Barriers and Success Factors for Implementation and Adoption of Healthcare Information Systems in Developing Countries: A Systematic Literature Review

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Abstract

Developing countries often struggle to implement sustainable healthcare information systems (HIS) due to poor government policy and technological legacy. Bangladesh is a prime example where a large number of patients are deprived of proper healthcare simply because their data is fragmented and not digitally recorded. Several researchers have shown how standard healthcare systems in hospitals can reduce the complexity of patient management, thus creating room for serving more patients at the same time. Such standard systems can dramatically improve the scenario for developing countries. This thesis gives an overview of key barriers that is hindering developing countries to implement such HIS. It also accumulates the success factors to overcome the issues.

This thesis used a systematic literature review (SLR) to analyze the relevant literature in the field of information systems. A review protocol was developed to conduct the SLR. Relevant studies were collected from three databases, IEEE Xplore, Ebsco Databases, ScienceDirect. The initial search resulted in 4014 studies. The search was further refined and through a process of selection using inclusion and exclusion criteria, 19 relevant primary studies were reviewed to answer the research questions. This study identified 24 barriers which have been grouped into six categories, and 19 success factors, grouped into four categories.

The results show that HIS implementation in developing countries is hindered due to the lack of infrastructure, lack of education and awareness, lack of financial supports, cultural and political issues, resistance and support unwillingness, and lack of system quality. The findings also brought success factors as suggestions for successful implementation of sustainable HIS. The study found that utilization of resources to be most significant success factor which influences the successful HIS implementation.

Keywords

healthcare, information systems, developing countries, adoption, barriers, success factors

Supervisor

Dr. Dorina Rajanen

Foreword

First and foremost, I want to express my gratitude to my beloved parents who always been with me and encouraged me to complete my graduation. Thesis work is always frustrating and challenging but their supports made it easier to me. Without their support and encouragement, it was quite impossible to complete this thesis.

Also, I would like to express my gratitude to my supervisor Dr. Dorina Rajanen who gave me proper guideline and insightful feedbacks throughout the thesis writing. Whenever I was trapped with some issues, she was dragging me from there by providing valuable suggestions.

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Abbreviations

CMMI	Capability Maturity Model Integration
DOI	Diffusion of Innovation
DSR	Design Science Research
e-health	Electronic Health
EHR	Electronic Health Record
EMR	Electronic Medical Record
GIS	Geographic Information System
HDI	Health Data Integration
HIS	Health Information Systems
HMIS	Health Management Information Systems
IS	Information Systems
IT	Information Technology
m-health	Mobile Health
OIM	Organization Innovation Model
ROI	Return on Investment
SLR	Systematic Literature Review
TAM	Technology Acceptance Model
TOE	Technology, Organization and Environment
UTAUT	Unified Theory of Acceptance and Use of Technology
WHO	World Health Organization

1. Introduction

Treatment is one of the basic needs of human rights. Healthcare sector is one of the most important sectors in the world (Hamed, El-Bassiouny & Ternès, 2017). In most countries, governments are expending a big portion of their budget to the health sector each year. Information systems (IS) are applied every sphere of our daily life from education sector to medical sector. The fruitful utilization of information technology in developed countries has brought vast expectations in less developing countries that information technology could be used to increase productivity, profitability, and efficiency in their nations as well as fostering quick development (Krishna & Walsham, 2005). The recognized health organization WHO (World Health Organization) declared that ICT could bring the desired outcomes in the health systems (Bukachi & Pakenham-Walsh, 2007). Developed countries are making the best use of information systems in healthcare whereas developing countries are still struggling with the implementing IS in their healthcare systems. Many of the literature review said that it is quite critical to implement IS in less developing countries. Billions of people in developing countries are deprived from proper resources, which range from natural resources to lack of access to technologies (Walsham, Sahay, 2006).

Successful health information systems (HIS) implementation is a complex matter (Braa, Monteiro, Sahay, 2004; Sligo, Gauld, Roberts, Villa, 2017) and its success depends on organizational, human, cultural, and technological factors (Judith et al., 2017). This area requires more research and ongoing feedback to help developing countries progress towards success (Sligo et al., 2017; Bawack & Kamdjoug, 2018).

This study builds upon and extends previous knowledge about HIS implementation in developing countries. Moreover, observing the current situation of HIS implementation in developing countries and providing suggestions for better improvement is one of the main goals of this study. Therefore, this thesis will be conducted by applying a systematic literature review (SLR). In this SLR, the guideline has been mostly followed from Kitchenham and Charters (2007) to conduct the review.

This thesis is structured as follows: chapter 2 describes the related research relevant to this study; chapter 3 describes the procedure of SLR that has been followed in this study; chapter 4 states the results of SLR; discussion is presented in chapter 5; chapter 6 presents conclusion.

1.1 Background study

Though health treatment is the basic right of human life, people are not getting proper treatment in developing countries, for example Bangladesh and India. In developing countries, medical systems are not well advanced as like developed countries. Developing countries have some financial budget restrictions and corruption in government sector. Corruption is one of the major problems in developing countries. In the case of HIS in developing countries, the condition of private clinics is a bit better than the government clinics.
Condition of government clinics are very miserable. The HIS are fragmented and contradictory in developing countries (Braa et al., 2007). Braa et al. (2007) added that medical sector, including clinic and hospital is bit developed in urban areas, but the rural

areas are not getting enough medical facilities, due to lack of internet, electricity, and insufficient resources (Day & Gray, 2005). In eastern Africa, most of the medical colleges did not have enough books and have unavailable/restricted access to the web (Bukachi & Pakenham-Walsh, 2007). Bukachi and Walsh emphasized that very few medical professionals have access to the internet connection in sub-Saharan Africa. In this case, the big reason is bad communication between rural areas and urban areas. Most healthcare projects in developing countries fail to succeed because of lack of proper planning and corruption. The developing country Tanzania developed a health management information systems (HMIS) for their national health systems to collect the data but HMIS systems was not developed fully as they desired (Nhampossa & Kimaro, 2007). Nhmpossa & Kimaro (2007) mentioned several reasons behind incompleteness of HMIS such as absence of some basic functionalities and systems bugs. It is a bit difficult to bring development to the IT sector in less developing countries due to lack of IT expert, lack of awareness of using computer, lack of IT plans, and unfit infrastructure (Kimaro & Nhampossa, 2005). Kimaro & Nhampossa (2005) also stated that in most cases developing countries rely on foreign IT experts to implement HMIS. Additionally, there are some challenging issue while implementing IT such as absence of coordination, low quality data, less focus on information (Avgerou & Walsham, 2001). The implementation of information technology in developing countries like in Africa has been obstructed by poor infrastructure, political commitment, insufficient resources (Bukachi & Pakenham-Walsh, 2007). Bukachi & Pakenham-Walsh (2007) added that development of health sector in developing countries an international matter of discussion now. Edejer (2000) said, HIS is incompatible to the web in developing countries. Edejer (2000) also blamed that a small number of women uses internet, technology and web in developing countries which is also a reason behind poorly developed information systems in developing countries. In some developing countries including Brazil, the current economic situation might bring extensive deficiencies in social policies including those related to public medical services (Tomasi, Faccini & Maia, 2004). Connectivity is not still well established in African continent and people from this continent use very slow internet connections (Bukachi & Pakenham-Walsh, 2007). Delivery of health services in developing countries is complex thing (Braa et al., 2004).

1.2 Research objective and motivation

The objective of this research is to determine the existing barriers in adopting and implementing successful HIS in developing countries, and to find out the success factors for successful HIS implementation and adoption in developing countries.

Developed countries in Europe and America currently place emphasis on the equal opportunities for all people while developing countries are struggling to meet their basic human rights, including medical treatment. In developing countries, a good amount of people are losing their life from different kind of diseases, for example cancer for lagging behind in proper use of latest medical technology in their health systems. In developing countries including Bangladesh, whole medical systems are not integrated. They do not have any central storage systems where patient's information and prescription could be stored. As a result, patients are bound to keep their prescription (paper version) with them for further uses.

The role of public healthcare in developing countries is undervalued. It is subsequently reasonable that the value and significance of ICTs in health is progressively being praised around the world (Chikotie et al., 2011). Healthcare services are difficult to assess because of their technicalities (Hamed et al., 2017).

1.3 Research questions

The aim of this research is to find out the barriers and success factors for successful IS implementation in healthcare in developing countries. Result of this research is expected bring new insights and opportunities to improve the current state of healthcare systems in developing countries. Throughout this thesis, the research questions will be as following:

1. What barriers have been reported for successful IS implementation and adoption in healthcare in developing countries?
2. What success factors have been reported for successful IS implementation and adoption in healthcare in developing countries?

2. Related Studies

This chapter describes background information on information systems implementation, IS adoption models and frameworks, IS success factors in general and information systems management. The models described in this chapter form the foundation of the research and literature review in this thesis.

2.1 IS implementation

Information systems can be developed through social or technological viewpoint (Hyötyläinen, 2013). According to Hyötyläinen (2013), the technological viewpoint focuses on function analysis and information collecting. On the other hand, the social viewpoint emphasizes the social and organization construction (Hyötyläinen, 2013). The information systems implementation is a progressive organizational process, in this case different types of innovation steps taken by the organization, and people of that organization play an important role in the process (Hyötyläinen, 2013). New IS implementation is a time-consuming issue. Information systems implementation is a part of IS development process which is allocated to distribution of IS in specific purpose of use (O'Brien, 2004). According to O'Brien (2004), IS implementation activities involve software acquisition, hardware acquisition, software development, testing and documentation. Information systems development cycle consists of five steps: systems investigation, systems analysis, systems design, systems implementation, systems maintenance (O'Brien, 2004).

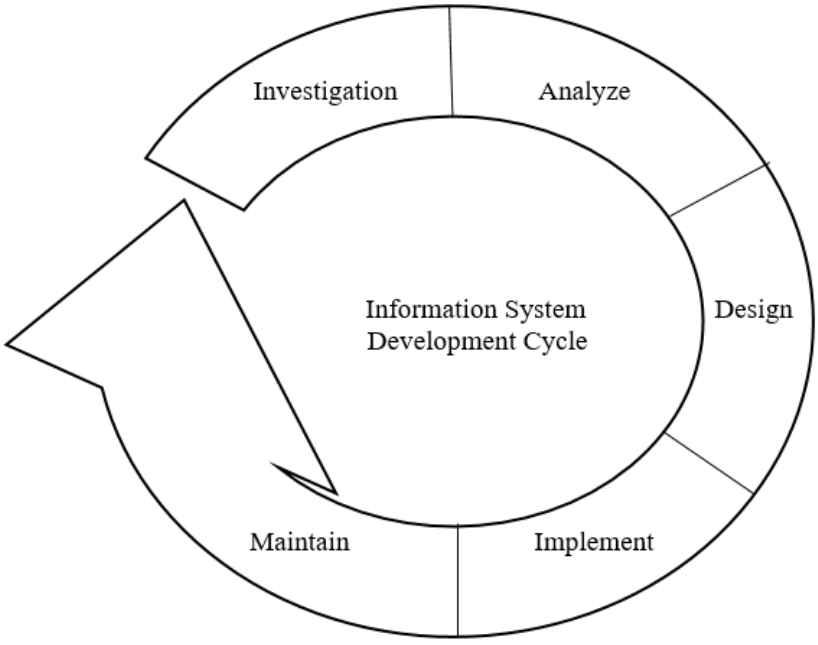

Figure 1. Information Systems Development Cycle (O'Brien, 2004)

It is very clear from the cycle that IS implementation is a part of information systems development process, see Figure 1.

