondary Use of Health Data: An American Medical Informatics Association White Paper. *Journal of the American Medical Informatics Association*, 14(1), 1–9. doi:10.1197/jamia.M2273

Saitwal, H., Feng, X., Walji, M., Patel, V., & Zhang, J. (2010). Assessing performance of an Electronic Health Record (EHR) using Cognitive Task Analysis. *International Journal of Medical Informatics*, 79(7), 501-506. doi:10.1016/j.ijmedinf.2010.04.001

Shah, S. N. (2010). *Understanding electronic health records and third-party application databases*. Retrieved from <https://www.ibm.com/developerworks/data/library/techarticle/dm-ind-ehr/>

Sousa, D. (2014). Validation in qualitative research: General aspects and specificities of the descriptive phenomenological method. *Qualitative Research in Psychology*, 11(2), 211–227.

Straub, D. W. (1989). Validating instruments in MIS research. *Management Information Systems Quarterly*, 13(2), 147–169.

Tan, W. S., Phang, J. S., & Tan, L. K. (2009). Evaluating user satisfaction with an electronic prescription system in a primary care group. *Annals of the Academy of Medicine, Singapore*, 38(6), 494. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.490.4369&rep=rep1&type=pdf>

Wager, K. A., Lee, F. W., & Glaser, J. P. (2005). *Managing Health Care Information Systems: A Practical Approach for Health Care Executives*. John Wiley & Sons.

World Economic Situation and Prospects. (2012). *Country classification, Data sources, country classifications and aggregation methodology*. Retrieved from [https://www.un.org/en/development/desa/policy/wesp/wesp\\_current/2012country\\_class.pdf](https://www.un.org/en/development/desa/policy/wesp/wesp_current/2012country_class.pdf)

World Health Organization. (2006). *Electronic health records: manual for developing countries*. WHO Regional Office for the Western Pacific.

Xanthidis, D., & Aleisa, E. A. (2012). Online Database System for Patients Data Organization. *Journal of Information*, 2(1), 11.

Xanthidis, D., & Koutzampasopoulou Xanthidou, O. (2019). *A Framework for the Deployment of an Electronic Medical Record ecosystem*. Paper presented at the SYSCON 2019, Orlando, FL.

Yoo, S., Kim, S., Lee, S., Lee, K.-H., Baek, R.-M., & Hwang, H. (2013). A study of user requests regarding the fully electronic health record system at Seoul National University Bundang Hospital: Challenges for future electronic health record systems. *International Journal of Medical Informatics*, 82(5), 387-397. 10.1016/j.ijmedinf.2012.08.004

Yoon, D., Chang, B.-C., Kang, S. W., Bae, H., & Park, R. W. (2012). Adoption of electronic health records in Korean tertiary teaching and general hospitals. *International Journal of Medical Informatics*, 81(3), 196-203. 10.1016/j.ijmedinf.2011.12.002

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