ELECTRONIC MEDICAL RECORDS: A DEVELOPING AND DEVELOPED COUNTRY ANALYSIS

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Abstract
Most medical records are kept on paper. This makes it difficult to use the available information for management of care, measuring of quality of care and improving care delivery. The healthcare industry is mostly data driven and it depends on the accuracy and availability of the data and since most of the data is on paper format; this limits access to the data by healthcare providers and acts as a hindrance to healthcare delivery. The implementation of Electronic Medical Records (EMR), which will change the out-of-date paper record keeping system to a computerised modern record keeping system, is imagined to have a lot of benefits for healthcare services.

The primary aim of this research is to gain an understanding of the implementation of Electronic Medical Records (EMR) systems in developed and developing countries. There is a direct relationship between the income of the country and the use of electronic information and communication systems as part of healthcare systems hence the division between developed and developing countries. A preliminary investigation suggests that developed countries have higher level of quality of care and higher adoption rate and usage of EMR systems when compared to developing countries. This study is a qualitative study focusing on understanding Electronic Medical Records (EMR) in developed countries and developing countries and making a comparison of the two scenarios. The qualitative study for EMR systems in developed countries is based on published information. For developing countries, the qualitative study is divided into published information and a semi-structured interviews. The semi-structured interviews are collected in South Africa, which is used as an example of a developing country. South Africa; with one of the lowest ranked health services and also a resource restrained country; is a good example of a developing country.

The outcome of the research study is a comparative analysis of EMR systems in developed and developing countries including: implementation strategies; rate of adoption of EMR systems; challenges associated with the adoption of EMR systems and the benefits realised from the implementation of EMR systems.

Keywords: Electronic Medical Records (EMR), Developed countries, Developing countries, Comparison, Implementation, Challenges, Benefits.

Introduction

Electronic medical records

Electronic medical records are part of Electronic Health (eHealth) systems. EHealth is defined as the use of Information and Communications Technology (ICT) for healthcare systems (World Health Organization, 2010:5). Electronic medical records are a vital and basic part of the implementation of information technology in the healthcare industry (Jin & Ahlfors, 2012:2).

The technological advances in information and communication technologies and computing have paved a way for the application of electronic medical records which will enable a comprehensive compilation of healthcare information (Kabene & Wolfe, 2010:60). The implementation of electronic medical records is envisioned to have a lot of advantages for healthcare services, there are risks and disadvantages associated with the implementation, however; research indicate that the advantages outweigh the associated risks (Buntin et al 2011:467; Hillestad et al, 2005:1104; Kabene & Wolfe, 2010:60; Orszag, 2008:3). Information technology provides the potential of capturing, organizing and presenting medical information in a form that will make it useful to all healthcare professionals and this will enable bridging the gap between captured data and knowledge (Al-Shorbaji, 2001:4).

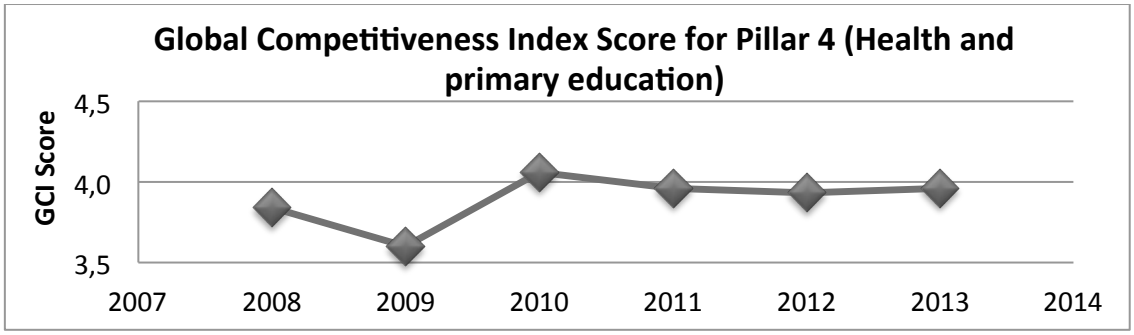
It is widely believed that the introduction and the adoption of electronic medical records will result in cost savings for healthcare industries, reduce service errors and improve quality of care (Hillestad et al, 2005:1103). The electronic medical records (EMR) systems when coupled with network systems, offers means of transferring information between doctors as part of improving the quality of care (Weeks, 2013:138). The employment of computerised systems in healthcare is seen as a foundation of a national health information network that will advance medical knowledge (Brooks & Grotz, 2010:77).

