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ICT in Business

Security in the Implementation of Electronic Health Records in Indonesia



Name : Levina Trixie
Student-no : 1148354
Contact : levina.trixie@gmail.com

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1st supervisor: Prof. dr. J.N. Kok

2nd supervisor: Dr. M.H. Ter Beek

MASTER THESIS

Leiden Institute of Advanced Computer Science (LIACS)
Leiden University
Niels Bohrweg 1

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General Information

Thesis Title: Security in the Implementation of Electronic Health Records
in Indonesia.

Author: Levina Trixie

Student Number: 1148354

E-mail Address: Leiden: l.trixie@umail.leidenuniv.nl
Private: levina.trixie@gmail.com

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Graduation Committee

First supervisor: Prof. Dr. J.N. (Joost) Kok

LIACS Professor

Phone: +31-(0)71-5277057

Fax: +31-(0)71-5276985

j.n.kok@liacs.leidenuniv.nl

Second supervisor: Dr. M.H. ter Beek

LIACS Member of Scientific Staff

Phone: +31-(0)71-5277038

Fax: +31-(0)71-5276985

Email: maurice.terbeek@isti.cnr.it

Homepage: <http://fmt.isti.cnr.it/~mtbeek/>

Abstract

Nowadays, the innovation of technology has such a huge impact in various areas of study. Information and communication technology, known as ICT, has been referred as 'key instrument' for healthcare development. With the development of technology, health care and medical areas can be developed into better improvement for people' benefits. An Electronic Health Records (EHR) is a digital record, which consists of a medical history of patient including its demographic, health improvement, patient health problems, medicine consumption, immune history, laboratory data, and radiology. With technology advances, another problem arise during the implementation, whether the security systems in Indonesia adequate enough or not. This research project will answer the question and explore another findings that might be useful for future.

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CHAPTER 1: Introduction

Nowadays, the innovation of technology has such a huge impact in various areas of study. Information and communication technology, known as ICT, has been referred as 'key instrument' for healthcare development. With the development of technology, health care and medical areas can be developed into better improvement for people's benefits. By referring to the ICT, it provides aid for healthcare workers to support with data sharing, data storage, and management. It was gradually migrated from paper based to electronically records for patients. Therefore, the concept of electronic health records is introduced to minimize the gap between specific patient data and healthcare data.

An Electronic Health Records (EHR) is a digital record, which consists of a medical history of patient including its demographic, health improvement, patient health problems, medicine consumption, immune history, laboratory data, and radiology. The data is important for handling patient problems, curing disease, and prevent future illness. EHR has the capacity to produce the full data records of patients and can help in a number of medical activities.

Problem Description

As technology become rapidly and globally growing, eventually most areas in life have to adopt as well, with no exception of health areas. With the big help in technology growth, healthcare has become better and better. By using IT, many hospitals feel that it gives them huge impact to handle patient more efficiently. In developing countries, IT seems quite significant issue and challenging to develop with. The EHR implementation in Indonesia and other developing countries is quite challenging and complicated. Poisant et al. (2005) stated that the integration of the EHR into clinical workflow must be taken into consideration in the early phases of planning in order to optimize the integration of the system into routine clinical use.

While looking at healthcare in developing countries such as Indonesia, some hospitals are still using paper for their daily operation. It is including the way they are handling patient data, finances, pharmacy, laboratory result, and billing. It will take more time and longer queuing time. According to Brands (2003), patient data can be also lost in the hospital because it was paper based and sometimes misplace somewhere else. Patient who come to hospital have to register first in the administration for data input. Moreover, based on the symptoms that patients have, they will be referenced to the doctors and get cured. If any medicine needed, they will have to go to pharmacy. Imagine that from all those steps, everything are handled manually and still rely on paper-based system, it will take longer time for the management to handle patient and even some patients will not be cured. Therefore, the implementation of management information hospital will be beneficial for the hospital and doctors as well as hospital staffs. Electronic health records will give a huge impact in the daily hospital activities and helpful in every aspects of curing the patients. In Indonesia, there is a concern about the security of the EHR. We hope that this thesis will help to overcome this concern, by using knowledge about implementation of the EHR.

The main research question for this thesis is:

*Is the **current security** adoption **adequate** for the implementation of **EHR** in **Indonesia**?*

The importance of ICT role in implementation of EHR has been recognized for several years. On implementation of EHR, new technology developments will focus on creating sustainability, give ideas for innovation, makes use of healthier people life, and will be more productive. Even though, ICT plays a significant importance of EHR implementation, nonetheless, the implementation of EHR in Indonesia and other developing countries still leaves important issues: the current security adoption gives a lot of concern in most hospitals in Indonesia to implement EHR accordingly. Hence, this issue will be answered in through this research study thoroughly.

Research goal and question

Accordingly, the main objective of this research study is to see whether the current security adoption in Indonesia is adequate enough for the implementation of EHR in most hospitals or not. This could help the hospital staffs having an insight about the actual EHR implementation by mapping out security consideration point of view. By pointing out this point of view, it is expected to improve the current EHR so it can reach the desired and appropriate EHR in hospitals to gain competitive advantage for healthcare improvement in Indonesia. In order to achieve this objective, the main research question would be:

Is the current security adoption adequate for the implementation of EHR in Indonesia?

To answer this main research question, we will formulate sub research questions that might help to answer it in appropriate manner. The following sub questions and its significance towards the main research questions are given as follow:

Sub-question 1: What is information security in the context of EHR implementation?

The first sub question is an important phase to set the scope of the research study. The focuses will be on the security adoption with the context of electronic health records. An overview of EHR is explained by considering impact of ICT in healthcare, and information security including its privacy and security on the insight of EHR.

Sub-question 2: What are the phases of EHR implementation that will be necessary for operational and functional activity in most Indonesian hospital? What are the barriers on the implementation itself?

In this sub-question, the stages of EHR will be introduced and consequently, based on the research made in most hospitals in Indonesia, the further exploration is needed to see what kind of EHR features will be necessary for both operational and functional activities in Indonesian hospitals.

Sub-question 3: How can the implementations of EHR become economically sustainable?

Although EHR is already implemented in Indonesia, the sustainability EHR is important for every hospital in Indonesia.

Sub-question 4: What are the critical factors, which results in security success or failure in the implementation of EHR with respect to security in Indonesia? How are the privacy and security regulation for patient data in EHR?

The EHR implementation will not always be successful and sometimes it can fail without knowing the exact cause. By combining input from various hospitals, the critical success or failure factors can be identified.

Sub-question 5: Is the current security system in Indonesian hospital adequate for EHR? How is the hospital management influenced by the implementation itself?

Based on the information gathered from previous sub-questions, these last sub-questions are aimed to look further in regards of security system being used in hospitals and see for the compatibility for EHR in Indonesia. It will also conclude the entire research project as well as answering the main research question.

Motivation

This thesis is based on the research questions stated in the previous section. Looking at the inefficiency of healthcare in Indonesia and in most of the hospitals, the implementation of EHR would reduce the redundancy work of hospital staff has to do. It would be a great impact to have a good EHR implementation in every hospital, as it will reduce the time, increase

productivity for doctors, nurses, and other hospital staff. In healthcare, there are many examples of such innovations ranging from electronic health records (EHRs), clinical decision support systems, via medical apps for mobile devices to next generation gene sequencing (Vavilis *et al.*, 2012).