2.2 Adoption of information technology

In this century, the most important and rapid growing technological revolution is computer-based information systems (Thong, 1999). Thong (1999) said adoption is a dependent variable of IS. Adoption is a procedure that includes a large number of exercises, choices, and assessments which incorporate the wide endeavor to effectively coordinate an advancement into the functional structure of a formal association (Price & Lau, 2014). IS adoption can be defined as utilizing computer software and hardware applications to complete tasks and decision making in the business (Thong, 1999). Most of the time it is very difficult to adopt IS in organizational level because of lack of resources (Thong, 1999). Prior studies on adoption and implementation of information systems have addressed some challenges. There are plenty of theories about technology adoption used in IS research (Oliveira & Martins, 2011). Two adoption models are widely used in organizational level, they are: the diffusion of innovation (DOI) and the technology, organization and environment (TOE) framework (Oliveira & Martins, 2011).

2.2.1 Diffusion of innovation (DOI)

DOI theory helps to develop conceptual models which evaluate the effect of latest technology on users over time (Alkhateeb, Khanfar & Loudon, 2009). Alkhateeb et al. (2009) mentioned in their study that DOI theory is extensive, specific, and analyze the rate of adoption. People are viewed as having distinctive degrees of eagerness to adopt innovations, and in this manner, it is generally noticed that the segment of the population embracing an innovation is roughly regularly allocated over time (Oliveira & Martins, 2011). Rogers (1995) stated in his studies that this allocation can be categorized into following five types of individual innovativeness: innovators, early majority, early adopters, late majority, and laggards. The innovation process generally involves number of people including both supporters and opponents of new concept whereas each of them play a vital role regarding innovation-decision (Oliveira & Martins, 2011).

Based on DOI theory at organizational level, Rogers (1995) developed a model which describes links between impacting factors and adoption of a specific innovation (Dibra, 2015). Figure 2 displays this relationship. It should be noted that DOI is different from the so-called organizational innovation model (OIM). The difference between organizational innovation model and adoption model (i.e., DOI) lies in the questions that must be analyzed (Dibra, 2015). Dibra (2015) mentioned in her studies that, according to Rogers' (1995), OIM concentrates on organization characteristics which help to adopt an innovation. The level of adoption centers around the apparent qualities of innovation that are considered to have significant impact on the capacity to be adapted to development (Dibra, 2015).

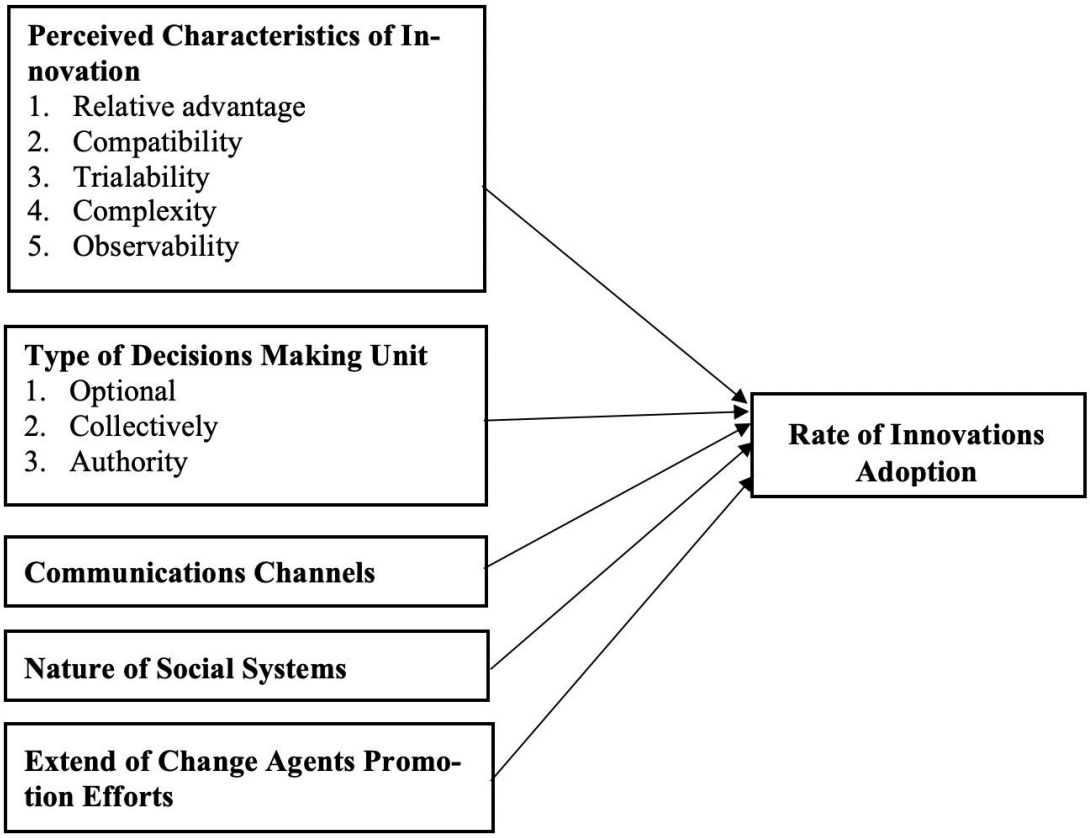

Figure 2. Rogers initial model on adoption of the innovation (Dibra, 2015)

The theory of DOI has been applied in various IS research and IS adoption studies, such as: material requirements planning, intranet, e-procurement, e-business (Oliveira & Martins, 2011).

2.2.2 Technology, organization, environment (TOE) framework

Several studies addressed the TOE model to describe IT adoptions. The components were grouped into a framework of technical, organizational, and environmental complexity, called TOE framework (Bosch-Rekveldt, Jongkind, Mooi, Bakker, Verbraeck, 2011). TOE model has been used in open systems, electronic data interchange (EDI), enterprise resource planning (ERP), e-commerce, knowledge management systems (KMS), and e-business (Oliveira & Martins, 2011). In industry-level TOE framework explains the adoption of innovations in an organization (Borgman et al., 2013). Borgman et al. (2013) mentioned in their studies that TOE theory distinguishes three different segments: technology, environmental, and organizational context to determine the adoption and implementation of an innovation. Those contexts have both limitations and advantages for the adoption of innovation (Borgman et al., 2013). The technology context of TOE framework refers to company's internal and external technologies (Borgman et al., 2013). The organizational context of TOE framework describes the internal communication process of a firm, amount of resources and size of the organization (Borgman et al., 2013). Borgman et al. (2013) also described that the environmental context of TOE frameworks relates to competitors, access to resources which is supplied by others, and the rules and regulations of government. Graphical view of TOE model is presented in Figure 3 based on Tornatzky & Fleisher (1990).

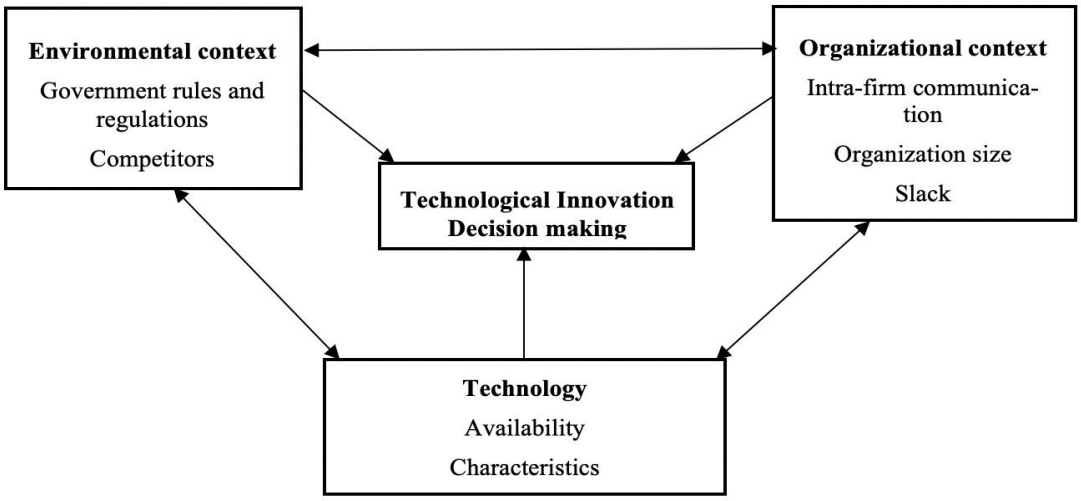

Figure 3. TOE framework (Tornatzky & Fleisher, 1990)

2.2.3 Adoption of health information systems

Web based integrated information systems provides some advantages (Joo & Hovav, 2016). Joo & Hovav (2016) discussed in their article about several adoption factors that influence information security of online-based integrated information systems. Joo and Hovav (2016) also mentioned about both organizational factors and individual factors for information systems adoptions. According to Joo and Hovav (2016) study, information systems adoption mainly depends on intention to use of the systems. Though HIS have seen fast advancement and expansive adoption, HIS partners encounter well-known levels of frustration related with more common systems development (Yusof, 2015). According to Yusof's (2015) study, a system should meet some criteria for adoption. These are systems quality, flexibility, information quality, service quality, systems development, training on that systems, user satisfaction, systems use, net benefits, and efficiency (see Figure 4).

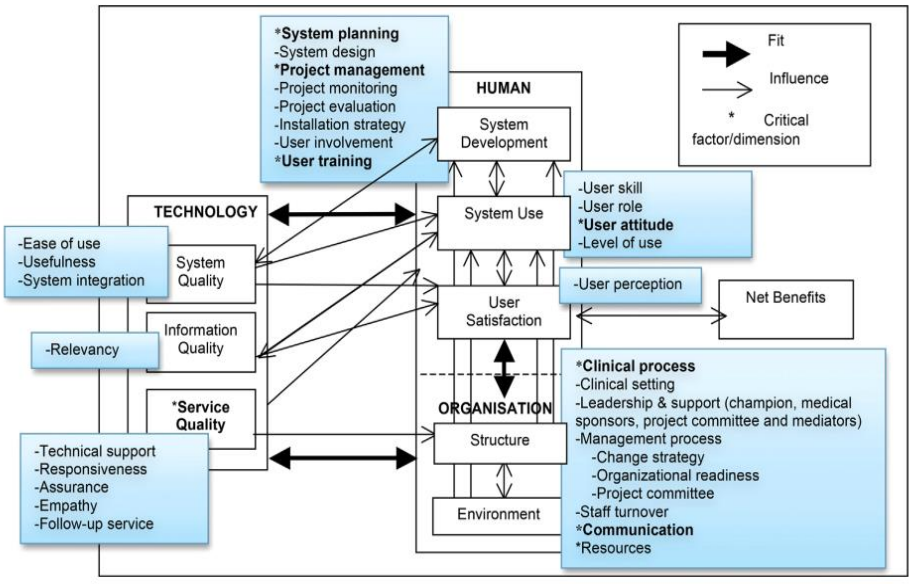

Figure 4. Factors influencing critical care IS adoption (Yusof, 2015)

There are also some very general adoption models outside of healthcare, they are technology acceptance model (TAM), information systems success model, UTAUT model, concerns-based adoption model (CBAM) (Price & Lau, 2014). Price and Lau (2014) is stated that capability maturity model integration (CMMI) concentrates on team managing development and this CMMI model is very useful in HIS development. Though the new systems already proven the benefits in improving the quality of healthcare delivery over the world, many less developed countries still rely on traditional healthcare systems which pose various issues, such as time wastage and issues of patient records (Bawack & Kamdjoug, 2018). Bawack and Kamdjoug (2018) stated in their paper that in the case of healthcare systems adoption, social influence can play a vital role; since HIS adoption mostly depends on level of involvements from patients, administration and government. HIS can be easily adopted if the HIS are mandatory and patients express their needs for these systems (Bawack & Kamdjoug, 2018). It creates an enormous impact on adoption. Bawack and Kamdjoug (2018) also mentioned that cost-effectiveness had no impact on doctor's motive to use HIS whereas user acceptance is a critical and significant factor in the HIS adoption. The root issues of critical care information systems adoption are poor planning, poor management systems of the project which affects systems installation and adoption (Yusof, 2015).