Overview of South African healthcare sector

Though South Africa's economy is deemed to be one of the most competitive in Africa and is currently ranked 56 out of 144 countries in the world (World Economic Forum (WEF), 2014:13), the performance of the health services is considered among the worse in the world. According to the Global Competitiveness Report (GCR), the health and primary education pillar is ranked at 132 out of 144 countries (World Economic Forum, 2014:17) with high rates of communicable diseases and poor health indicators.

When compared to countries in the same economic bracket, South Africa spends a substantial amount of its GDP on the health services. Between 2008 and 2012, an annual average of 8.9% of the country's GDP was spent on health services (The World Bank, 2012:1); Economist Intelligence United, 2010:8). Despite the high GDP spending on health services, South Africa's health services status is much worse than countries of similar economic level (Economist Intelligence United, 2010:8). A review of the Global Competitive Reports over the past six years also indicates that there has been no improvement noted in the country's health services as indicated in Figure 1. The condition

of the healthcare services and the lack of improvement has attracted a lot of attention towards means of improving care delivery.



Based on: World Economic Forum's World Competitiveness Reports (2008:15, 2009:17, 2010:19, 2011:17, 2012:17, 2013:17)

Figure 0. Trends of the GCI Score of pillar 4 for South Africa

In South Africa; the healthcare services are divided into public and private healthcare sectors. The public sector which comprises of state owned health facilities is used by 84% (42.6 Million) of the population and most of which live below the poverty line (South African National Department of Health, 2011:9). It should be noted that poverty; which is associated with unsafe drinking water, poor sanitation, pollution, etc.; increases the burden on healthcare facilities and resources and negatively affects the quality of care (Furu *et al*, 2008:56).

Besides the overall poor performance of the health services in the country, there is a vast difference between the performance of the public and private healthcare services. It should be noted that South Africa is one of the economies in the world with a great divide between the poor and the rich (Armstrong et al, 2008:12). The Minister of Health (South African National Department of Health, 2012a:13) noted that the economic divide has greatly manifested in healthcare services and can be seen in the differences between public and private sectors in his opening statement for the 2011/2012 Annual Report. Harrison (2009: 33) highlights that efforts to improve the quality of care needs to be driven by political and health leaders. It should be further noted that the Ministry of Health's role in providing overall guidance on activities that contribute to improving the public health services has been characterised by policies without emphasis on the implementation, monitoring and assessment (Coovedia et al., 2009:15), which has further worsened the service delivery especially within the public healthcare sector.

Over the past few years, the South African National Department of Health (NDOH) has initiated a number of reforms and initiatives to improve the healthcare systems in the country and has made significant progress in certain aspects of healthcare including progressive legislation and policies.

Objectives

A preliminary research shows that developed countries have higher level of quality of care when compared to developing countries. A high level investigation also shows that developed countries have implemented electronic medical records and their healthcare sector have benefited from it. The primary objective of the study is to gain an understanding of the electronic medical records in developed countries and developing

countries and make a comparison of the two scenarios of EMR systems. And also provide an overview of the approach towards electronic medical records implementation.

The associated research is as follows:

i. Developed Countries:

Explore electronic medical records in developed countries including:

- Implementation procedures employed
- Challenges faced by developed countries during implementation processes
- How the challenges in developed countries were addressed
- The benefits of electronic medical records and how they compare to the predicted benefits

ii. Developing Countries:

Explore electronic medical records in developing countries including:

- Implementation and adoption efforts
- Challenges faced by developing countries

As an example of a developing country; explore efforts towards implementation of medical electronic records in South Africa including:

- Current implementation and adoption of electronic medical records
- Challenges associated with implementation
- Benefits realised from the implementation of EMR systems

Research methodology

Because the research is of analytical nature and not statistically oriented, qualitative research methods are employed. Qualitative research allows for deep understanding of a specific situation or event (Buys, 2010:2), and it is preferred for engineering studies and for complex problems associated with healthcare research (Blumberg et al 2008:192). Secondary data is used for the qualitative analysis in this study. Secondary data has important implications for qualitative research within healthcare services especially when dealing with sensitive topics. The approach to the use of secondary data in this research is focusing on selecting the data that is appropriate to the research question being studied and the availability of resources for the research.

For the comparative analysis, data is required for both developed and developing countries. The secondary data used for the study of developed countries is in the form of published articles and statistical records. The secondary data used for the analysis of EMR systems in South Africa (as an example for a developing country) is in the form of audio clips of semi-structured interviews. The semi-structured interviews used for this study were collected by GSTM students between 2011 and 2013. This data was collected for several masters' research dissertations on health information technology by several Master's research students. The data is available as 'raw' data in the form of semi-structured narrative enquiry. Because several researchers were responsible for the collection of this data, the data has increased breadth which is advantageous for this study. The sources of the secondary data used for this qualitative research is summarised in figure 2, and table 1 provides a description of the participants of the semi-structured interviews.