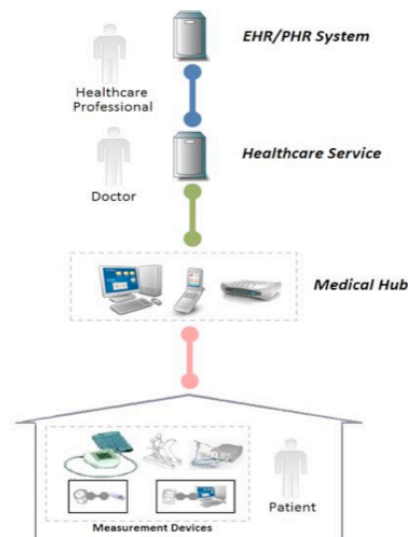


Figure 1: RPM system architecture (Vavilis *et al.*, 2012)

As a result, this new technology will make quality of patient life better as well as cheaper and faster services for the hospital. However, there are some privacy and security threats of patient data since people are still unfamiliar with the new technology and easier to collect, store, and search for the data consequently endangering patient's privacy.

Chapter Summary

This chapter will indicate the main research question and its problems concerning with EHR. Research goals together with motivation of doing this project will be elaborate for further analysis. In order to answer the main research question, two of theoretical frameworks will be introduced in the following chapter. Diffusion of Innovation and Technology Acceptance Model are chosen for the background framework of this research.

CHAPTER 2: Innovation Framework

During clinical process some physicians often found out that it was quite challenging to answer every question from patient. Therefore, the mechanism of EHR allows them to assist with better understanding and answer those unsolved problems. In this chapter, the support theory for security consideration on implementation of EHR in Indonesia will be described in detail. Diffusion of innovation (DOI) and technology acceptance model (TAM) will be used for theoretical framework for this research study. Diffusion of innovation is used as a support theory for this research study because it investigates possible factors, which support the initial adoption of implementation together with sustainability use of EHRs. Technology acceptance model will examine the interaction between hospitals staff and patients, and hospitals visions and missions.

2.1 Framework: Diffusion of Innovation

For hospitals to adapt EHR into their systems indeed it is not an easy task. Conveying they're thoughtful, not everyone truly understands how to operate EHR especially when people already being convenient with paper-based. However, it is really important to have a good teamwork in hospitals and accelerating unnecessary paper works. Therefore, to answer those problems, theory of diffusion of innovation is being introduced. In the implementation of EHR, the problem relies not only limited to introducing the new systems with new interfaces, but it will also affect workflow of the entire hospitals systems. DOI will examine how people react towards the new systems in general, whether they are rejecting or accepting. According to Rogers (2003), there are five aspects in DOI including innovator, early adopter, early majority, late majority, and laggards. By using this theory, we could see thoroughly what kind of social influences play the great influences in any individuals to accept or reject EHR.

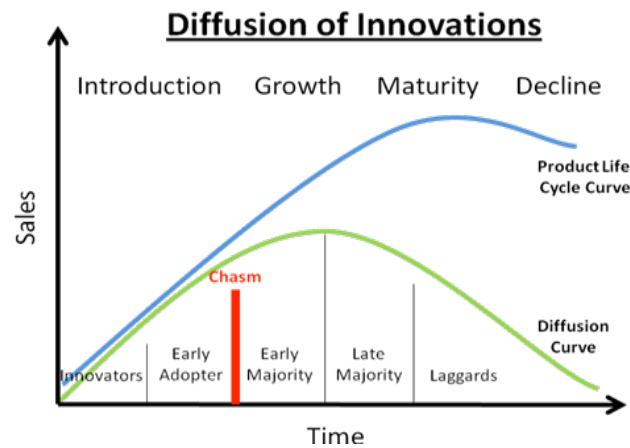


Figure 2: Diffusion of Innovation (Rogers, 2003)

Four elements in Diffusion of Innovation theory

According to Rogers (2003), there are four important elements in DOI, these include innovation, communication channel, time, and social system. Each of it will affect the decision of individuals to accept new technology to fit into their systems. Innovation is rather a new idea for people who perceived it, but it was invented for long time ago.

Innovation

Innovation described by Rogers as “an idea, practice, or project that is perceived as new by an individual or other unit of adoption.” (Rogers, 2003). As the perception of innovation was invented long time ago, but it rather new thinking and idea for any individuals who perceive it. One of main reason why people hardly accepted in new ideas is because of uncertainty. Uncertainty leads people’ minds whether to accepts or rejects to certain new changes. There is a way to minimize uncertainty among people, by explaining its advantages and disadvantages of the new ideas. Therefore, people will know what the benefits of particular innovation.

Communication channel

Communication is classified as the second element of diffusion of innovation theory according to Rogers. Communication by it means, is “a process in which participants create and share information with one another in order to reach a mutual understanding.” (Rogers, 2003). In order for the message to be delivered

to the recipient, they need channel or media to transport it. Moreover, a channel is by which a message gets from the source to the receiver” (p. 204). Some channel, which can be considered as a powerful media transmitter, is mass media communication. It can be very successful in persuading people mind and perception in acceptance of innovation-decision. TV, newspaper, radio, and even advertisement, can be classified as mass media communication.

Time

Based on Rogers (2003) argument, time element is being ignored in behavioral research. The innovation-diffusion process, adopter categorization, and rate of adoptions are included a time dimension.

Social system

Last element in DOI theory is social system. Rogers (2003) described social system as “a set of interrelated units engaged in joint problem solving to accomplish a common goal” (p. 23). Because the process of diffusion of innovation is happened in social system, therefore, it will also influenced by social hierarchy in organization.

The Innovation-decision process

Principally, Rogers (2003) classified innovation-decision process into three steps: (1) optional, (2) collective, and (3) authority. Optional innovation-decision process describes that each individual have the rights whether to accept or rejects to innovation whereas in collective process, the decisions which are being made, depends on members agreement of the systems. However, authority innovation-decisions are made based on certain authority people among the group. Their authority can be differed from various position, rank, or expertise. Moreover, innovation-decision process can be dependent by consensus made by other people. Those processes can be described in the following figure:

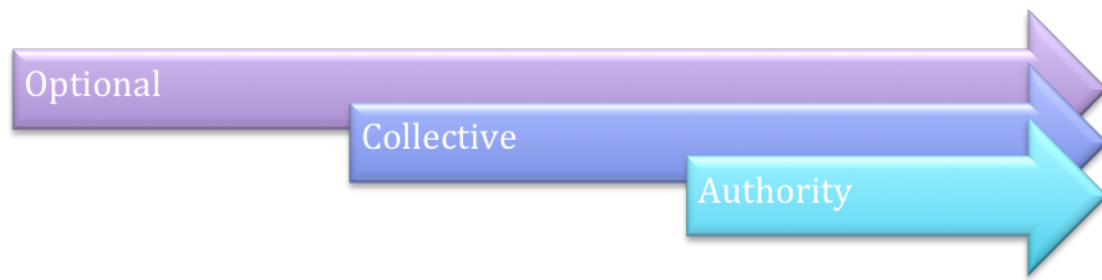


Figure 3: Innovation-decision process

2.2 Framework: Technology Acceptance Model

Technology Acceptance Model (TAM) elaborates the use and acceptance of information systems and technologies developed by Fred Davis (Davis, 1989). It was according with Ajzen and Fishbein's theory of reasoned action (TRA) that rational of people behavior by their beliefs (Ajzen, 1980). TAM is not only useful for predict the user acceptance behavior towards innovation, but also elaborates why some systems might not acceptable by users. There are two influencing factors in this theory including perceived usefulness and perceived ease of use.