2.3 Success factors for implementing information systems

In the last few decades, the greatest challenges for information technology (IT) & information systems (IS) professionals is overall business strategy with planning and investments (Pekmez, 2016). Pekmez (2016) stated that IS has impact on the environment during its life cycle: most importantly consumption of electricity by use of servers and computers. To implement information systems successfully, some strategy should be noted: well-planned strategy, systematic strategy and thinking toward environmental concerns. Also, cultural difference is a big issue whether implementing information systems, particularly when project manager is totally new to the global context (Biehl, 2007). Biehl (2007) also stated some factors, these factors which could help to implement global information systems, such as top management support, business process capability, understanding goals, training, user attitude, sufficient financial resources, and data accuracy. Among them, top management support is the key factor while implementing complicated systems. Pekmez (2016) summarized some key success factors for sustainable information systems and these factors are given below:

- Cloud computing- no need of data centers and ingest less energy,
- Using virtualization software to separate servers into various machines,
- Keep replacing the aged equipment which is energy efficient,
- Use of thin-client machines,
- Using renewable resources,
- Activation of power management on servers.

In every sphere, there are some critical success factors for project or systems implementation. Pinto and Slevin (1988) found ten characteristics as critical success factors for project or systems implementation.

Table 1. Ten critical success factors for project or systems implementation (Pinto & Slevin, 1988)

Factors	Short Description
Project mission	Project's goal clarification and primary directions
Top management support	Support from top management regarding necessary resources providing
Project plan	A point by point specification of each steps which are required for systems or project execution
Client consultation	Good communication with the client and listening their demands
Personnel	Necessary personnel training for the project team
Technical tasks	Make sure the availability of required tools and technology to accomplish the technical tasks.
Client acceptance	Always keep in mind, ultimate goal of the project is to sell the product to the customer. So, focus on their demand.
Monitoring and feedback	Timely monitoring each phase
Communication	Proper communication between the team members
Trouble-shooting	Be ready to tackle unexpected crises

Top management support is the common factor which is discussed in the most studies. Complex projects or systems implementation needs better preparation and more time and resources (Biehl, 2007). In that case middle management should play a significant role for successful implementation. For example, an ERP system in a company's North America and European locations and middle management was largely responsible for its successful implementation (Biehl, 2007). Many people may leave the firm when the systems go to production which is very frustrating and exhausting for successful implementation (Biehl, 2007). In this case, middle management should always prepare themselves to tackle this kind of situation. The design-reality gap model can be applied as a tool for risk management on HIS project (Heeks, 2006). The design-reality gap can be referred to as of gap that exists between the "concept of design" and "current realities" (Heeks, 2006). IS success depending on service quality as well, which includes; tangible, reliability, responsiveness, assurance and empathy (DeLone & McLean, 2003). DeLone & McLean (2003) briefly described these qualities as below:

- Tangible – IS has latest version of hardware and software,
- Responsiveness – IS employees willing to provide good service to users,
- Assurance – IS employees have sound knowledge about their responsibilities and duties,
- Reliability – Information systems is dependable,
- Empathy – User has good interest on IS.

DeLone and McLean presented a success model for information systems for measuring the complex variable in information systems research. This model became popular during the period 1993 to 2003 (DeLone & McLean, 2003). This model is known as D&M

IS success model. Generally, this model is used for reporting IS effectiveness and success (DeLone & McLean, 2003). Some researchers have used this model by considering a success model (DeLone & McLean, 2003). D&M model's has two independent variables namely system quality and information quality, and four dependent variables namely use, user satisfaction, individual impact, organizational impact.

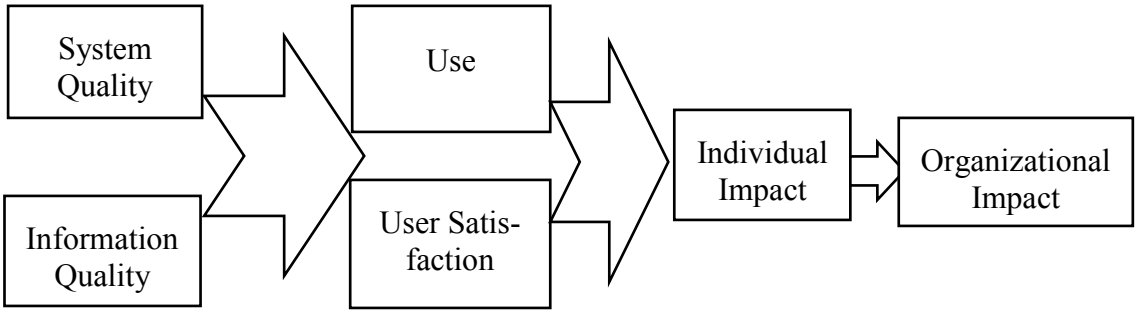

Figure 5. D&M IS success model (DeLone & McLean, 2003).

In addition, Pinto & Slevin (1988) included four factors as external factors to the implementation process. These factors are: characteristics of the project team leader, power and politics, urgency, environmental events (Pinto & Slevin, 1988).

2.4 Summary

Based on the reviewed models, it is observed that to a large extent, IS implementation depends on social context including personnel, client acceptance and user satisfaction. In most cases, successful IS implementation and adoption are difficult due to lack of resources. According to Rogers DOI theory, the most important thing of adoption is that the adopters should get to know the idea, behavior and the product. Rogers observed that innovation adoption depends less on technical outcomes, it is mostly depending on social perspective or subjective commentary of innovations by the adopter (Suddaby, 2013). From TOE framework, it can be assumed that technology adoption depends on technology, organization and environment. Apparently, resource availability is the key factor for the adoption of any technology. It may be a serious issue that motivates or hinders technology adoption.

In summary, I can say that IS adoption not only depends on the outcomes of the systems, but also depends on nature of social systems: how people are interested to cope up with new technology.

3. Systematic Literature Review

I chose systematic literature review (SLR) method to analyze and investigate available information about information systems adoption and its implementation in developing countries. SLR is carried out to survey past studies on information systems implementation failure factors, process of implementation, derive decisions and conclusions. General overview of SLR is presented in this chapter.

SLR is the most common and widely used methodology for identifying, evaluating and coordinating available research (Okoli & Schabram, 2010). SLR has been used to answer specific research questions (Rai et al., 2015). SLR is very popular in software engineering and health information systems (Kitchenham & Charters, 2007). Basically, SLRs are primarily concerned with some issues of empirical evidence which may have been acquired using some techniques (Okoli & Schabram, 2010). The primary objective of SLR is to come up with extensive summary of literature related to a research question (Rai et al., 2015). According to Rai et al. (2015), the systematic review process is mainly divided into three phases, such as: planning the review, conducting review, reporting review.

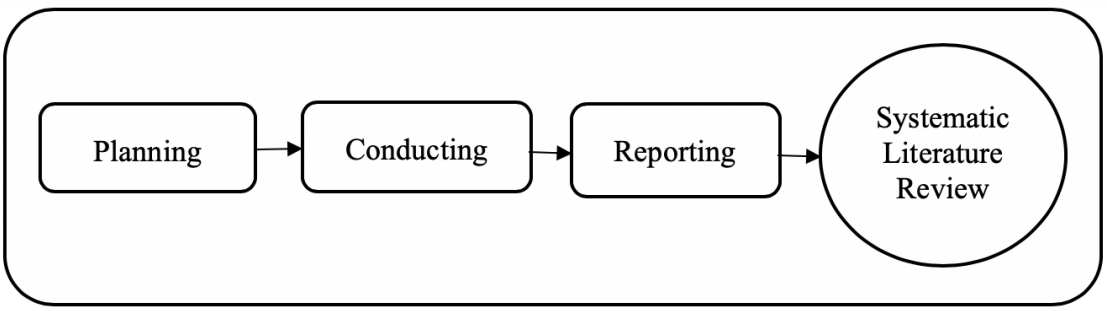

Figure 6. Systematic literature review process (Rai et al., 2015)

Planning phase has three stages, they are: identify research gap, specify research questions, and define review protocol which means choosing appropriate keyword and search strings (Rai et al., 2015). The conducting phase includes some stages like search strategy, resources, inclusion criteria, exclusion criteria, primary studies selection, quality assessment, data synthesis (Rai et al., 2015). Rai et al. (2015) also said report review consists of writing review report and validate report. A detail process of SLR is depicted in Figure 7 based on Rai et al. (2015).