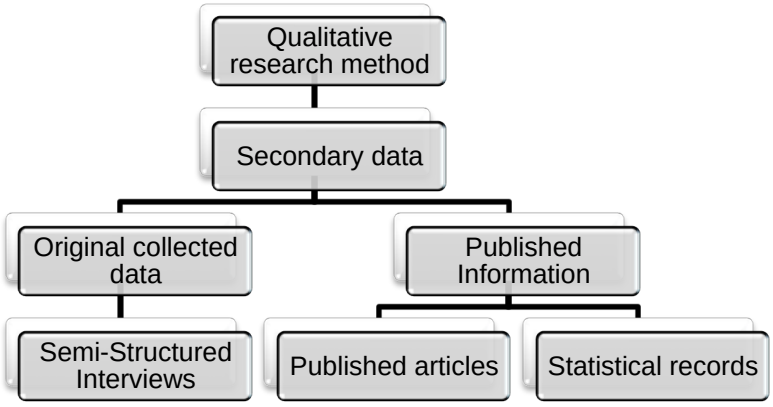


Figure 2. Qualitative research methods

Table 1: Description of participants for semi-structured

Healthcare facilities	Two healthcare facilities that have implemented eHealth systems are used, that is, one in the western cape and one in Gauteng. o Western cape health facility is a provisional government district hospital o Gauteng health facility is a primary healthcare clinic. The clinic is actively involved in eHealth initiatives and is in the early stages of an EMR system role out. The facility is run by the Health Department and the University of Pretoria and is used for practical training for medical students
Vendors of Technology	Technology suppliers that were involved in the healthcare centres discussed in the latter include: o The company that supplies high performing and secure ICT solutions to the country's corporate and public healthcare service sectors and they provided the Enterprise Content Management (ECM) solution for the Western Cape health facility o The company that provides web based mobile solution which supplied the Mobile health technology (mHealth) system o The company that provides the Electronic medical Records (EMR) solution

To investigate and understand electronic medical records (EMR) systems in developed and developing countries and making a comparison of the two scenarios; the approach outlined in figure 3 is used.