Perceived usefulness is "the degree to which an individual believes that using a particular system would enhance their job performance." Moreover, perceived ease of use is "the degree to which an individual believes a system will be effortless and easy to use." (Davis, 1989). Both perceived usefulness and ease of use are the main factors in TAM, which influenced people attitudes on how to adapt to new innovation. According to David, there are some external variables, which might affect to system development, system design and implementation process as well as the characteristics, and user training support. Individual attributes and related job tasks are one of many external variables that influencing people attitude towards accepting innovation.

2.3 Chapter Summary

Diffusion of Innovation is used a support theory for this research study because it investigates possible factors, which support the initial adoption of

implementation together with sustainability use of EHRs. Technology acceptance model will examine the interaction between hospitals staff and patients, and hospitals visions and missions. Qualitative method will be used during the rest of the project, and several interviews will be conducted for data collection. Different hospitals as well as expertise from different field will be introduced in this research with the purpose of data collection.

CHAPTER 3: Electronic Health Records

This chapter will try to answer the first sub-question being made in the previous chapter: What is information security in the context of an EHR implementation? In order to answer the first sub-question, we first give a brief description about hospital information system, as it will cover what EHR is about. Hence, the introduction of HIS (Hospital Information System) will be presented together with more detailed about electronic health records.

3.1 Hospital Information System

As to define hospital information system (HIS) definition, the information system definition needs to be given first. According to Rainer (2011), Information system is the planning, development, management, and use of information technology tools to help people perform all tasks related to information processing and management. With the definition of information system already in mind, HIS definition can be given. In broad context, the hospital information system is the sociotechnical subsystem of a hospital, which comprises all information processing as well as associated human or technical actors in their respective information processing roles (Ammenwerth, 2004). However, there is the more clinical function of HIS that is more useful for the operational activity of the hospital, which termed the clinical information system (CIS).

The non-clinical part of HIS is more larger as it handles such operational activities including administration, finance, patient registration, and billing system. There are some limitations of CIS in Indonesia due to medical regulation from the health ministry, and due to lack of capability of human resources. From our interviews, it became known that many hospitals in Jakarta have already implemented HIS, but due to lack of knowledge of medical information system, the integration of EHR and EMR was introduced a bit later. Although those implementations are promising, due to the costs, many hospitals still reconsider about it.

CPOE (computerized physician order entry) systems that work as one of other EHR functionalities, authorized users to enter e.g. drugs prescriptions, radiology results, and laboratory tests into the system rather than doing it paper-based. It helps physicians and other medical staff to reduce the unnecessary time needed to do the clerical job. By having a digitalized order entry, some medical errors possibility made by the medical staff can be eliminated. Furthermore, it will also help the staff to look for any required data faster and more effectively.

3.2 Security in EHR

In this sub-section, the important relation between security and healthcare systems will be described more details. There are many barriers that organizations faced as they implement EHR such as increased costs, staff resistance, and surfeit security issues (Hewitt, 2010). Security is supposed to secure and protect the entire data stored by EHR including patients records and that an authorized party can only retrieve the data. Patients are required to share their private information regarding their current health issues and history to physicians to acquire correct diagnosis and treatment however; they might also refuse to do so if they think it might not safety enough. Based on the research done by NRC and (Rindfleisch, 1997) it was shown that the broad spectrum of organizational threat can be classified into five different levels, which are:

1. *Accidental disclosure*

Accidental disclosure means here that hospital staffs reveal patient information to other parties accidentally. For instance, some staff might send email to the wrong address through P2P.

2. *Insider curiosity*

Some medical personnel while handling their case, might be interested in other patient' cases and they are trying to take a look on purpose just for the sake of curiosity when they are not suppose to.

3. *Data breach by insider*

This case has happened in the past in hospitals and is considered as a serious problem, e.g. patient confidential information might be sold to other person for getting some amount of money and profit.

4. *Data breach by outsider with physical intrusion*

There are cases where temporary or contract workers, who have access to the hospital system, try to “steal” hospital data and sell it to other hospitals.

5. *Unauthorized intrusion of network system*

There might be unauthorized parties who are trying to gain access to hospital crucial information, for example hackers, resentful employees, and other revengeful parties.

Security for EHR covers patient’s confidentiality as well as integrity, availability, and accountability. In order to improve healthcare quality, patient medical records and information are needed eventually and plays a major role. For patients and other parties to be comfortable to participate, the protection of EHR security and other medical records must be reliable and trustable enough. Otherwise, many people will feel insecure and threaten by sharing their private information. For instance, patient with medical history of HIV, obstetrics, mental health, or other sensitive health information could become more easily accessible as health records become fully automated. However, if this private health information is easily accessible by other people, it will evidently represent patient’s privacy breach. Implementing such firewalls and encryption technology throughout the system could ensure the security in EHR.

3.3 Information security and technology

As briefly described in the previous section, most hospitals have been already implementing firewalls and encryption technology in the medical records system to fully ensure EHR security. In Indonesia, as most of EHR implementations elsewhere, this is done by hospital incentives, and many of them are relying on

the password protection for the security. One of the important tools for data security is by using audit trails as some of the security breaches might have resulted from misuse of access privileges by authorized persons (Barrows, 1996).

To improve its information security, we could take a look at several mechanisms that are being offered. One of security mechanisms being used in EHRs is biometric identification. For that type of identification, each hospital might use some of pattern recognition techniques like retinal analysis, voice recognition, and fingerprint analysis. They can choose any methods that are suitable for the hospital or they can also use all the available methods to really ensure the security system.

The above methods are used to identify any authorized parties who can have access to EHR. However, most users as well as many hospitals in Indonesia believe that password user protection is sufficient enough to have secure EHRs. But in reality, many programs that are using password protection still depend on sub-routines that check against a hash-code of the password (Horst, 2001). Hence, there should be some other mechanisms, which could improve the security of EHRs. (U.S. Department of Health & Human Services, 2012; Pascale Carayon, 2009)

3.4 Chapter Summary

Introduction of EHR including its security and examples of fraud concerning this matter will be explained in the next chapter. Several methods of EHR security will be elaborated with the perspectives for hospitals in general. In further explanation, EHR implementation will be discussed containing its stages, barriers, and benefits of EHR implementation in health information systems, especially in Indonesia.

CHAPTER 4: EHR Implementation

In this chapter, the different stages of EHR will be further explained. Generally, there are different implementation stages that are necessary for the hospital to have an operational system. Together with the features of EHR, the benefits of it will also be explained in the appropriate manner.

4.1 Implementation Stages

Traditionally, there are five different EHR implement stages that hospital needs to adapt. These stages hold different goals and functions that hospital needs to achieve. After they follow and accomplish each stage, the functionality and quality of patient data can be measured accurately. There are five differences of EHR implement stages can be described as follows:

Stage 1: Assessment

In this stage, the third party or consultants distribute the survey to gather any necessary requirements for the implementation. This stage is the basic and foundation of the following stages in the process implementation. The whole hospital day-to-day operation will be examined carefully. It is to ensure that EHR system is indeed match with the hospital vision and worth it to be implement. With the current situation at most hospitals in Indonesia, the first stage will be very useful and helpful to gather the important information so the implementation itself would not be a waste. In this stage, the administrative system will be looked thoroughly so they know exactly whether it is already well organized and documented in the correct manner or not. Moreover, the clinical information system needs to be evaluated for its effectiveness, efficiency, and clearness for the staff to be understood.