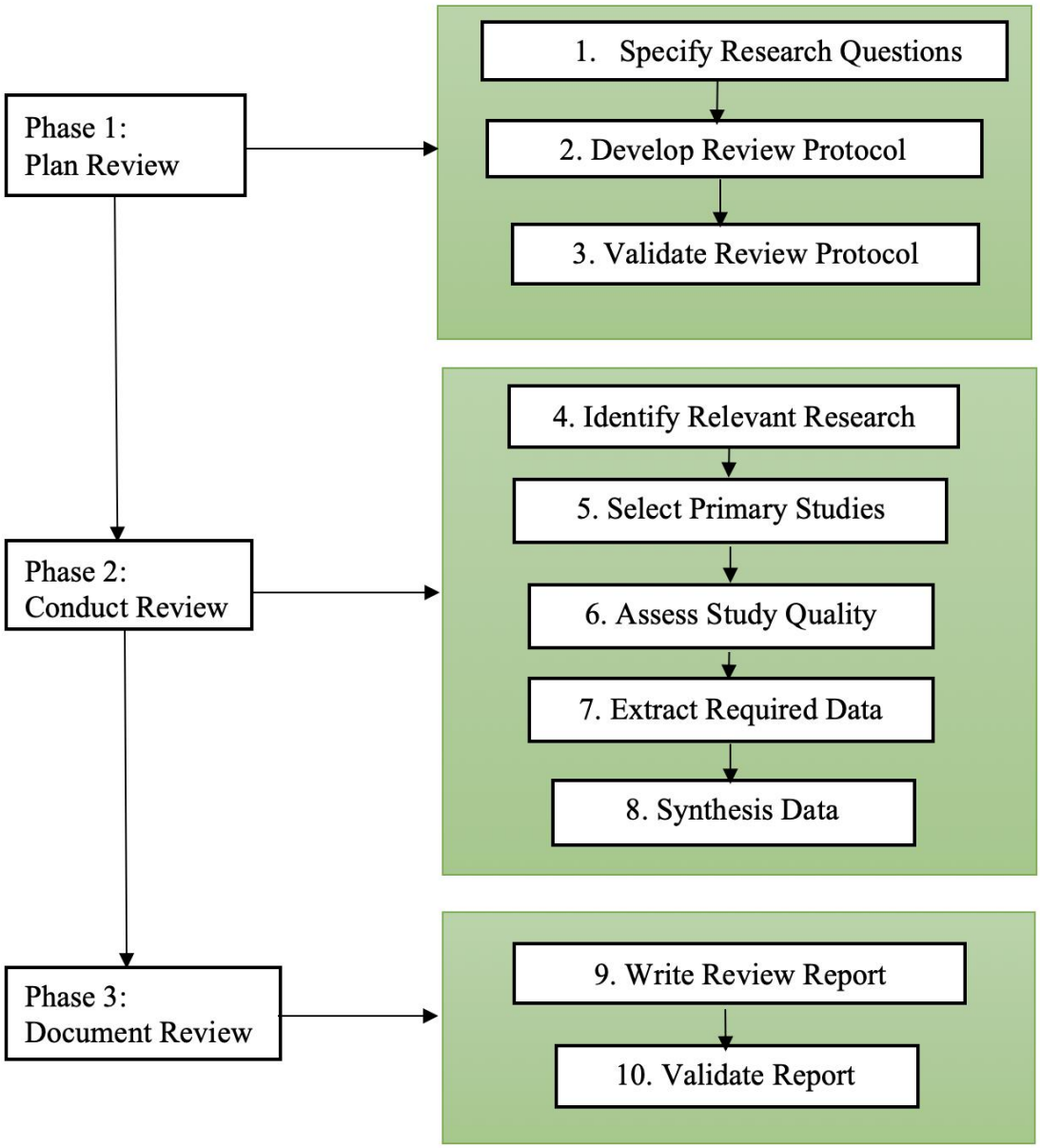

Figure 7. Detailed systematic literature review process (Rai et al., 2015)

3.1 Advantages and disadvantages of SLR

According to Kitchenham and Charters (2007), SLR brings some advantages, they are presented below:

i. SLR can provide information about the impacts of some phenomenon over an extensive variety of empirical methods,
ii. The methodology is well-defined which makes it less prone to bias associated with literature review. However, it is still prone to publication bias in primary studies,
iii. In quantitative studies, it is quite feasible to mix the data using meta analytic techniques.

The major drawback of SLR is that it requires more effort than other methods or other traditional reviews (Kitchenham & Charters, 2007).

3.2 Planning the review

To undertake SLR in a field, firstly it is necessary to ensure the need for such review (Kitchenham, 2007). That means, in the planning phase, the motivation of engaging in SLR should be clarified. As I mentioned earlier, planning review has three stages with some criteria. Review protocol defines the strategy which is used in conducting review. A brief review was conducted from information systems literature to define the components in review protocol. The example of some studies which were reviewed in the initial stage, including Bukachi & Pakenham-Walsh, 2007; Nhampossa and Kimaro, 2007; and Braa et al. 2007. These studies helped the researcher to get the initial knowledge about healthcare systems in developing countries.

Research Questions: Most of the SLR studies said that it is mandatory to define the research questions before conducting the review. The research questions which are intended to be answered through this study are:

1. What barriers have been reported for successful IS implementation and adoption in healthcare in developing countries?
2. What success factors have been reported for successful IS implementation and adoption in healthcare in developing countries?

Development of review protocol: After identifying the need for review and stating the research questions, review protocol will be designed. According to Rai et al. (2015), review protocol specifies the procedures for conducting the review process which process helps to collect fair information. It has various stages like search strategy, study selection, quality assessment and so on (Rai et al., 2015). Appendix A presents the review protocol for this study. It is suggested that review protocol should be evaluated by the expert/researchers (Kitchenham and Charters, 2007).

3.3 Reasons for performing SLR

SLR can be conducted for some reasons which are discussed by the Kitchenham and Charters (2007):

i. To summarize the existing evidence concerning a technology,
ii. To identify the gap of current research or studies and provide appropriate suggestions,
iii. To provide a framework which is appropriate for the new research activities.

The need for undertaking SLR appears from the interest to sum up existing scientific knowledge about healthcare technology adoption in developing countries. This SLR is needed to extract and analyze healthcare IS implementation in low and middle income countries and provide some suggestions as success factors for the improvement.

3.4 Conducting the review

Literally, conducting the review is the execution of review protocol. The step of the conducting review is described in Figure 7. This phase is followed up according to the agreed protocol (see Appendix A). Identifying the research gap, selecting primary studies from selected databases using search string is the main stages of conducting review.

According to Kitchenham (2004), SLR involves several discrete activities. There are six stages in SLR including search strategy (Kitchenham, 2004). The five other stages include inclusion and exclusion process, selection of primary studies, quality assessment, data extraction and data synthesis. This section discusses the processes of conducting SLR with the aim of identifying relevant primary studies which is related to research questions.

3.4.1 Data sources and search strategy

The goal of the search strategy is to find out the suitable studies which are closely related to research questions. It is important to have an unbiased search strategy to uncover primary studies (Kitchenham, 2004). For collecting studies, primarily three electronic databases have been selected:

- IEEE Xplore
- ScienceDirect
- Ebsco Databases

The most important reasons for selecting these databases are that they are widely used in information systems and allow advanced query search. IEEE Xplore and ScienceDirect have enormous number of peer reviewed articles collection which provides full text access to publications. ScienceDirect is a reliable source of information of scientific, technical and medical research. Ebsco databases in various subject areas with SFX link whether the item is available electronically or direct link for the full text. The search string was formulated based on the research questions and search string was used in the selected databases. The purpose of preliminary searches is to identify existing systematic reviews and evaluating the potentiality of relevant studies (Kitchenham & Charters, 2007). Each of the databases returned unique number of relevant literatures. Figure 8 presents the flow chart of search strategy based on Kitchenham (2004).

To develop the search strategy, I collaborated with my supervisor. The search phrase was constructed by a combination of keywords inferred from the research questions of this study. The search string obtained was then used in the selected databases. According to the research questions, a generic search string was constructed to be used in the selected databases.

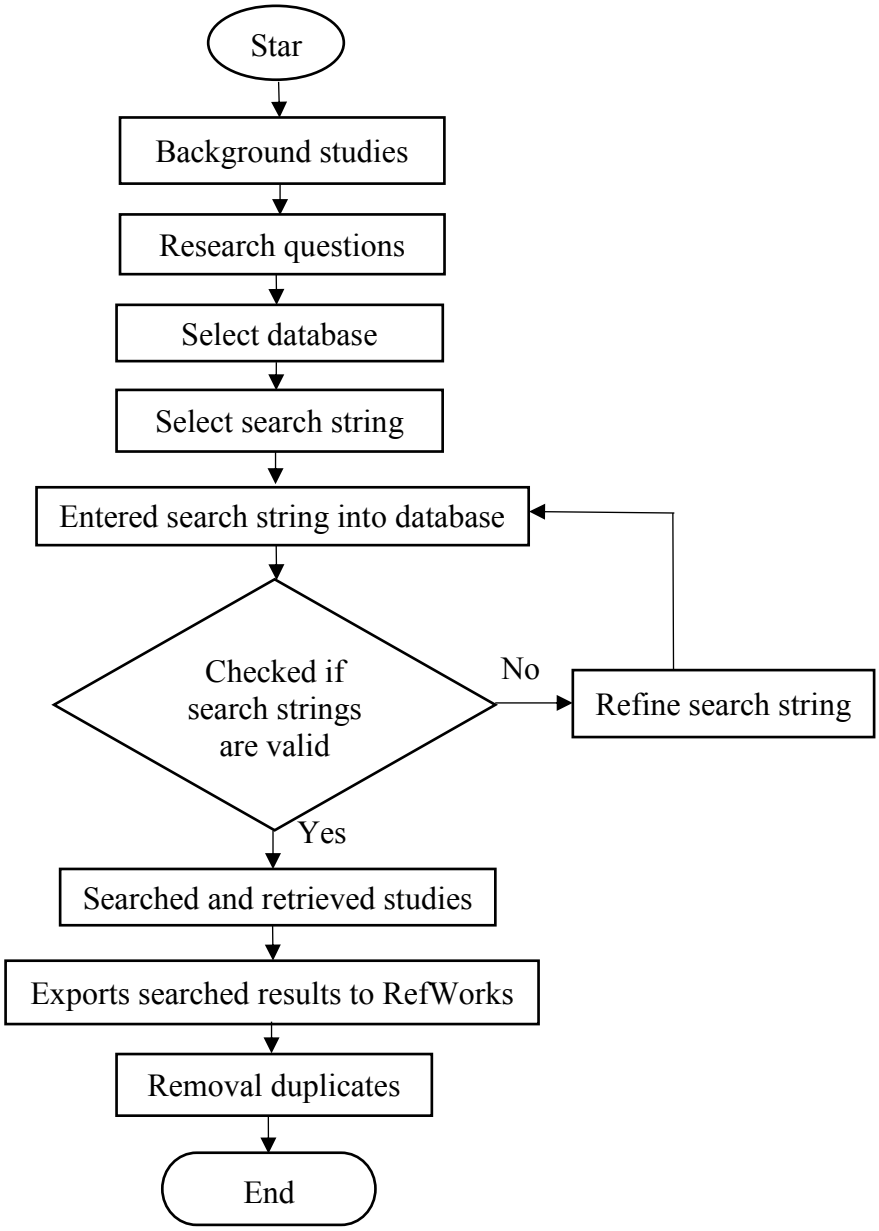

Figure 8. Search strategy (Kitchenham, 2004)

3.4.2 Pilot search

To get an idea about the available number of studies in this field, a pilot search was performed. Kitchenham & Charters (2007) suggested to perform pilot searches. For this study, the pilot search was performed on Google Scholar. A pilot search was performed with default search option on Google Scholar using the input keyword “information system implementation in healthcare in developing countries” without quotes. After searching on Google Scholar 872000 results were found which includes books, chapter, magazines, articles, etc. Then modified the search keyword and placed quotes, for example "information system in developing countries". In this case, Google Scholar returned 550 results. This indicates that “information system in developing countries” as a single concept brought less interest than distinct keywords. Hence, I should mention that before searching “information system in developing countries” keyword with quotes, I tried with "information system in developing countries in healthcare" and it returned nothing as results.

After getting a rough idea from the search result in Google Scholar, I consulted with my supervisor. She proposed various search phrases, synonyms and suggested to use advance search options in the selected databases in order to get reasonable number of articles and relevant studies. The amount of hits was unmanageable to review that's why we agreed to restrict the search to the most recent articles which were published from January 2017 to pre-prints dated 2019. Refining criteria were applied while searching into the selected databases (IEEE Xplore, ScienceDirect, and Ebsco). Refining criteria includes selection by year (articles published between 2017 and 2019), conference paper, journal papers, review articles and peer reviewed articles.

Moreover, due to database limitations, it was necessary to change the search string to be usable in each database to get reasonable results. The final search phrase was:

("Information systems" OR "information technology" OR "ICT") AND ("adoption factor" OR "success factor" OR impediment OR barrier OR failure) AND (healthcare OR health) AND ("developing countries" OR "less developed countries")

The results of final search in each database are presented below in Table 2. The primary search was performed on 5th September 2018. All in all, the formulated search string returned 4014 studies. After applying refining criteria by years 2017-2019, I obtained 729 studies.