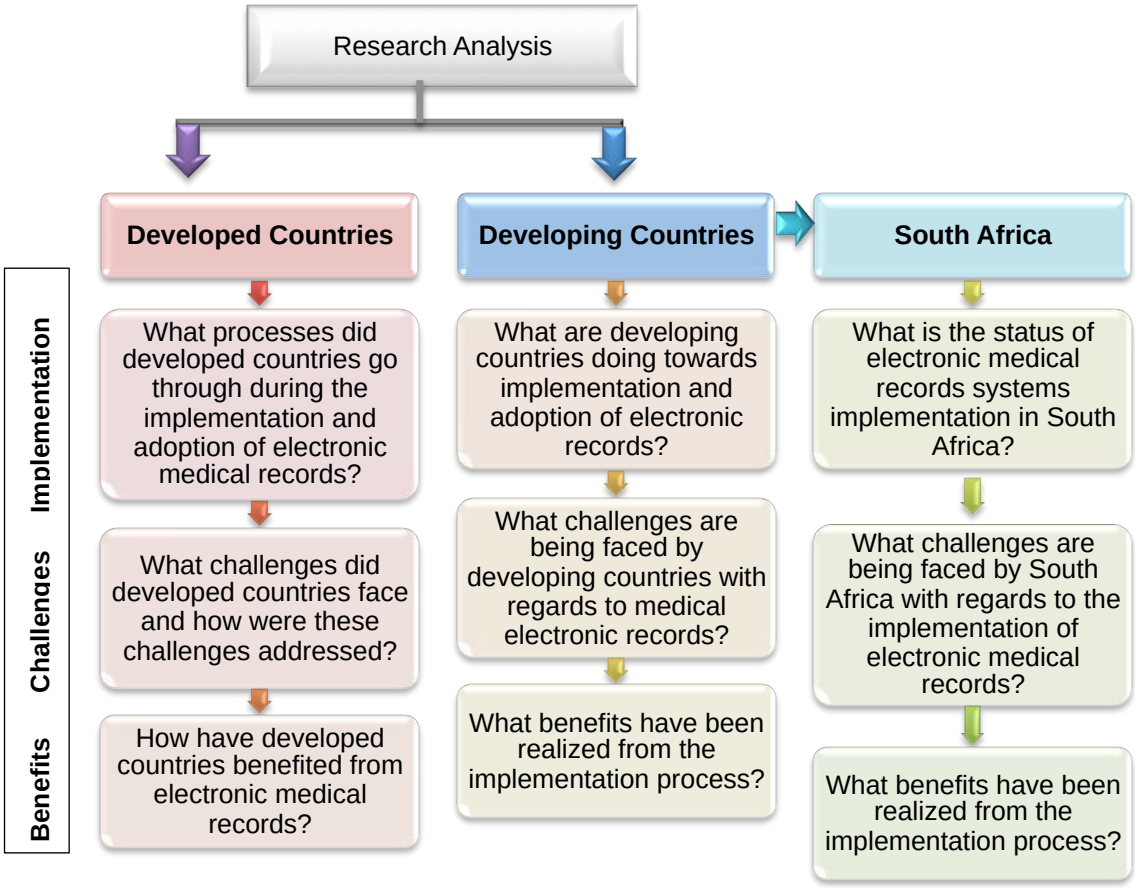


Figure 3. Research framework

The research framework is such that similar attributes are studied and analysed for both developing and developed countries for comparison purposes. Over and above reviewing South African healthcare, an overview of other pilot projects in areas with limited resources is important for developing a bigger picture with regards to EMR systems in developing countries.

Results

The research results are discussed along the same lines as the research framework. Three aspects are discussed; that is; implementation; challenges and benefits associated with EMR systems.

EMR Adoption

Developed countries

As noted previously, developed countries have adopted EMR systems to a certain extent. There are systems in place that are used to measure and quantify the adoption of EMR systems. A model called The Electronic Medical Records Adoption Model (EMRAM) is used to measure and quantify adoption levels of EMR systems. EMRAM is used by Canada, core hospitals in Europe, the Middle East, Asia and Australia (Health Information and Management Systems Society - HIMSS, 2012a:6).

The EMRAM is as summarized in table 2; with stage 7 being healthcare centres with the most advanced EMR systems and stage 0 being centres with minimal EMR systems.

Table 2: EMRAM Stages (Health Information and Management Systems Society - HIMSS, 2012a:7)

Stage 7	Knowledge drivel engagement for a dynamic, multi-vendor , multi-organizational and interconnected healthcare
Stage 6	Closed loop care coordination across care team members
Stage 5	Community-wide patient record using applied information with patient focus
Stage 4	Care coordination based on the actionable data using a sematic interoperable patient record
Stage 3	Normalized patient record using structural interoperability
Stage 2	Patient centred clinical data using basic system to system interchange
Stage 1	Basic peer-to-peer data exchange
Stage 0	Limited to no electronic communication

For EMR in developed countries, Australia and United States of America (USA) are used as examples in this study because of their competitive economies, competitive healthcare systems and availability of published information on implementation of EMR systems. The economy of the United States of America is ranked 3rd in the world with a Global Competiveness Index Score (GCI Index) of 5.54 (World Economic Forum, 2014:13) and the primary health pillar is ranked 49th with a score of 6.06 (World Economic Forum, 2014:17). The economy of the Australia is ranked 22nd in the world with a Global Competiveness Index Score (GCI Index) of 5.08 (World Economic Forum, 2014:13) and the primary health pillar is ranked 17th with a score of 6.46 (World Economic Forum, 2014:16).

The adoption of EMR systems have shown tremendous growth in United States of America as indicated in figure 4, which shows the percentage of hospitals per EMRAM stage between 2008 and Q2 of 2015. From figure 4, it can be noted that there is an increase in hospitals with stage 5 to 7 EMRAM and a decline to hospitals with stage 0 to 3. The latter indicated increased adoption and complexity of EMR systems