In order to implement the system, the comprehensiveness of hospital software and hardware need to be examining thoroughly. It will be a waste if the software and hardware are not supportive enough for the implementation. The software

is including computer operating system, servers, utilities, and Internet connection. Unfortunately, for some hospitals outside Jakarta, having high-speed Internet connection is considerably difficult. It is because to install its component in other province and cities requires more budget and effort. Luckily for most hospitals in Jakarta, high-speed Internet connection will not be a problem and it is easy to get reliable connection.

Stage 2: Planning

After completing the assessment of hospital requirements, the hospital starts planning the next phase of the implementation. Based on the requirements gathered in the first stage, hospitals should already know what they want to achieve in the next few years by implementing EHR. In the planning phase, how to transform the assessment gathered in the preliminary work into actionable information is being examined. Hospital goals and objectives are should be clear by now and based on those objectives, EHR should be implemented in a correct manner. To execute the EHR plan, several documentations are needed. It is because to implement it, there are a lot of things to be considered, and many people are involved in the activity.

Moreover, in the planning phase, not only documentation plan is needed but also training plan, hardware and software planning, communication plan, and budgeting plan. Similar like other project implementation planning, in this phase, the planning of EHR implementation have to be done precisely. To include in the planning stage, designing and redesigning workflow is essential because hospital need to know the current activity being done and what the next activity will be. Once it is complete, they will start to analyze the workflow and see how works should be done.

In RSCM, the hospital team decided the plan very carefully. It was because the system was rather new for them and there was a little knowledge about EHR. Therefore, they looked carefully regarding their initial goals and objectives in curing patients. Starting from identifying their current issues with the old system, they were continuing to determine non-value and value added if they

were using EHR for daily operation. It was truly uneasy task and rather complicated. There were many parties being involved in the implementation process including hospital board of executive, shareholders, and especially hospital staff as the person who will use the new system everyday. Board of executive was concerning about budget and costs of implementation as well as the future benefits of the implementation. Consideration of training the staff was also part of planning phase. This training was really important, as most people in the hospital did not have adequate knowledge of using EHR in a further detailed.

Stage 3: Implementation

After finishing the planning phase, hospital starts to implement EHR into their system. The goals of EHR implementation are to improve medical work and efficiency, patient doctor communication involvement, to maximize information sharing, develop healthcare quality and patient safety, and to minimize errors (Carayon *et al.*, 2009). In EHR implementation, several activities are included. Training hospital staff is crucial as well as testing the system for the first time. In order to get the right and convenient interface, the system will be configured and tested for several times. Hardware and software compatibleness will also be looked in this phase. It is because if those two components are not compatible with EHR requirements, it will be a waste. Based on the documentation plan made during planning phase, hospital will execute the plan accordingly. As soon as the plan works, hospital will begin to migrate their data into the new system.

In cases like most hospitals in Jakarta, vendors or consultants do EHR implementation. Therefore, during implementation hospital team decided which vendor gives the best value added. Selected vendor initiated the implementation and installed hardware and software needed for the new system. While installing the components, they configured and customized the system. There are always problems with the new system. Hence, having a good interface will help them to use the new system more conveniently and reduce unnecessary problems. Finally, they trained their staff to fully understand how to operate the system well. Additionally, testing the new system also part of their implementation phase. For instance, RSCM staff always emphasis that training is the most

important in the implementation process. Even with training, their staffs still make some mistakes.

Stage 4: Evaluation

In this stage, hospital management team will evaluate the current progress of EHR including quality of clinical works, how the staff reacts about using the systems, and privacy and security concern about data protection. As mention in the previous stages, it is essential for hospital to achieve its goals and objectives because one of the main reasons hospital wants to implement EHR is having an efficient and effective way on handling patient needs with EHR. The new system is not only covers about patient historical data, but also includes financial reporting, and improves reporting capabilities. By using EHR, it is hoped that hospital could improve patient and doctor engagement, which is lack in some hospitals in Indonesia.

In some private hospitals in Jakarta, the old systems were not allowing them to communicate with patients longer. Compared to few years ago, this day, doctors are having good relation with patients because with new system they can accelerate patient registration process up to the pharmacy and have longer patients consultation time. Normally, doctors limited patient consultation time up to 10 minutes but nowadays; they could loosen the time to 15-20 minutes without disturbing other process. The systems shorten registration process so patient could have more consultation time with doctors.

Stage 5: Continuous Improvement

Finally, the last stage of the implementation is improving the current system to get better. Maintaining the current system to get better is not an easy job to do. After few months of implementation, hospital management team should flashback whether EHR gives them the desired goals and benefits that they want to achieve. By now, hospital should realize whether EHR gives the entire data needed or not.

4.2 Barriers of Implementation

During the implementation phase, there are many obstacles and barriers that many hospitals face in Indonesia. Even though the implementation of EHRs was introduced a bit late in Indonesia compared to most other countries, the idea of EHR was received and accepted positively by many private hospitals. On the other hand, public hospitals still a bit reluctant regarding the implementation. It is because they still think that the costs and benefits they will get are not equally balanced. This problem also occurred in RSCM. From the interviews, it was found out that they are still felt for EHR, benefits they will get were not significant enough, especially for executive level. Convincing board of executive of the hospital itself required great effort and time.

The most challenging barrier during the initial implementation was about technological and financing limits. It was including network availability and costs. Nowadays, the availability of network and high-speed Internet are not a big deal in Jakarta. Nevertheless, back to few years ago, it was quite difficult and limited to have a reliable high-speed connection. Even up until now, some eastern provinces in Indonesia still do not have reliable Internet connection. It is because the installation of Internet mainly only focuses in most of business district areas, which are mostly in Java Island. That is why for other areas than Java, Internet is still difficult to achieve by many hospitals in other islands including Sumatera, Sulawesi, Kalimantan, and Papua. Even though many hospitals in Jakarta already equipped with reliable high-speed Internet, but sometimes the connections are not stable enough. Network availability from servers to each device is unstable hence medical staffs find it a bit reluctant to use the system. Costs also became the biggest constraint in implementation process. Many hospitals in Jakarta are still reconsidering to implement EHR and HIS because it was too expensive. To purchase the system, they need investors to invest on the project. It is quite a big scalable project especially for hospitals in developing countries.

According to staff in several hospitals in Jakarta, they found out that it was quite challenging and difficult to adapt working with EHR. It required excessive

amount of time for staff with no adequate typing skills to type patient data into the system. There were a lot of data variations they need to type and at the same time they also have to interact with patients. For instance, for inpatient care, there will be too much lists in which clinical staffs need to insert including medicine lists, patient personal information and historical records, allergies symptoms, and many more. Filling these kinds of information with staffs who have no prior typing skills indeed was time consuming.

Each list has to be added into the system while previously, they could have just done it verbally. Almost in every interview being done, doctors and nurses feel that it was very difficult to change people habit. Having a transformation from the old to new system is not always an easy task. People already comfortable with old system thus they still feel awkward with new system. Some doctors stated that there was no adequate training for medical staff from the management team which sometimes lead to poor report performance.

One of nurses who work in PIK hospital stated that somehow the new system was a bit inflexible. Because of the thought getting rid all the paper works, hospital management team were trying to digitalize almost everything (Lorenzi & Riley, 2000). It was already difficult for them to fully understand how to operate the new system, however there are too many options for adding patients data. This problem might happen because there is lack of proper training from management team. Having a digitalized system that could minimize possibility of errors and maximize work efficiency is indeed a good thing; however in order for the people to be able to work comfortably, an adequate training and knowledge have to be balanced (Lorenzi & Riley, 1995; Lorenzi *et al.*, 1997). Management team has to be selective of choosing the right options for their practice.