Table 2. Search query, databases and results for this study

Search query	Database	Date/time	Results from first hit	Results after refining by years (2017-2019)
("information systems" OR "information technology" OR "ICT") AND ("adoption factor" OR "success factor" OR impediment OR barrier OR failure) AND (healthcare OR healthcare OR health services OR health) AND ("developing countries" OR "less developed countries")	IEEE Xplore	5th September 2018 @21:36	1901	277
	EBSCO host	5th September 2018 @23:21	101	15
	ScienceDirect	5th September 2018 @23:46	2012	437
	Total		**4014**	**729**

3.5 Inclusion and exclusion criteria

Literature selection criteria helps to get the most appropriate study materials. Inclusion and exclusion criteria should be based on research questions. These criteria help the researchers to justify the papers whether the paper is suitable for their study or not.

The following inclusion criteria were applied for this study:

- Written in English,
- The articles should focus on "information systems adoption or implementation in developing countries",
- The article which talked in general about health information systems adoption or implementation was taken into the account,
- The study should be published between January 2017 and December 2019,
- Journal paper OR Conference paper.

The following exclusion criteria were applied for this study:

- Full text not available,
- The article did not address "information systems in developing countries in healthcare",
- The article addressed "information systems in **developed** countries in healthcare",
- Duplicate articles,
- Publication is part of magazines, book chapter, training materials, thesis, etc.

3.6 Study selection process

The study selection was a very meticulous and painstaking process. There were seven main steps involved in the primary study. The process is clearly described in Table 3.

Table 3. The steps of selecting primary studies

Process steps	Number of excluded studies	Number of studies left
Step 1: Search as September 2018		**4014**
Step 2: Exclude by the year (2017-2019)	3285	**729**
Step 3: Exclude magazines, books, chapter, courses	107	**622**
Step 4: Duplicates removal	3	**619**
Step 5: Not in English language	1	**618**
Step 6: Exclude based on title and abstract	551	**67**
Step 7: Full text not available	2	**65**
Step 8: Exclude based on full text scanning and quality assessment	46	**19**
Total included		**19**

In phase 1, I searched in the selected databases with the search query and I found 4014 studies.

In phase 2, I refined the results by the year (2017-2019). After refining by the year 729 studies were left.

In phase 3, I excluded 107 studies which contained magazines, books, chapter, and courses. In this stage, 622 studies were left. I exported those 622 studies into RefWorks. RefWorks is an online tool for reference management.

In phase 4, after exporting those 622 studies into RefWorks, removed the 3 duplicates studies using duplicates option in RefWorks and after duplicates removal 619 studies were left.

In phase 5, I excluded studies which were not in English. Hence, only one study was not in English. That means 618 studies were in English.

In phase 6, I excluded 551 studies based on their title and abstract. After excluding based on title and abstract 67 studies were left.

In phase 7, I eliminated the papers which did not contain full text. Then 65 studies were left.

In phase 8, I excluded the papers based on full text scanning and quality assessment. Finally, I obtained 19 papers for analyzing and reporting of results.

3.7 Quality assessment

After completing step 8, I excluded 46 studies by scanning the full text of article and based on quality assessment checklist. Kitchenham & Charters (2007) pointed out in their study that there is no concurred meaning of study "quality", but a study can be said to be of good quality when it minimizes systematic errors and maximize applicability. Quality assessment ensures the quality of the studies remained to be analyzed. Six checklist questions were used to assess the quality of the study. After assessing the quality, 19 papers were taken into the account for further analysis and discussion (see Appendix B for the list of retained primary studies).

Table 4. Checklist for the quality assessment (adopted from Sheuly, 2013)

Quality checklist questions	**Yes or No**
1. Does the paper clearly address the objective?	
2. Does the paper clearly mention the results?	
3. Are adoption factors/ barriers clearly mentioned?	
4. Does a paper clearly mention about information systems adoption/implementation in healthcare?	
5. Does a paper clearly mention about information systems adoption/implementation in healthcare in developing countries?	
6. Does a paper clearly address limitation of the study and future work?	

3.8 Data extraction

Data extraction strategy was used to gather all of the information to address the research questions by reading full text of the selected primary studies (see Appendix B). One Excel spreadsheet was prepared for data extraction and recorded the required data in that form. In this stage, my goal was to find out the answers of my research questions. The aim of this stage is to design an extraction form (see Appendix C) in order to get accurate information regarding research questions (Kitchenham & Charters, 2007). The following data were extracted from the selected primary studies.

- Primary information about the article including article title, author name, publication year, key words,
- Name of the country/countries on which the research was conducted,
- Name of the used methodology,
- The success factors/barriers, to find the answers to RQs.

3.9 Data synthesis

Data synthesis implies summarizing the recorded data which is acquired from the primary studies (Kitchenham & Charters, 2007). In this study, descriptive synthesis method was used to analyze the extracted data from the primary study. Descriptive synthesis means that results and findings going to be presented in tables, charts and in natural languages. Therefore, descriptive data analysis technique was used to answer the research questions.

In the data extraction process, the main concepts related to adoption factors, success factors in healthcare systems were identified from each selected study. Then those factors were presented in tabular form for better understanding. Also, publication type, publication year, research methods used; this information are presented in the charts.

In the next chapter, the results related identified factors in healthcare technology are presented.

4. Results

This chapter will focus on outcomes of SLR process which has been discussed in the previous chapter. In total 19 primary studies (see Appendix B) were selected which could meet the criteria to answer my research questions. In this chapter, I will visualize and describe the results of my study.

4.1 Study classification

The following subsections discuss about classifications of selected primary studies. The selected primary studies has been given unique identity ([P1], [P2], [P3], [P4]……. [P19]) for easy SLR referencing. The list of primary studies with their unique ID is stated in Appendix B. The selected primary studies are conducted by using different research approaches.

4.1.1 Publication trend

As I mentioned earlier, I considered only those studies which were published between January 2017 and December 2018. I found 13 studies which were published in 2017 and 6 studies were published in 2018. Figure 9 shows the distribution of studies per year. From the distribution of studies, it is clearly visible that 68% articles were published in year 2017, rest of 32% were published in 2018. Recently published studies represent the most current situation of using information systems in healthcare in developing countries.

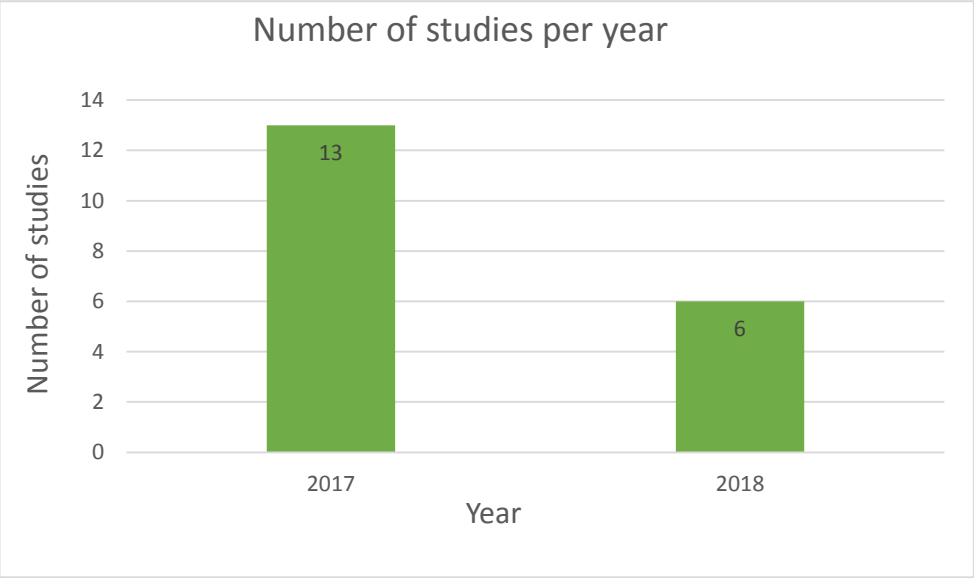

Figure 9. Publications by year

The pie chart in Figure 10 depicts the frequency of studies source. There were 11 journal articles representing 58% of primary studies and 8 conference articles representing 42% of primary studies.

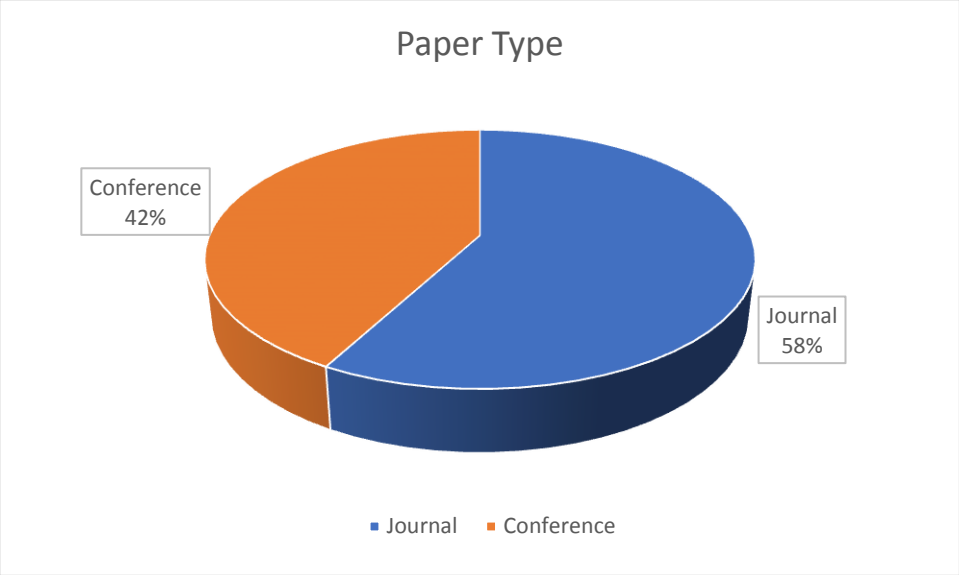

Figure 10. Primary study types

4.1.2 Research methods

Nineteen primary studies used various research methods such as interview, survey, action research, literature review research and design science research as shown in Table 5. Eleven studies (58%) were empirical studies and eight studies (42%) were non-empirical studies.

Table 5. Classification of research methods of nineteen primary studies.

Research Type	Number of primary studies	Percentage	Reference
Survey	8	42%	[P2], [P3], [P5], [P6], [P10], [P12], [P13], [P16]
Systematic literature review	7	37%	[P4], [P7], [P8], [P9], [P11], [P15], [P17]
Design science research	2	11%	[P18], [P19]
Action research	1	5%	[P1]
Conceptual research	1	5%	[P14]

Table 6. Classification of type of research.

Type of study	Survey	DSR	Action research	SLR	Conceptual research	**Total**
Empirical	8	2	1			**11**
Non-empirical				7	1	**8**

Table 6 indicates that eleven empirical studies used three types of research methods. Most of the studies employed the survey approach, two studies the design science research (DSR) approach, and one study employed the action research approach on the readiness assessment in several organizations in Kenya. Eight non-empirical studies used two types of research methods such as SLR and conceptual research.