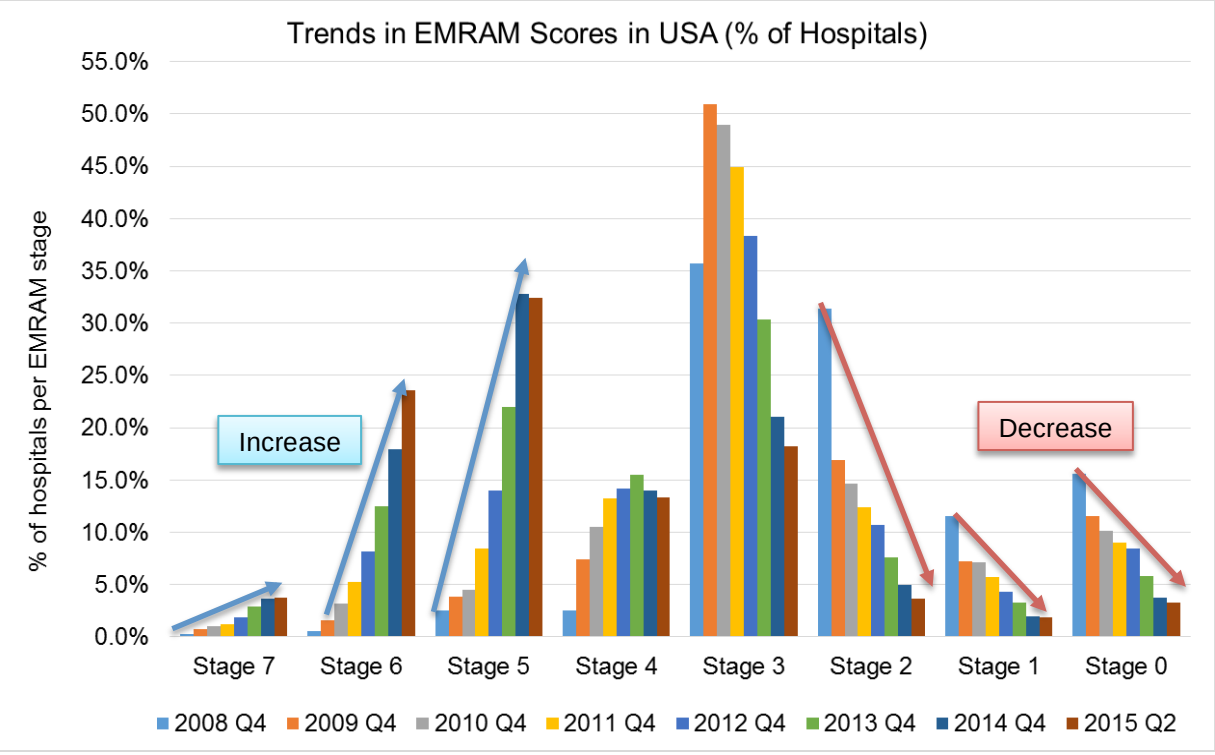


Figure 4. Percentage of Hospitals per EMRAM stage (USA) (Data extracted from: Health Information and Management Systems Society - HIMSS, 2015: online; Health Information and Management Systems Society - HIMSS, 2013:3)

Developing countries

Due to unique scenarios that exist in developing countries, the adaptation of EMR systems and EHR systems in developing countries is limited (Sood et al., 2008:1). A survey by the World Health Organization indicates that the African region and South East Asia have high use of paper and indicates minimal transformation to electronic records. The limited adoption of EMR systems in developing countries is due to limited or lack of understanding of the problems and challenges surrounding the delivery of healthcare in poor settings and addressing these special needs (Douglas, 2009:2). As means of providing real-life examples of systems that can function in resource restricted settings, pilot EMR systems have been put in place in several developing countries to establish and provide a body of knowledge as to how EMR systems can be efficiently and effectively implemented (Douglas, 2009:2).

South Africa is no exception to the rest of the developing countries. The implementation of EMR systems in South Africa is minimal. The National Department of Health, based on the eHealth strategy of 2012, has put together future strategies towards implementation and rolling out of eHealth systems. According to Weeks (2012:173), the transformation of the healthcare services in South Africa requires planned strategies and policies; together with a change in the traditional thinking and learning culture; to incorporate diverse disciplines that will manage the challenges associated with the transformation to ensure quality health for all.

EMR Challenges

Developed countries

Challenges associated with EMR implementation in developing countries is summarised in figure 5.