While EHR gives extra benefits for hospital, there are also many barriers and obstacles that they need to overcome. EHR are reducing unnecessary costs needed, medical errors, and improve patient care (Shekelle *et al.*, 2006). Nevertheless, it remains to be barriers for physicians and doctors to fully accept

EHR into the practice. The system often fails because it is trying to satisfy hospital management needs instead of medical staffs and users (Lorenzi et al., 1997). That is why at the beginning of the implementation, physicians and other medical staffs feel unsatisfied with EHR. With continuous improvement, EHR is trying to satisfy physicians and users by getting better interface and less complicated systems.

4.3 EHR benefits

EHR offers significant benefits for hospitals as well as physicians and medical staff. By computerizing medical documents and patient record history, it is minimizing potential medical errors, reducing costs, improving patient care, and engaging doctor-patient relationship (Shekelle *et al.*, 2006). By using EHR, the benefits can be perceived for both hospital management and physicians. The use of EHR offers a variety of benefits, which will be described in more details in the next paragraph.

EHR helps physician to reduce number of errors occur in the practice. During the practice, physicians often made medical errors with paper-based, which might results in important errors. In the interview, some doctors and nurses told that they sometimes made slight mistake while filling documents for patients. For instances, in paper-based, they have to look patient history separately while in EHR, when they open for relevant patients record, their history including any allergies and other medical symptoms are being displayed concurrently. Moreover, there is a chance of having medical spelling error due to unreadable handwriting from the prescription, which can cause wrong medicine given from pharmacy. With EHR, not only patient history records are being displayed, but also there will be updates regarding new medicine needed for that particular indication. If patients are having a surgery, any medical staffs who are opening their files will know immediately if patient has any allergic to particular medicine or antibiotics.

Having EHR also means improving quality of patient care. It helps physician to give patient accurate information concerning their medical evaluation. In the new system, they could give follow-up information to patient after consultation hour by sending email. Additionally, a reminder about the upcoming appointment can also be send through email. In EHR, patients who are seeking for more than one physician are also being record in the system. Therefore, doctors might know to whom they might consult if there are something occurred. By having better quality of patient information in the records, it helps to reduce the number of errors and thus it will improve quality care of healthcare. The good thing about having all patient data in the records is doctors might know what diagnosis made by other doctors. Consequently, there will be no double diagnostics being made from different physicians.

The main factor of EHR adoption is for improving efficiency especially time efficiency. With paper-based, hospital staff have to spend more time organizing patient data. To organize everything in a neat order will take forever and usually they do not have much patience with that kind of things. With this feature, it offers a huge help for administrative people within hospital to organize their work in a correct order. It is also fasten the search process for patient records with insurance claim. By not using paper-based, the storing costs will be eliminated accordingly. Moreover, EHR will improve patient data confidentiality, which is lack in paper-based system by using unique username and password security for each staff.

4.4 Chapter Summary

This chapter explained about the EHR implementation with some information necessary during the process including various stages of EHR, which will be necessary for operational activity in several hospitals in Indonesia. In total, there are five stages including assessment as the first stage, planning, implementation, evaluation, and last stage continuous improvement. In these stages, details of what hospital want to achieve by implementing EHR are being explained. It is important because in order to work effectively, the new system has to be match

with hospital goals and objectives. By having those stages explained clearly, hospitals might have a clear mind and idea what to achieve by replacing paper-based with EHR.

However, during any implementation process there will always be a barrier. As for the most challenging part from the process is about technology and financial problem. Indonesia is an emerging country with many islands and therefore it is quite challenging to have a good IT infrastructure in across the islands. Moreover, physicians often feel that it is somewhat difficult to adapt with new system as they already get used with paper-based and from the interview, it was found out that changing people habit is indeed relatively challenging task. Another barrier that arise during implementation process is insufficient training that many physicians as well as nurses felt. For hospital staff with no prior typing skills, it is time consuming and makes the work less efficient. This problem might encountered because lack of training from the hospital management.

Despite of barriers during implementation phase, EHR offers clinical and non-clinical benefits benefit for both hospitals and physicians. By implementing EHR into hospital management systems, any possible medical errors could be minimized. In the paper-based system, physician often made mistake during diagnostics patient symptom. For instance, any allergy that a patient had might be forgotten to be included in the files, which could lead to serious problems if other doctors read the records. The important factor of EHR implementation is to improve work efficiency both clinical and non-clinical including time efficiency. It will take more time to organize and handle patient history records in paper-based as most staff feels a bit reluctant to manage those kind of works. With EHR, physician can improve quality of patient care. In the new system, there will be a reminder for patients follow up scheduled consultation with physicians, and there is an email sent to patient for that.

CHAPTER 5: Questionnaire and Interviews

In this chapter, all interviews that have been done will be explained with further details. All the interviews took place in several hospitals in Jakarta, Indonesia. Numerous doctors, nurses, and IT staff were being randomly chosen for this research. There was a limitation during the interview as it was only 8 hospitals in Indonesia that implement EHR into their hospital systems. The detailed explanation of different hospitals will be discussed in the following lists:

City	Type of Hospitals	Hospital name	Type of EHR installed
Jakarta	Public	RSCM (Rumah Sakit Cipto Mangunkusumo)	Partial
	Private	RS PIK (Pantai Indah Kapuk)	Partial
	Private	Mitra hospital	Partial
	Private	RS Puri Indah	Fully
West Java	Private	Eka Hospital	Fully
Klaten Regency	Mother and Child public hospital	RSIA Aisyiyah (Rumah Sakit Ibu dan Anak Aisyiyah)	Partial
Bali	Public	RSU Tabanan (Rumah Sakit Umum Tabanan)	Partial

Table 1: list of hospitals that implemented EHR

According to the list, it was only two hospitals, which fully implement EHR features and functions into their operational systems. However, due to time constraint and difficulty of interviewees, the entire interviews were only made in Jakarta.

5.1 Questionnaire

In total, there are 10 questions being asked to interviewees and these questions are related to this main research question, including:

A. Questions related to features and implementation

In the first two questions, the focus will be on exploring the further features and implementation of EHR from each hospitals.

- 1) What are the features of EHR implementation that will be necessary for operational and functional activity in most hospital?
- 2) Are there any rules to implement EHR in general?
- 3) How can the implementations of EHR become economically sustainable?

B. Questions related to current security adoption for EHR

The next questions will ask regarding the current security adoption being used for the implementation of EHR.

- 4) What is information security in the context of implementation of EHR?
- 5) How does hospital manage their data security in implementation of EHR?
- 6) What are the critical factors which resulting in security success or failure in the implementation of EHR with an emphasis in developing countries?
- 7) How can be the investment of security system would be plausible and reasonable for EHR?

C. Questions related to security issues on implementation of EHR

As there are some issues in the security in the implementation of EHR, the following questions are being asked to answer those issues.

- 8) What is the current security issues which hospital faced in the implementation of EHR?
- 9) What are the future plan for prevent security issues in the implementation of EHR?

10) How to prevent the mitigation of data breach and fraud in the implementation of EHR with an association between public and private hospital?