4.1.3 Research countries

The primary studies were conducted on various developing countries. Studies were conducted on Bangladesh, Ghana, India, Iran, Kenya, Malawi, Namibia, South Africa, and Thailand. Research conducted in different regions such as Latin America and Sub Saharan Africa was also found. Three studies did not mention the name of the countries. Basically, those studies addressed the overall IS implementation in healthcare. Some topics were quite relevant to developing countries that is why I took them into account for analysis. The distributions of primary studies with regard to the country focus is shown in Table 7.

Table 7. List of countries used in nineteen primary studies

Country/region	Number of studies	Reference
Bangladesh	2	P[10], P[18]
Ghana	2	P[2], P[3]
India	1	P[6]
Iran	1	P[5]
Kenya	1	P[1]
Malawi	1	P[13]
Namibia	1	P[16]
South Africa	1	P[12]
Thailand	1	P[14]
Latin American's developing countries	1	P[17]
Sub Saharan Africa	2	P[11], P[19]
Developing countries	2	P[9], P[15]
Overall countries	3	P[4], P[7], P[8]

4.1.4 Research focus

The primary studies are categorized based on research focus. Eight primary studies focused on adoption factors, eight studies focused on barriers and three studies focused on both barriers and adoption factors. I took only those studies into my consideration, which clearly mentioned about the adoption factors and barriers. The classification of studies based on research focus is shown in Figure 11.

Adoption factors: The category includes the factors which may influence the adoption or successful IS implementation in healthcare in developing countries. Hence, in this study adoption factors are synonyms with success factors, in that they are found to positively influence the adoption or successful HIS implementation. Dibra (2015) pointed out in her study that adoption and implementation are the two outcomes of decision-making regarding an innovation. Eight out of nineteen studies indicated that their research focused on adoption factors. For instance, P[1] study discussed the electronic medical record (EMR) systems adoption factors in Kenya. In P[1] study, the adoption factors are declared in the context of management personnel. P[10] study has a focus on e-health adoption in the rural areas of Bangladesh, in which the factors are defined from an end users survey.

Barriers: The category includes the factors which may hinder the adoption or successful IS implementation in the healthcare in developing countries. Eight out of nineteen primary studies have focused on barriers which may have negative influence in our discussion area. For example, P[6] study discussed about barriers of electronic health record (EHR) use in affluent region in India. This study P[6] has focused on barriers of EHR use in small region of India and these barriers has been reported from IT employees perspective who are employed in that organization.

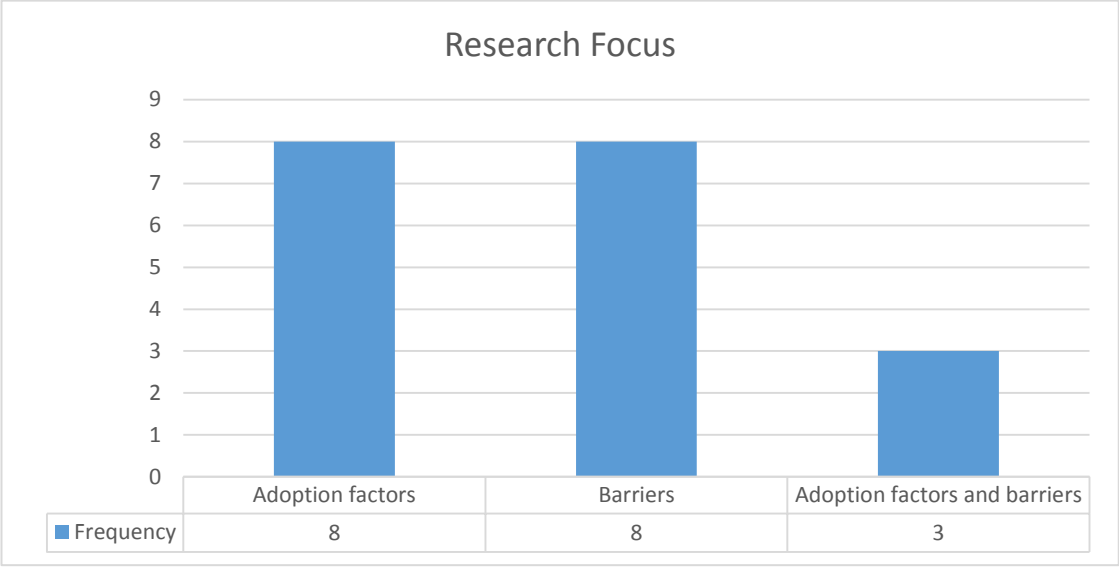

Figure 11. Classification of primary studies based on research focus

4.1.5 Technology focus

In this section, I categorize the primary studies based on technology focus. Every study discussed a different technology such as Electronic Health Record (EHR), Health In-

formation Systems (HIS), m-health (mobile health), geographic information systems, e-health, telemedicine, internet of medical things, and virtual clinics. Five out of nineteen studies were conducted on EHR. Some studies define EHR as electronic health record, some others define it as electronic medical record (EMR). In this study, EHR and EMR are used interchangeably. Six studies are conducted on HIS among nineteen primary studies. Some studies define HIS as health information systems, some other define it as hospital information systems. In our study, keyword HIS means health information systems, but hospital information systems are included under this abbreviation as well. Three studies are conducted on m-health. Five studies have been conducted on various technologies that is why I grouped them as "others" in Table 8. The classification based on technology focus is shown in Table 8. More detail about other technologies are further described in section 4.1.6 and Table 9.

Table 8. Classification of primary studies based on technology focus

Technology name	Number of studies	Reference
EHR	5	P[1], P[3], P[6], P[7], P[11]
HIS	6	P[4], P[5], P[8], P[14], P[15], P[16]
m-health	3	P[9], P[2], P[12]
Others	5	P[10], P[13], P[18], P[17], P[19]

4.1.6 Characteristics of each study

Table 9 depicts the overview of all primary studies which specifies the year, paper type, research method type, type of study, country/ region, focus of the study, and technology. Here, "C" indicates conference paper and "J" indicates journal paper. Also "E" indicates empirical study and "NE" indicates non-empirical study. As I mentioned earlier every study addressed a specific technology. For instance, P[13] discussed about geographic information systems which is a computer based systems for mapping and analysing the existing things by integrating database operations (Chikumba, 2017). In healthcare GIS is used for data integration and unique visualization because it has the ability to manage large volumes of data very quickly (Chikumba, 2017).

Table 9. Detailed description of each study

Primary study	Year	Conference (C) /Journal (J)	Research method	Empirical (E)/ non-empirical (NE)	Country/ region	Adoption (A) /Barriers (B)/ A& B	Technology
P1	2017	J	Action re-search	NE	Kenya	A	EHR
P2	2017	J	Survey	E	Ghana	B	m-health
P3	2017	J	Survey	E	Ghana	B	EHR
P4	2017	J	SLR	NE	Overall coun-tries	A	HIS
P5	2017	J	Survey	E	Iran	A	HIS
P6	2017	J	Survey	E	India	B	EHR
P7	2017	C	SLR	NE	Overall coun-tries	B	EHR
P8	2017	C	SLR	NE	Overall coun-tries	B	HIS
P9	2018	J	SLR	NE	Developing countries	A&B	m-health
P10	2018	J	Survey	E	Bangladesh	A	e-health, telemedicine
P11	2017	J	SLR	NE	Sub-Saharan Africa	A&B	EHR
P12	2018	C	Survey	E	South Africa	A	m-health
P13	2017	C	Survey	E	Malawi	A	Geographic IS
P14	2018	C	Conceptual research	NE	Thailand	A	HIS
P15	2017	C	SLR	NE	Developing countries	B	HIS
P16	2018	C	Survey	E	Namibia	A	HIS
P17	2018	J	SLR	NE	Latin Ameri-can's develop-ing countries	A&B	Internet of medical things
P18	2017	J	DSR	E	Bangladesh	B	Health data integration
P19	2017	C	DSR	E	Sub-Saharan Africa	B	Virtual clinics

4.2 Analysis of results

The following sections describe the results of SLR related to barriers and success factors of information systems adoption in healthcare in developing countries.

4.2.1 Barriers

In this study, I organized the found 24 barriers of hospital information systems adoption in healthcare in developing countries into six categories. The categories are summarized in Table 10.

Hence in table 10, the categories are presented with a number and percentage. The number indicates the number of studies which addressed that specific category. For instance, [P7, P9, P11, P15, P17, P18, P19] these seven studies addressed the category of education, training and awareness. That is why 7 has been written in front of this category. Percentage has been derived as follows:

Percentage = (N*100)/ total number of primary studies
N= number of studies which addressed that specific category
Whereas, "total number of primary studies" has constant value which is 19.

Education, training and awareness

Lack of education, training and literacy: the most common barrier cited by 6 of the 19 was education and training. Illiteracy is a great problem in all developing countries. Low education and training level leads to lower motivation for accepting any kind of new technology. The lack of education is a primary barrier to the implementation of EHR [P7]. In addition, training has a great impact on EHR acceptance. Proper training to the end users of EHR can increase the probability for getting end users acceptance [P11]. Lack of proper training and inadequate knowledge is a common barrier for technology adoption [P7, P11, P17, P19].

Lack of computer skills: in developing countries people have limited skills on computer. Low computer literacy level is a negative factor for technology adoption [P11]. Lack of computer skills is associated with the people resource barriers [P7].

Lack of awareness: People in developing countries are not very much aware about the importance of medical technology. According to [P7] study, lack of awareness of the importance of EHR/EMR represents one of the major barriers. Lack of awareness about technology among the people hamper the EHR adoption [P9]. In developing countries research practice have not become popular yet. There are minimal research opportunities in developing countries which may indicate the low acceptance of technology adoption [P15]. In contrast, developed countries are used to with the research practices that is why they have good health information systems adoption rate in their countries.

Inadequate staff: Low income countries face problems for the inadequate human resource [P7, P15].

Table 10. Frequency of barriers in primary studies

Barriers	Source of resource	Frequency
Education, training and awareness 7 (37%)		
Lack of education, training and literacy	P7, P11, P15, P17, P18, P19	5
Lack of computer skills	P7, P11	2
Lack of awareness importance of EHR and minimal research	P7, P9, P15	3
Inadequate staff	P7, P15	2
Infrastructure 7 (37%)		
Network unavailability	P2, P7, P9, P15	4
Insufficient power supply or electricity	P2, P9, P11	3
Lack of centralized healthcare database	P7	1
No unique id like social security number	P18	1
Financial supports 7 (37%)		
Lack of funding or Financing health systems	P3, P15, P17, P19	4
Deficiency	P6, P7, P19	2
Uncertainty of return of investment (ROI)	P6, P7	3
Initial investment and other costing	P7, P11	1
System quality 5 (26%)		
Data reliability	P3, P7, P8	3
Lack of core features	P7, P8, P9, P19	4
Data security	P3, P7, P8	3
Culture and political issues 4 (21%)		
Lack of familiarity with technology & technology acceptance culture	P2, P7, P15	3
Absence of national policy on m-health and ICTs	P9, P15	2
Political issues	P7, P15	2
No local language	P9	1
Overpopulation	P15	1
Resistance and support unwillingness 3 (16%)		
Resistance from physicians	P6, P7, P11	3
Lack of future support from vendors	P7	1
Lack of systems maintenance	P7	1
Lack of project planning	P7	1

Infrastructure

Network unavailability: lack of network availability and insufficient power supply is an example of infrastructural barriers to the m-health implementation [P2]. Network resources include twisted pair cable, fiber optic cable, cellular, and satellite wireless technology [P7]. Poor internet connectivity is additionally a restricting component in remote zones that prompts difficulty in transmission of data [P9]. Network availability makes easier m-health adoption in developed countries [P9]. Network unavailability is big problem and it hampers the adoption of health technology in developing countries [P15].