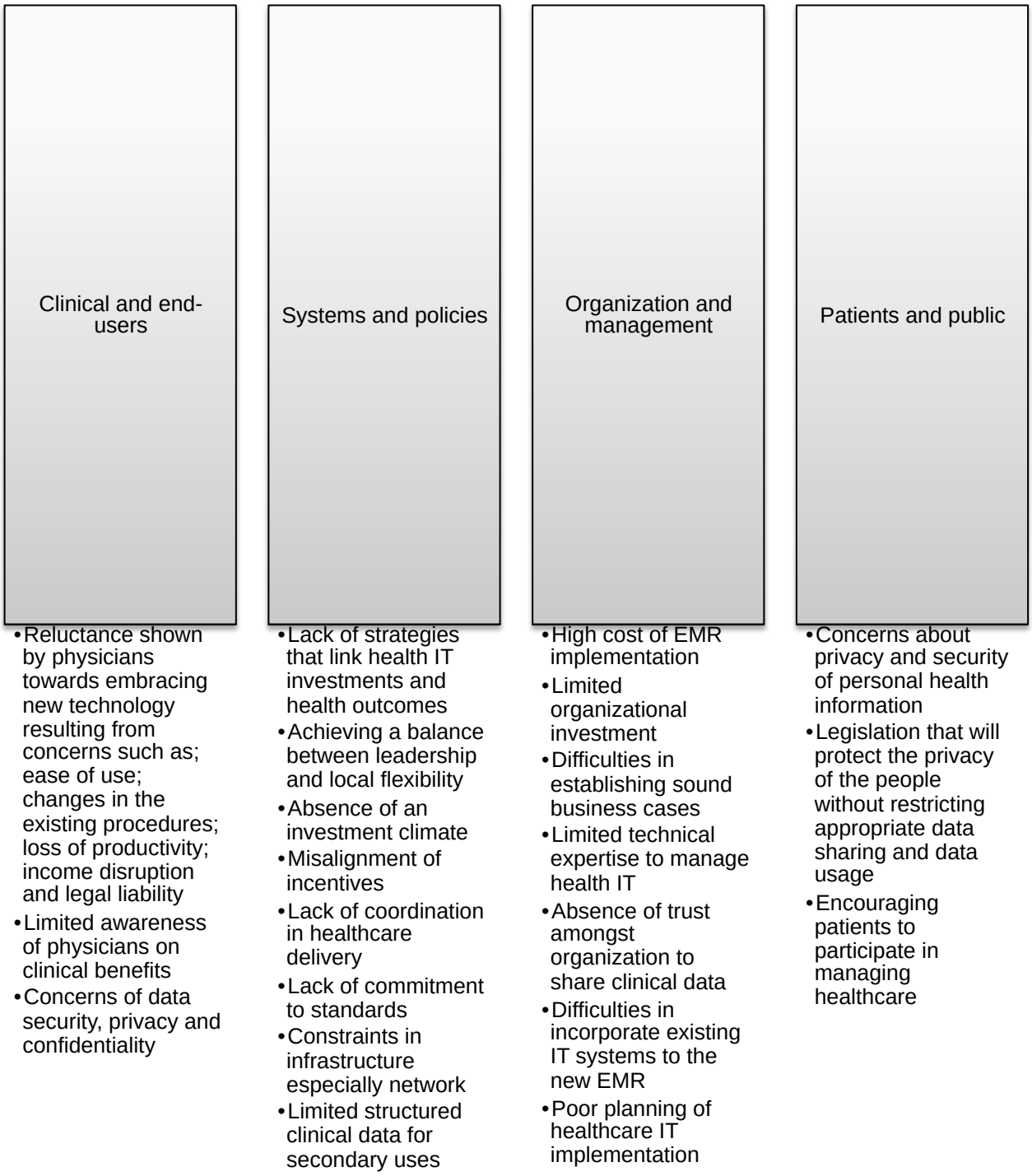


Figure 5. Summary of challenges associated with EMR systems in developed countries. (Accenture Connected Health Services, 2012:43-65; Guerriere & Kim, 2013:2; Menachemi & Collum, 2011:52; Miller & Sim, 2004:119-124; The Common Wealth Fund, 2012:20; World Health Organization, 2012:25).

Developing countries

Developing countries face additional challenges over and above the challenges faced by developed countries. Circumstances that are external to healthcare delivery affect both the incident and outcomes of the health industry and the effectiveness and efficiency of care delivery (Kim et al., 2013:7). According to the World Health Organization (2012:28); developing countries are handicapped by lack or resources, which make the

implementation of electronic systems very difficult. Several researchers elaborate on the challenges faced by developing countries and these are summarised in figure 6.