Some questions are not applicable for some doctors and nurses as they are focusing more on how EHR helps their daily operation instead of technical point of view. The table below will describe the interviewees, which are involved in this research, including:

Name	Occupation	Workplace
Bing Christanto D.	Head of IT department	RS PIK
dr. Rahyussalim, SP.OT	Orthopaedic Surgeon	RSCM
dr. Bonifacius Lukmanto, SP.B	General Surgeon	RS PIK
Kurniawan	IT manager / co-owner	PT. QPRO Sukses Mandiri
Liana Mangkusaputra	Nurse	RS Mitra Kemayoran
dr. Yahya Darmawan, SP.OG	Obstetrics & Gynaecology Surgeon	RS Mitra Kemayoran

Table 2: list of interviewees

There are six people including doctors, nurse, and IT staff from different background being involved in this research. The detailed result from the interviews will be elaborate in the other chapter.

5.2 Hospitals History

Cipto Mangunkusumo Hospital

Cipto Mangunkusumo Hospital (RSCM) is the general national hospitals in capital city of Indonesia, Jakarta. It was established in 1919 during Dutch colonial with the name 'Centrale Burgerlijke Ziekeninrichting Salemba' which later was renamed Cipto Mangunkusumo Hospital to honour of Dr. Cipto Mangunkusumo a

member of the Indische Partij in Dutch colonial period (RSCM Hospital, 2011). As the general national hospital in Jakarta, RSCM serves not only patients from Jakarta but also from other provinces and even from other foreign countries. With a long history built around the time, RSCM considers the needs of people in the health area and keeps growing for better care in the future. One of them is by giving the best service and treatment in each health unit. Therefore, there are 11 health units, such as:

- 1) Emergency unit
- 2) Polyclinic unit
- 3) Hospitalization unit
- 4) Operating room
- 5) Blood transfusion
- 6) Medical rehabilitation
- 7) Radiology
- 8) Radiotherapy
- 9) Laboratory
- 10) Pharmacy, and
- 11) Integrated Cardiac Unit

Operationally, RSCM has a laboratory that operates 24/7, even on Sundays it is operating especially for patient whom needs urgent laboratory check. There is not only a focus on providing health services to patient, but the hospital also provides other non-health services including free hotspot, ATMs, restaurants and canteens, and a pharmacy.

Since May 2010, RSCM has decided to open another sub unit hospital, which is more modern and available for private patients called RSCM Kencana (RSCM Hospitals, 2013). The reason they opened another private hospital is to enter the competition with other private hospitals in Jakarta. With rapid globalization, they could not ignore the fact that if they are competent enough, they will lose staffs as well as patients. Moreover, the management team wants to build hospital management system in accordance with the best practices. Therefore, RSCM Kencana was built to fulfill those objectives.

CHAPTER 6: Results of Questionnaire

The introduction of EHR has been targeted to reduce number of unnecessary workload for physicians and enhancing quality improvement care, but also at the same time introducing new costs needed and complexity to hospital environment. Having a sustainable EHR towards costs would support physician in making better medical decisions in terms of system selections, and optimization. Especially in developing countries, introducing new system in medical environment contains more risks and consideration for every party involved. For hospitals in a big and most populated city in Indonesia, for instance Jakarta, it will not be a significant barrier for EHR adoption, however, for small hospitals, it will become more significant problems for any barriers and maintaining its sustainability.

6.1 Interview Results of questionnaire

In total, there are six interviews being conducted. People whom experienced in their fields are being approached during this project through interviews. The entire interviews itself took place in several hospitals in Jakarta from different professions including doctors, nurse, and IT consultant. We decided to make it as semi-conducted interviews which easier to follow. The whole interviews were made in Jakarta because of time and costs limitation, as it was not easy to approach for the interviewee in both Jakarta and other cities.

During the interviews, we decided to approach one of the oldest and biggest public hospital in Jakarta, RSCM (Rumah Sakit Cipto Mangunkusumo). We managed to interview one of influence people who understand about EHR implementation in RSCM. dr. Rahyussalim, SP.OT from orthopedic department managed to spare his valuable time to share his knowledge and opinions regarding EHR implementation in RSCM. He mentioned that EHR implementation in RSCM was done partially. RSCM itself is divided into two main hospitals; one is opened for public, which still held the origin from colonial heritage, and the other is the new branch called RSCM Kencana, which built to compete with common modern hospitals in Jakarta. However, up until now, they

still could not manage to implement the whole features of EHR because it requires large amount of money. EHR was introduced for the first time in RSCM in 2007. It was indeed a difficult task when it first introduced this system into society. Not only it requires large amount of money, but it also difficult to convince people to adapt to this new systems, especially executive levels.

It was mentioned in the interview that dr. Rahyussalim, faced hard time to convince higher-up to invest the required fund for implementing EHR in the hospital. Even though it was hard to persuade higher-up, there are many investors, who were willing to invest in this new innovation. Compared to private hospitals, public hospital received more attention both from government and other private parties. Moreover, like the other obstacles during implementation of any new systems, he found out that the most problematic point was about training. It was already in the agenda but it was still difficult to do. Actually, he was really willing to be trained, but apparently, there were some people who are not. In reality, there are still people who just do not care about the implementation and the management team still found it was somehow challenging. The objective of this implementation is simply to help the operational activity in the hospital itself.

In terms of software and hardware supports, he said that they did not have any difficulties at all, as majority; Internet and other technical support are already available in any places in Jakarta. For Kencana, they decided to do full implementation. However, for RSCM, because it is an old hospital with old systems, they implemented partially. Moreover, not all EHR features are being implemented in their systems. It took some time and more funds to build it. Furthermore, even though, the building is separated, their IT system is centralized. Another problem that arise during the implementation in RSCM was culture. dr. Rahyussalim stated that it was really challenging to change people habits. Previously, RSCM was using paper-based for their operational activities including administration, finance, pharmacy, and billing. Therefore, the transition process from paper-based to electronically systems is not an easy task to do. Many people at first did not see the benefit of it. The team had to change

people mindset about EHR, so they did not see EHR implementation as a burden. Of course, any kind of changes will make people feel not familiar and very unpleasant. But once they know exactly the benefits, they will adapt eventually and the implementation will be successful without any constraint, he said.

During the interview, he also mentioned concerning security in EHR especially for RSCM. Earlier back then when the hospital used paper-based, they were facing difficulty towards data fraud of patient records. In their systems, they are still relying on username and password. It was already decided that from the beginning, the hospital would like a system that has restricted access. It means that only hospital staff could access the system. Because it is an Internet-based, not all people can have access to the systems. A pre signed-up agreement is given to the staff for not sharing their individual password and credential information to other people. After implementing EHR into their systems, the hospital has not experience any data fraud, in which they experienced when using, paper-based.

Move to the next interviewee, we managed to interview another expertise from PIK (Pantai Indah Kapuk) Hospitals, one of private hospitals located in North Jakarta. Mr. Bing Christianto and dr. Bonifacius Lukmanto, SP.B are the second and third interviewees that we could manage to interview. Mr. Bing Christianto is the head of IT director, which have more experience in IT field for the hospital itself and dr. Bonifacius Lukmanto is the head of general surgeon in the hospitals. We included an IT specialist in this interview is because we would like to compare and gained more results and information from different perspective. During the interview, Mr. Bing was mentioned that implementing EHR that would fit with their systems was rather difficult. The difference with public hospital is funding for any telemedicine implementation is much easier than private hospitals, he said. Similar with RSCM, PIK hospitals also already implemented partial EHR. Based on the interview results, most of private hospitals in Jakarta are implementing partial EHR. Partial EHR in this context means that only half of the features are implemented in the systems. The reason why partial EHR is chosen by most hospitals is because of the costs and culture. As already mentioned in the previous interview, it is hardly less encouraging to

change people habits and their way of thinking. Most people are already comfortable and getting used of paper-based systems. Hence, for people to fully adapt with computerized takes more time and effort.