Insufficient power supply or electricity: another big problem is insufficient power supply. Lack of electricity has been identified in many studies by the researchers [P2, P9, P11]. [P2] study indicated this problem as infrastructural barrier to the implementation. Load shedding is a common scenario in developing countries. It will be extremely challenging for developing countries to ensure the availability of electricity [P9]. Shortage of electricity is a field level barrier for m-health adoption in developing countries [P9]. Providing constant power supply is big challenge for developing countries [P11]. Healthcare in Sub-Saharan Africa could not use the EHR continually for many months because of shortage of electricity [P11].

Lack of centralized healthcare database: in developing countries, generally they do not have centralized database for healthcare. Lack of centralized healthcare database can be a barrier for healthcare technology adoption [P11].

***No unique id like social security number*:** In developing countries, people do not have a unique health identification number or social security number that is why healthcare centers cannot store patients' information by their identification numbers [P18]. Moreover, due to illiteracy, people are unable to spell their full name and date of birth properly [P18]. Table 11 shows an example of discrepancy of name recoding which is adapted from [P18].

Table 11. Ambiguity in patient's name input (adapted from [P18])

Actual patient name	Inputted name
Sobuj Chowdhury	Mr. Sobuj Chowdhury
	Sobuj Chowdhury
	Mr. Sobuj
	Sobuj Chy.
	Sabuj Chowdhury
	Sabuz Chaudhury

Financial supports

Lack of funding or financing health systems: it has been reported in many studies that lack of financial funding is a constraint in health section for implementing IS projects [P3, P15, P17, P19]. Financial constraints are well known threats or challenge in developing countries for adopting patient centric healthcare [P15]. Due to lack of funding, one hospital in Ghana could not customize various aspects of their existing EMR systems [P3].

Deficiency: economic deficiency is another issue confronting the improvement of telemedicine in Africa [P19]. Lack of capacity to implementing and contract for an EHR is barrier to health information systems use [P6].

Uncertainty of return of investment (ROI): uncertainty about ROI from an EHR is a barrier to health information systems use [P6]. Any private clinic thinks about ROI before implementing any kind of health information systems. According to my opinion ROI can be marked as a big issue for implementing health information systems. [P7] indicated that ROI might put down the EHR implementation.

Initial investment and other costing: low adoption of EHR can be linked to high investment cost, some initial cost and maintenance due to training and support cost [P11]. Initial cost and implementation cost are the procedure resource barriers [P7]. Initial investment and implementation cost have been highlighted as major barriers of adoption of HIS in the reviewed papers.

System quality

Data reliability: Adoption of technology, for example HIS and EHR depends on service quality in terms of responsiveness, data reliability, accuracy and etc. [P8]. Data entry errors break the data reliability [P3]. Data entry error is a barrier to existing EMR usage

at Komfo Anokye Teaching Hospital Emergency Centre in Ghana [P3]. Data security and confidentiality is deterrent in EHR systems adoption [P7].

Lack of core features: lack of core features such as complex design, time consuming for a certain process, lack of accuracy backpedals the HIS adoption [P7, P8, P9, P19].

Data security: data security is perceived as a barrier to EMR usage at Komfo Anokye Teaching Hospital Emergency Centre in Ghana [P3].

Culture and political issues

Lack of familiarity with technology and technology acceptance culture: WHO brought up that the adoption of m-health depends significantly on user's acceptance and study has shown that the frame of mind towards devices has a vital role in clarifying user behavior and technology acceptance [P2]. Many studies discussed about cultural barriers in technology adoption. [P7] stated that cultural change is required to embrace EHR technology. Diversity of culture may backpedal the adoption of patient centric healthcare systems in developing countries [P15].

Absence of national policy on m-health and ICTs: presence of national policy is important for m-health and ICTs adoption in developing countries. Due to absence of national policy, m-health adoption becomes difficult in developing countries [P9].

Political issues: in developing countries the main problem is political instability. Political unwillingness is responsible as barrier in EHR adoption in developing countries [P7]. Corruption of political parties is a big issue in developing countries. Corruption also hinder the HIS implementation and adoption.

No local language: mobile health development in non-local language have negative influence on m-health adoption [P9].

Overpopulation: overpopulation hampers the adoption of patient centric healthcare services in the developing countries [P15]**.**

Resistance and support unwillingness

Resistance from physicians: the review results identified resistance from physicians, user and management [P6, P7, P11]. Uncertainty of ROI is the main reason for resistance from management and physicians [P6]. End users and physicians are not eager to adopt EHR in the sub-Saharan African countries [P11]. [P7] reported "user resistance" as a major barrier.

Lack of future support from vendors: lack future support from vendors interrupt the EHR adoption [P7].

Lack of systems maintenance: lack of systems maintenance negates the implementation of EHR [P7].

Lack of project planning: lack of proper project planning might impede the implementation of EHR systems [P7].

4.2.2 Success factors

In this study, I organized the found 19 success factors of information systems adoption in healthcare in developing countries. I organized those 19 success factors into four categories. The categories are summarized in Table 12.

Table 12. Frequency of success factors in primary studies

Success Factors	Primary Resource	Frequency
Utilization of resources and monetary factors 8 (42%)		
Available resource	P1, P3, P4	3
Power supply	P1, P16	2
Connectivity	P12, P16	2
Affordable price	P10, P11, P12, P17, P16	5
Reduce cost	P12, P13	2
Culture and political issues 7 (37%)		
Social influence	P2, P5, P12, P10	4
Influence from government	P1, P9, P11	3
Relationship between management and employees	P4	1
Top management leadership	P4	1
Context of use	P16	1
Geographical location	P16	1
Education, training and awareness 6 (32%)		
Training	P3, P4, P11	2
Educational	P5, P11	2
Awareness	P10, P12	2
Skillful staff	P4	1
System quality 6 (32%)		
Ease of use	P2, P4, P9, P10, P12	4
Remote access to patient	P9, P12	2
Security and privacy	P12, P17	2
Systems features	P2, P3, P4, P12, P17	5

Utilization of resources and monetary factors

Under this category I found five success factors such as: available resource, power supply, connectivity, affordable price, reduce cost, and previous resource use.

Available resource: IT infrastructure is important for successful and sustained EMR adoption [P1]. Here available resources include financial resource, human resource. [P3] proposed to assign specific employee for specific task to carry out EMR task. A clear distribution of employees based on employee's own strength may have positive impact on adoption of HIS [P4].

Power supply & connectivity: Power supply and connectivity are the basic demand for successful IS implementation. [P1] evaluated that at least 75% power supply is necessary in a day to support the EMR implementation. For m-health adoption, connectivity has important role. In developing countries, mobile data is still expensive for some people [P12]. Availability of internet connectivity influences the m-health adoption.

Affordability: five of nineteen studies talked about affordability of HIS which means it is a very important success factor for developing countries. Affordable price should be taken into account for e-health adoption in Bangladesh [P10]. Low adoption rate of EHR in sub-Saharan Africa due to unaffordability of implementation and maintenance cost [P11]. Affordability of services was recently recognized as one of the empowering

factors toward the success of m-health [P12]. Affordability is one of the main adoption factors of internet of medical things in Latin America [P17]. Affordability is the criteria for HIS adoption in Namibia [P16].

Reduce cost: if previous resources, including employees and resource from previous systems can be used in new systems it has great positive impact on new systems adoption [P13]. Saving money motivates people to use e-healthcare [P12].

Culture and political issues

Social influence: influence from community leaders or assembly members to use the systems has impact on adoption [P2]. This factor has been broadly discussed in UTAUT model which is appreciated model for explaining the intention to adopt a new technology for seeking healthcare [P2]. [P5] found cultural factor as successful factor in their hospital information systems evaluation. Positive word-of-mouth, (e.g. easy-to-use and money saving) within the society help to adopt e-health service to rural areas in developing countries [P10]. People alluded that social influence is a motivating factor which motivate people toward the use of e-healthcare [P12].

Influence from government: in [P1], the assessment evaluation showed that healthcare support from authorities (e.g. Ministry of Health) is a factor contributing to successful and sustainable EMR adoption. Government can impose national health policy for m-health which can result better usage of m-health [P9]. Government can involve the private sector as potential provider of m-health which may increase the scalability of m-health [P9]. Some researchers reported in their studies that some sort of government incentives would be a requisite for substantial utilization and adoption of EHR in sub-Saharan African nations [P11].

Relationship between management and employees: as a factor in the organizational level, good leadership from top management and better relationship between top management and employees are key factors in the success of HIS implementation [P4].

Context of use & geographical location: similarly, geographical location and context of use play a vital role as environmental requirements for HIS evaluation [P16].

Education, training and awareness

Training: proper training of EHR users is an effective way to achieve end users' acceptance [P4, P11]. Training should be ongoing episodes so that users can become more popular with the systems [P3, P11].

Education: it is reported in [P11] that computer education can be included to medical students to increase their ability to use EHR more effectively. [P5] study reported six success factors for HIS implementation in Iran and education is one of them.

Awareness: previous research showed that awareness is an enabling factor for the success of m-health [P12]. Awareness can be spread through advertising the benefits of using them [P10, P12].

Skillful staff: staff have the ability and strength to discover new ideas and use their capability in proper way to their work station [P4].

System quality

Ease of use: ease of use is an enabling and motivating factor for the success of m-health or e-health in developing and developed countries [P2, P4, P9, P10, P12]. Ease of use is a motivating factor toward the use of self-healthcare [P12]. Ease-of use creates positive attitude to the user mind [P10]. [P4] mentioned some characteristics which bring up successful implementation of HIS and ease of use one of them. This factor influences the intention to use the technology [P2].

Remote access to patient: remote access to patient is an enabler for m-health adoption factor in developing countries [P9]. Self-healthcare users must be able to use the systems from anywhere and anytime [P12].

Security and privacy: [P12, P17] found that privacy and security is important factors which increase better user acceptance.

System features: some basic features should be included in the systems such as effort expectancy (regular use) [P2], fast response time of the systems [P3], easily customized systems and quality interface design [P4], user satisfaction after using the systems [P12], and result accuracy [P17].

5. Discussion

This chapter of the thesis discusses the findings of SLR and answers the research questions defined in earlier chapters.

What barriers have been reported for successful IS implementation and adoption in healthcare in developing countries?
Based on the results presented in chapter 4, there are 24 barriers identified from the primary studies. These barriers are grouped into six categories, summarized in Table 10. Based on the analysis of primary studies, the barriers which received most mentions were: Infrastructure (37%), Financial supports (37%), Education, training and awareness (37%), System quality (26%), Culture and political issues (21%), Resistance and support unwillingness (16%).

These results show that successful HIS implementation in healthcare in developing countries seems to be harder to implement than people expect, as researchers found lack of infrastructure and lack of funding are the main reasons. Executing the proper plan in developing countries would become difficult due to political instability, corruption, and overpopulation. If these political issues cannot be solved immediately, successful implementation of IS in developing countries will remain difficult. Proper planning and positive cultural bias may reduce the complexity of successful implementation. The results indicated that lack of education, training and awareness has huge negative impact on IS implementation and adoption. Generally, the rate of illiteracy is higher in developing countries.