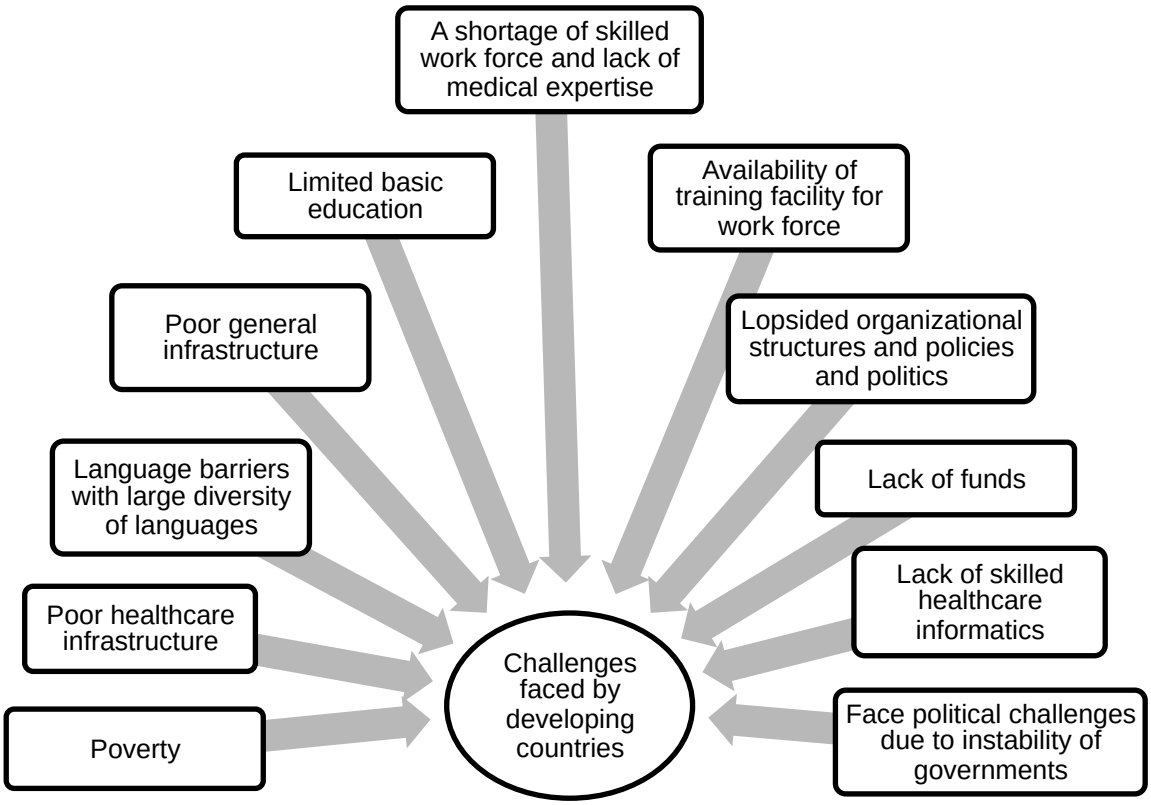


Figure 6. Summary of challenges faced by developing countries (Extract from: Douglas (2009:41); Dupas (2011:29); Furu et al. (2008:14); Kalogriopoulos et al. (2008:1); Kim et al. (2013:7); Sood et al. (2008:3-4); Were at al. (2010:237); Williams & Boren (2008:142); and World Health Organization (2006:30).

South Africa, like the rest of the developing countries, faces similar challenges. From this study, that is, using the data collected in South African healthcare; the main challenges associated with EMR systems are as summarised in figure 7. It should be noted that the South African public and patients were not part of the population that took part in the study. The challenges listed are only based on the end-user (both clinical and non-clinical), the providers of the technology systems (EMR vendors) and policy makers.