For the medical records, they still have some work done manually. They already implemented EHR for radiology, billing system, administration. For administration process, there are several steps to be followed, such as patient registration, patient referral to doctors, and pharmacy. Every costs being spent by patient, either service costs for the doctors or laboratory costs will be automatically updated to the system and come to the billing for patient to be paid. The doctor itself will do this while they are conversing with patients. Mr. Bing mentioned during the interview, at the beginning of implementation phase, the software they were using did not supportive enough for them to implement EHR. There were a lot of adjustment needs to be done for them to finally implementing EHR. Currently, they are using SAP for medical information system only. It covers billing and administration function only. They are still considering the funding because it costs them great amount of money to implement full features of EHR. The higher-up was reluctant and still needed to think further regarding this matter. They were thinking for another options for chemical patient information including inpatients, body temperature result, blood pressure, and how the current patient conditions. Moreover, they already looked up for local developers who offer for better price to build the systems. However, there are things that need to consider, which might arise, one of them is people. They have to be sure whether the people ready or not with the new system. Also he indicated that it would take longer time than usual for eventually people adapt to the new systems. During the interview, dr. Bonifacius Lukmanto stated that there was not enough training from management team at the hospitals, especially for medical staff. There was not enough time for them to receive full training session. From his opinion, some doctors were not willing to be trained because they did not think it was necessary and it would waste their time.

Regarding security matters, PIK hospitals are also relying on unique ID and passwords for its personnel. They are using SAP software for their operational

systems including billing, administration, and finance. From SAP itself, it has its own user ID and password. Each ID has its authority and access. Only accounting people have access for accounting module, and only inpatients staff can have access to inpatients module. IT team has set up for the roles and so on. The better the software did the programming, the better for data complexity so that patients could have access to their data but not modify them.

The next hospital that we could manage to interview is Mitra Kemayoran Hospital. The interviewees for this interview include two people, which are dr. Yahya Darmawan, SP.OG and Mrs. Liana Mangkusaputra. dr. Yahya Darmawan is a Obstetrics and gynaecology surgeon, which has more experience in his field while using the system, whereas Mrs. Liana Mangkusaputra has already experienced in assisting doctors and using EHR during the activities. During the interview, dr. Yahya specified that for viewing patient medical records, they were still doing it manually, meaning that only partial EHR was implemented in the hospital systems. He and Mrs. Liana said that up until now, it was only radiology, laboratory, pharmacy, and patient anatomy result which already using full EHR implementation. Other than that, they are still doing it manually. However, billing, finance, and administration process already using electronic systems.

As far as both dr. Yahya and Mrs. Liana know, hospital systems is a centralized systems, so apparently, they could see the needed data in each department. However, their access are restricted by username and passwords. These username and passwords will be changed frequently and they will get the notice for it. Not all users can access the whole data; only certain people could see the entire data. As same as PIK hospitals and RSCM, the staff members have to sign agreement concerning their confidentiality, that they will not share their ID and passwords to other parties. We asked if there is any concerning difficulty regarding the security, both of them said that there was no problem at all while using the systems. They mentioned that there was a penalty for breaching the signed agreement, as they would get fired from their job. As far as they concerned, for EHR implementation, the hospital is using consultants to make

things easier, as they thought. To ensure that EHR would be successful or not, there are a lot of things that need to be considered. One of them is having user friendly and reliable IT infrastructure. Mrs. Liana also mentioned that users are encouraged to accept changes and how fast they could adapt to new systems. Moreover, the programs, which made from the management team so far, must satisfy hospital needs and what can the hospital achieve by using this system.

At last, Mr. Kurniawan from Qpro solutions was willing to share his valuable information to help this research. During the interview, he stated that from his experiences with several clients, trust is their biggest concern. It is because they are a local company that provides health service; so they have to compete with other well-known brand such as SAP, METCNET, and many more. Most of them already have more experience and the hospitals see that aspect more. However, in terms of costs, they are confident enough that they are reliable enough so hospitals do not have to worry much. The company offers packages depending on hospitals' budget; therefore, it will be adjustable according to the condition. For approaching hospitals and persuading them to use their products is quite challenging, he said. It depends on the hospitals' management and visions. Some hospitals require simplicity and less complex systems, nonetheless some of them require more complex systems depending on the needs. The first step of their approaches is distributing survey to gather all the required information regarding hospital needs, and based on the filled survey, they will modify the programs adjusted to their needs. They have different stages of the system offered including Business Process Reengineering, consultation, audit assessment, and Training and Education. One of their clients, only use the services for training and education purposes, he mentioned.

The security of the systems works in this way; the company will have people maintaining the system via server and host IP. To ensure the systems security, they are also providing guarantee and monitoring the progress of designated systems with online documentation as well. Rather than outsourcing the security systems, they were decided to implement the security in the system as well so user will not get confused. From registration, billing to payment, they will make

the modules as less as possible for user, because they know that doctors and hospital staff might not have much time to handle complicated work. The programs have a lot of modules, for instance in patient records, there are specific procedures and steps for users to input for their data, as well as other modules. He is confident that EHR implementation will be a great success in every aspect respectively. Nonetheless, it will take time especially for people to adapt. He said, it was very difficult to convince people to change their habit. Many people still think that using manual was more comfortable and did not really applicable to use sophisticated system. Most people still think that the new systems will just make things more complicated. And even though many investors are trying to invest, some hospitals are still reluctant to use medical record because the costs are too high for them, especially for small to medium hospital.

6.2 Chapter Summary

In this chapter, all interview results we have been doing is presented. The interviewees in this research are experts in their field with various experiences from different hospitals and IT Company. According to the results, most of them mentioned that the problem with EHR implementation is people. Changes require people to adapt accordingly with the situation; however, it will take time and effort. It depends on work culture in the workplace. The perspective from doctors and medical staff as well as IT staff is different. Both of them have different opinion regarding EHR, but they agreed that EHR is secure enough in protecting patient records and to prevent from data fraud, which they experienced before with paper-based.

Many parties are still reluctant to implement EHR into their systems, it is simply because many people are not fully understand the benefit of it. Especially for people from analog era, using digital systems is quite challenging and hardly acceptable for them. Without proper and adequate training, they will not perform well in their jobs. Some hospitals were decided to implement EHR in-house, but some decided to outsourced from third parties. Both public and private hospitals were implementing EHR partially. Up until now, there is no hospital implements full EHR, because of other factors, which already mentioned

in the previous section. In the table below, there is a summary of findings from the interviews.