What success factors have been reported for successful IS implementation and adoption in healthcare in developing countries?
Based on the results presented in chapter 4, there are 19 success factors identified from the primary studies. The success factors are grouped into four categories, summarized in Table 12. Based on the analysis of primary studies, the success factor categories are: Utilization of resources and monetary factors (42%), Culture and political issues (37%), Education, training and awareness (32%), System quality (32%).

These success factors point out that IS implementation in healthcare in developing countries cannot be solved within a short period. It will need proper planning and proper use of the resources. For developing countries, affordability of the systems can influence the management to install HIS which is good fit for the organization and gain the best benefits. The results indicated that the important thing for hospital management is to overcome the uncertainty about ROI and then conquering the customer satisfaction. Moreover, the results show that a partial support from government can increase the HIS implementation rate in developing countries.

Comparison with existing D&M IS success model: In this section, I discuss the findings of the SLR in relation to the success model by DeLone and McLean (2003).

As I discussed in section 2.3 (see Figure 5), the DeLone and McLean's IS success model has two independent variables, namely systems quality and information quality, and four dependent variables, namely intention to use, user satisfaction, individual impact,

and organizational impact. In D&M IS success model, systems quality can be measured by measuring constructs such as perceived ease of use, access, efficiency, system features, response time, reliability, relevance, and consistency (Urbach & Mueller, 2011). Interestingly, I found that, in most primary studies analyzed, systems quality is missing from modeling the adoption or implementation of HIS in developing countries, though characteristics of system quality appear as success factors in 32% of the studies.

In Table 13, I map the constructs in D&M IS success model with the success factors identified from the SLR. As shown in the discussion below the table, the success factors identified in the review can be used to understand and explain specific factors in the D&M model.

Table 13. Comparison of HIS success factors with D&M IS success model

D&M success model	Success factors based on my review
Systems quality	**Systems quality** 1. Ease of use 2. Remote access to patient 3. Security and privacy 4. Systems features
Information quality	-
Intention to use	**Utilization of resources and monetary factors** 1. Available resource 2. Power supply 3. Connectivity 4. Affordable price 5. Reduce cost
User satisfaction	-
Individual impact	**Education, training & awareness** 1. Training 2. Educational 3. Awareness 4. Skillful staff
Organizational impact	**Culture and political issues** 1. Social influence 2. Influence from Government 3. Relationship between management and employees 4. Top management leadership 5. Context of use 6. Geographical location

From the table above, we can see that IS success factors for developing countries' healthcare matches with several dependent and independent variables of D&M success model. Systems quality, one of the independent variables, evaluates performance of a systems itself. Systems quality success factors such as ease of use, remote access to patient, security and privacy and systems features can be categorized and identified as determinants of system quality in the D&M model. There was no relevant success factor for information quality variable.

Intention to use variable measures the degree to which users are willing to utilize a systems' full capability. Monetary and logistic resources could significantly contribute to increase intention of usage of a system. While these factors could affect the user satisfaction variable as well, no factors found in literature review were directly related with user satisfaction.

Individual impact is a dependent construct that measures effect of information on behavior of the users. Education, training and awareness success factors could improve efficiency of this variable on individuals. These variables collectively influence organizational impact. However, organizational impact is also affected by success factors such as culture and political issues. Social influence, influence of government -, and sociocultural issues are quite prevalent in developing countries. As most healthcare institutions operate in an organizational structure, these factors critically contribute to the information systems' success in healthcare.

D&M success model contains six variables, while this literature review identified success factors for four variables: systems quality, intention to use, individual impact and organizational impact. Some of the factors overlap between variables. But this also indicates that previous literature overlooked success factors related with two variables: information quality and user satisfaction. As exploring those areas were out of scope for this research, future research can focus on identifying success factors for those variables.

6. Conclusion

In this thesis, I presented a systematic literature review (SLR) of empirical and non-empirical studies on health information systems (HIS) in developing countries. Hence, I analyzed 19 primary studies describing 11 different developing countries, presenting qualitative findings and stated barriers and success factors for HIS implementation and adoption in healthcare in developing countries.

The results regarding barriers show that lack of education, network unavailability, lack of power supply, lack of funding, resistance of users are the barriers more often identified as responsible for low adoption rate of HIS in developing countries. Given the nature of these barriers, it should be noted that it is not easy for the developing countries to overcome those barriers within a short period. It should be also noted that minimal research scope in developing countries represents reason for low adoption rate. I can summarize the category of political issues that it would be very difficult to implement HIS in developing countries unless the authority of these countries become strict against the corruption. Authorities in developing countries should investigate the current infrastructure and reform the infrastructure where needed.

The results regarding success factors shows that systems affordability, social influence, influence from government, ease of systems use, proper utilization of resource use are the frequently mentioned success factors for successful HIS implementation in developing countries. Some studies pointed out that for successful implementation of HIS, awareness and social influence can be spread through positive word-of-mouth advertising. To increase the end user acceptance, HIS systems should be able to save user's money and time.

6.1 Study limitation and threats to validity

This SLR was conducted in a systematic way to cover all possible studies related to information systems implementation in healthcare in developing countries. The main limitation of this study relates to the search strategy. The list of limitations of study are given below:

- I reviewed only those papers that were accessible in three databases: IEEE Xplore, ScienceDirect, Ebsco Databases.
- I did not include books, magazine, chapters in our primary studies.
- I ignored the articles that were not full text available.
- I included only those articles which were published between 2017 and earlier 2019.

Validity threat is a factor that has negative influence on research results. Data extraction bias might be the biggest threat to validity for this study. The data extraction was done by one author and followed the guidelines from Kithcenham & Charters (2007). To reduce the bias of data extraction, supervisor was contacted during establishing review

protocol (Appendix A) and creating data extraction form (Appendix C). This study was conducted by single author so there are higher possibilities to have validity threat in comparison with the studies which are conducted by multiple researchers. To minimize this bias, the author had to review some task more than once. As an example, reading the abstract (for study selection process) author had to review abstract more than once to reduce possible errors by the author.

6.2 Future research suggestion

This study was conducted based on the literature review. For a future study, empirical research is needed to test and validate the findings of research. Moreover, for future research, I suggest conducting survey on failure rate of HIS in a specific developing country, for example Bangladesh.

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Appendix A. Structure of review protocol

1. Background
2. Research questions
3. Search strategy
    a. Search strings
    b. Searched in selected databases
4. Study selection criteria
    a. Inclusion criteria
    b. Exclusion criteria
5. Study selection procedure
6. Study quality assessment
7. Duplicates removal
8. Data extraction techniques
9. Data synthesis extraction

Appendix B. List of primary studies and ID

Author	Title	ID
Muthee, V., Bochner, A. F., Kang'a, S., Owiso, G., Akhwale, W., Wanyee, S., & Puttkammer, N. (2018)	Site readiness assessment preceding the implementation of a HIV care and treatment electronic medical record systems in Kenya	[P1]
Brinkel, J., Dako-Gyeke, P., Krämer, A., May, J., & Fobil, J. N. (2017)	An investigation of users' attitudes, requirements and willingness to use mobile phone-based interactive voice response systems for seeking healthcare in Ghana: a qualitative study	[P2]
Gyamfi, A., Mensah, K. A., Oduro, G., Donkor, P., & Mock, C. N. (2017)	Barriers and facilitators to Electronic Medical Records usage in the Emergency Centre at Komfo Anokye Teaching Hospital, Kumasi-Ghana	[P3]
Sligo, J., Gauld, R., Roberts, V., & Villa, L. (2017)	A literature review for large-scale health information systems project planning, implementation and evaluation	[P4]
Alipour, J., Karimi, A., Ebrahimi, S., Ansari, F., & Mehdipour, Y. (2017)	Success or failure of hospital information systems of public hospitals affiliated with Zahedan University of Medical Sciences: A cross sectional study in the Southeast of Iran	[P5]
Powell, A. C., Ludhar, J. K., & Ostrovsky, Y. (2017).	Electronic health record use in an affluent region in India: Findings from a survey of Chandigarh hospitals	[P6]
Gesulga, J. M., Berjame, A., Moquiala, K. S., & Galido, A. (2017)	Barriers to Electronic Health Record Systems Implementation and Information Systems Resources: A Structured Review	[P7]
Mohamadali, N. A., & Ab Aziz, N. F. (2017)	The Technology Factors as Barriers for Sustainable Health Information Systems (HIS) – A Review	[P8]
Aamir, J., Ali, S. M., Boulos, M. N. K., Anjum, N., & Ishaq, M. (2017)	Enablers and inhibitors: A review of the situation regarding m-health adoption in low- and middle-income countries	[P9]
Hossain, N., Yokota, F., Sultana, N., & Ahmed, A.	Factors Influencing Rural End-Users' Acceptance of e-Health in Developing	[P10]

(2018)	Countries: A study on Portable Health Clinic in Bangladesh	
Odekunle, F. F., Odekunle, R. O., & Shankar, S. (2017)	Why sub-Saharan Africa lags in electronic health record adoption and possible strategies to increase its adoption in this region	[P11]
Ndayizigamiye, P., Soni, T. C., & Jere, N. (2018, May)	Factors Motivating the Adoption of Self-Healthcare Monitoring Mobile Applications by the South African Youth	[P12]
Chikumba, P. A. (2017, May)	Exploring Integrative Approach of GIS Implementation: The Case of GIS in Health Management in Malawi	[P13]
Sombat, P., Chaiyasoonthorn, W., & Chaveesuk, S. (2018, April)	The Acceptance Model of Hospital Information Systems in Thailand: A Conceptual Framework Extending TAM	[P14]
Pankomera, R., & van Greunen, D. (2017, May)	Mitigating Vulnerabilities and Threats for Patient-centric Healthcare Systems in Low Income Developing Countries	[P15]
Hamunyela, S., & Jere, N. (2018, May).	An Evaluation of Health Information Systems (HIS) for Namibia	[P16]
Luna-delRisco, M., Palacio, M. G., Orozco, C. A. A., Moncada, S. V., Palacio, L. G., Montealegre, J. J. Q., & Diaz-Forero, I. (2018, June).	Adoption of Internet of Medical Things (IoMT) as an opportunity for improving public health in Latin America	[P17]
Khan, S. I., & Hoque, A. S. M. L. (2017, January)	Health Data Integration with Secured Record Linkage A Practical Solution for Bangladesh and Other Developing Countries	[P18]
Faruk, N., Surajudeen-Bakinde, N. T., Oloyede, A. A., Bello, O. O., Popoola, S. I., Abdulkarim, A., & Olawoyin, L. A. (2017, December)	On Green Virtual Clinics: A Framework for Extending Healthcare Services to Rural Communities in Sub-Saharan Africa	[P19]

Appendix C. Data extraction form

1. Context information
    a. Title
    b. Author Name
    c. Publication Year
    d. Keywords
    e. Name of the country
    f. Type of study (empirical or non-empirical)
    g. Type of research method
    h. Data collection and analysis techniques
2. Research questions related information
    a. Was the paper barriers or success factors
    b. What success factors were identified
    c. What barriers were identified
    d. How dependent variables were defined
    e. What kind of information systems was studied
3. Answer to the research questions