Categories	Findings	
	Public hospital	Private hospitals
Human resources	Most doctors from several hospitals stated, it was difficult enough to change people' habits because they were more experience with paper-based.	
Security	From both physicians and IT staff in the hospitals feel that there is no security threat up until now and it works perfectly fine with the systems.	For private hospitals, doctors did not feel any security threats from using the new systems.
	They are relying on using unique ID and password for data protection.	Each doctor and hospital staff is given a unique ID and password to access the systems.
Finance	There was no financial problem for implementing the systems. Many investors are willing to invest in this project.	There was still under discussion regarding financing the projects, and some hospitals are still reluctant to implement EHR.
Success rate	Physicians and hospital staff are confident that EHR implementation will be very useful and helpful in every aspect.	
Management	There will be always any disagreements towards higher-level people in the hospitals from physicians and lower level staff.	There are some disagreements towards management team regarding the implementation issues.
Development	They were using in-house development because it was easier to maintain if there are any issues during the implementation process.	Outsourcing is the best option for them because it is less effort for any maintenance and costs.
Stakeholders	Less political wheel for EHR implementation.	More political wheel for EHR implementation.
EHR modules	Every EHR features and modules are important for hospital daily activities.	
Challenges	There is no significant problem of using the systems.	Physicians have to divide focus on communicating to patients and putting the data into the systems.
	Training people to be able and fully understand how to operate the systems are difficult.	There is no enough training for staff and physicians to be able to operate the systems appropriately.
	Not all people coming from medical background, therefore some medical terms are not well known. Consequently, there is slight mistake when inserting data into the systems.	
	Cultures and habits are some issues, which are concerned by physicians.	
Internet availability	There is no issue for having reliable internet connections in big cities, however it will be quite difficult in small cities.	

CHAPTER 7: Conclusions

The objectives of this research is to explore the current security EHR implementation in Indonesia, in this case is limited to Jakarta. With this project, it will hope to give a better insight academically to medics and IT people in Indonesia for better understanding about EHR and healthcare information systems. Moreover, it is expected to be a great influence and give impact in health care systems in Indonesia. According to the main research question for this project: ***Is the current security adoption adequate for the implementation of EHR in Indonesia?*** We are hoping to be able to answer the question in a correct manner.

7.1 Limitation of study

This research is limited to only in security scope only for EHR implementation. The geography for the interview is also limited only to Jakarta. It is because most private hospitals that already implemented EHR although only partially, located in Jakarta. We think that it will be much easier to approach hospitals in Jakarta for time efficiency. Moreover, time constraints become one of main reasons for geography selections. This project is constrained by interviewees' willingness for interview, which also becomes another major obstacles for this project. We distributed copies of invitation letter for conducting an interview, but many of them rejected with the reason of do not have enough time. And therefore, we appreciated their decisions.

7.2 Summary of findings

As already described in previous chapter, there are some differences between public and private hospitals on how the approach for EHR implementation. Public hospital was decided to have in-house development for the implementation, whereas private hospitals were decided to hire third parties or consultants. The reason for private hospitals are using third parties is because it will be easier to adapt the new systems. Normally, using third parties will make

less work and more efficient as they will provide everything including training and manuals until the systems fully implement. People and culture play the biggest roles in EHR implementation for many hospitals in Jakarta. Changing people habit is not a task that can be done within a night. It will take longer time during transition process from manual systems to finally enter electronically. People who are already convenience with paper-based will feel reluctant at first to suddenly use new systems. Hence, proper training is needed to provide people with adequate knowledge about EHR.

According to research of questionnaire, having a proper training also become another obstacle after the implementation. Even though hospitals management teams are providing training for the staff, some people are not willing to do and do not care about it. It will become significant problems in the future because hospital staff is the end users who are going to use it in their daily activities. EHR is secure enough in protecting patient records and to prevent from data fraud, which most hospitals experienced previously with paper-based. Every interviewee that we had interview, stated that they were optimist that EHR will be successfully and gives significant impact in health systems in Indonesia.

In order to answer this main research question, the formulated sub research questions might help to answer it in appropriate manner. The question for this research is answered by gathering data from interviews made from different hospitals and expertise. The following sub questions and its significance towards the main research questions are given as follow:

Sub-question 1: What is information security in the context of EHR implementation?

Security is supposed to secure and protect the entire data stored by EHR including patients records and that an authorized party can only retrieve the data. Security for EHR covers patient's confidentiality as well as integrity, availability, and accountability. In order to improve healthcare quality, patient medical records and information are needed eventually and plays a major role.

For patients and other parties to be comfortable to participate, the protection of EHR security and other medical records must be reliable and trustable enough.

Sub-question 2: *What are the phases of EHR implementation that will be necessary for operational and functional activity in most Indonesian hospital? What are the barriers on the implementation itself?*

There are five different EHR implement stages that hospital needs to adapt. These stages hold different goals and functions that hospital needs to achieve. After they follow and accomplish each stage, the functionality and quality of patient data can be measured accurately. There are five differences of EHR implement stages can be described including assessment, planning, implementation, evaluation, and continuous improvement. During the implementation phase, there are many obstacles and barriers that many hospitals face in Indonesia. The most challenging barrier during the initial implementation was about technological and financing limits.

Sub-question 3: *How can the implementations of EHR become economically sustainable?*

The main factor of EHR adoption is for improving efficiency especially time efficiency. With paper-based, hospital staff have to spend more time organizing patient data. To organize everything in a neat order will take forever and usually they do not have much patience with that kind of things. With this feature, it offers a huge help for administrative people within hospital to organize their work in a correct order. It is also fasten the search process for patient records with insurance claim. By not using paper-based, the storing costs will be eliminated accordingly. Moreover, EHR will improve patient data confidentiality, which is lack in paper-based system by using unique username and password security for each staff.

Sub-question 4: *What are the critical factors, which results in security success or failure in the implementation of EHR with respect to security in Indonesia? How are the privacy and security regulation for patient data in EHR?*

Most hospitals have been already implementing firewalls and encryption technology in the medical records system to fully ensure EHR security. In Indonesia, as most of EHR implementations elsewhere, this is done by hospital incentives, and many of them are relying on the password protection for the security. One of the important tools for data security is by using audit trails as some of the security breaches might have resulted from misuse of access privileges by authorized person. Human resources will also play the major role for the implementation, because at the end, hospitals staff are the end user that will use the systems.

Sub-question 5: *Is the current security system in Indonesian hospital adequate for EHR? How is the hospital management influenced by the implementation itself?*

Most interviewees stated security systems that implemented in their hospitals is reliably secure. Compared with paper-based, they are comfortable enough with the current systems. Each staff is provided with access that restricted by unique username and passwords. These username and passwords will be changed frequently and therefore, not all users can have access to the whole hospital data; only certain people could see the entire data.

7.3 Recommendations for future research

Generally, many hospitals already have thought on implementing EHR in their systems. EHR is already growing in many hospitals in Jakarta since 2007. Health systems in Indonesia in the past day were relied on manual work such as paper-based. However, since the introduction of electronic health records, slowly hospitals in Jakarta are trying to adopt this to fit into their systems although most of them were trying to do it partially because of applicable constraints.

From technology perspective, many hospitals are still implementing EHR partially. It is hoped that the next two years, they will be able to implement full EHR. More local IT company has to be more active in developing EHR systems within affordable budget so hospitals have more variance in choosing the best fit with their vision. With technology advances, any barriers during the implementation could be eliminate and having smarter programs for health systems.

From the users perspective, it is hoping that in the next few years, EHR will fully implement and work accordingly. It will make things less complicated and more efficient. Proper training is necessary so people will know more the benefits of EHR. User engagement and active marketing would also be actively involved to create awareness of EHR.

Indonesian government should involve more actively in EHR as it came up during the results, EHR receives less attention from government. It is important because providing the best services for people is a necessity for citizen. Various interesting findings during this research is linked to people mindset of how EHR will give impact on physicians workflow and efficiency. This interest is compound and offers more opportunities for future research. Related issues including data lost in patient records, the need for sufficient training, and technical supports. It is hoped that in the future there will be more research related to this subject and people will pay more attention for security matters of EHR.

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