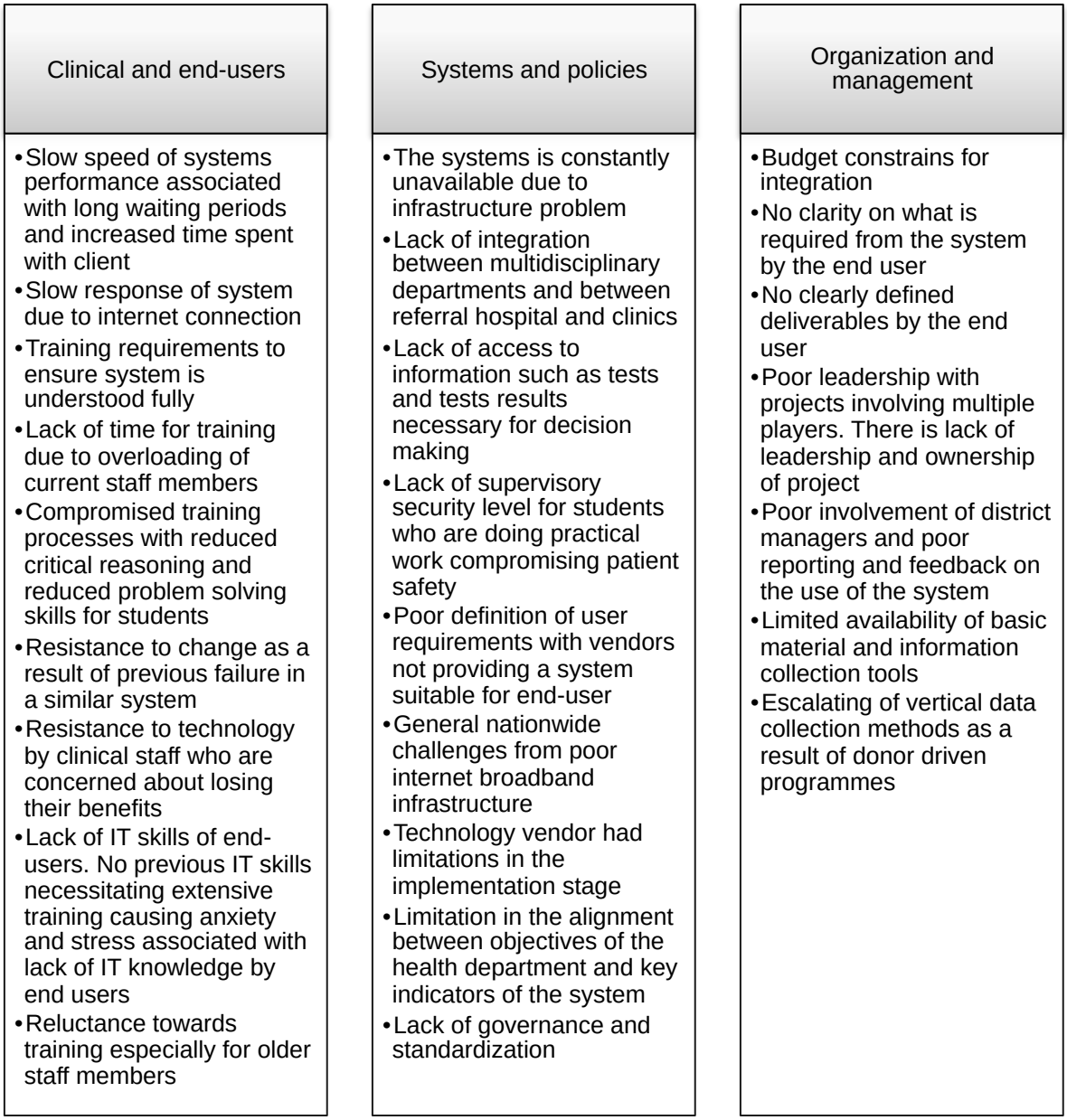


Figure 7. Summary of challenges faced by South Africa

EMR Benefits

Developed countries

The EMR system has been proclaimed as massively advantageous for the healthcare industry (Ayers et al., 2009:134). Most researcher have aggregated the benefits of EMR systems and concluded that a complete EMR system should produce substantial benefits for individual hospitals and for global healthcare (Health Information and Management Systems Society – HIMSS, 2012b:4) A summary of the benefits of EMR adoption in developed countries as follows:

- Improved quality and EMR use results in health system level benefits, such as reduced numbers of duplicate tests and adverse drug events
- Increased efficiency of organization and community-based practices experience efficiencies in workflow as staff time is redeployed

- Improved management of organization performance
- Increased coordination of care and EMR use supports improved interactions and communications among care team members and between providers and patients
- Advanced use of EMRs can improve health outcomes and patient safety through preventive care and chronic disease management
- EMR benefits the consumer/patient through patient centred care
- Improved patient satisfaction /experience within the healthcare centre

Developing countries
The major benefit of electronic medical records in developing countries is the improvement in the quality of healthcare delivery especially since these areas are marginalised and predominantly associated with a high burden of disease (Douglas, 2009:1).

EMR systems is still at early stages or limited to pilot sites in developing countries (Watkinson & Lee, 2012:199). Table 3 provides a summary of the significance of pilot EMR systems implemented in Kenya, Haiti and Cameroon (Williams and Boren 2008:143).

Table 3. Benefits of EMR pilot projects in developing countries

Country	**Implications or Significance**
Kenya	• The systems is serving the population by improving the quality of care, contributing to research and training • The system is simple and inexpensive
Haiti	• The system has been successfully implemented and is of importance in the impoverished areas
Cameroon	• Significant decrease in coding time and consultation was noted after 4 months from implementation • Resulted in better management of patients • Making data from previous patient visits readily available

For the South African case study, it should be noted that even though the study aimed at establishing benefits associated with the EMR systems, due to fact that the implementation of the EMR system was still at its early stages when the research was conducted, most of the respondents had no contributions to this section. The basic befits established from the semi-structured interviews are:

- Accessibility to patient information whenever it is required
- Organised data, better management of data and having data back-ups
- Management of critical resources

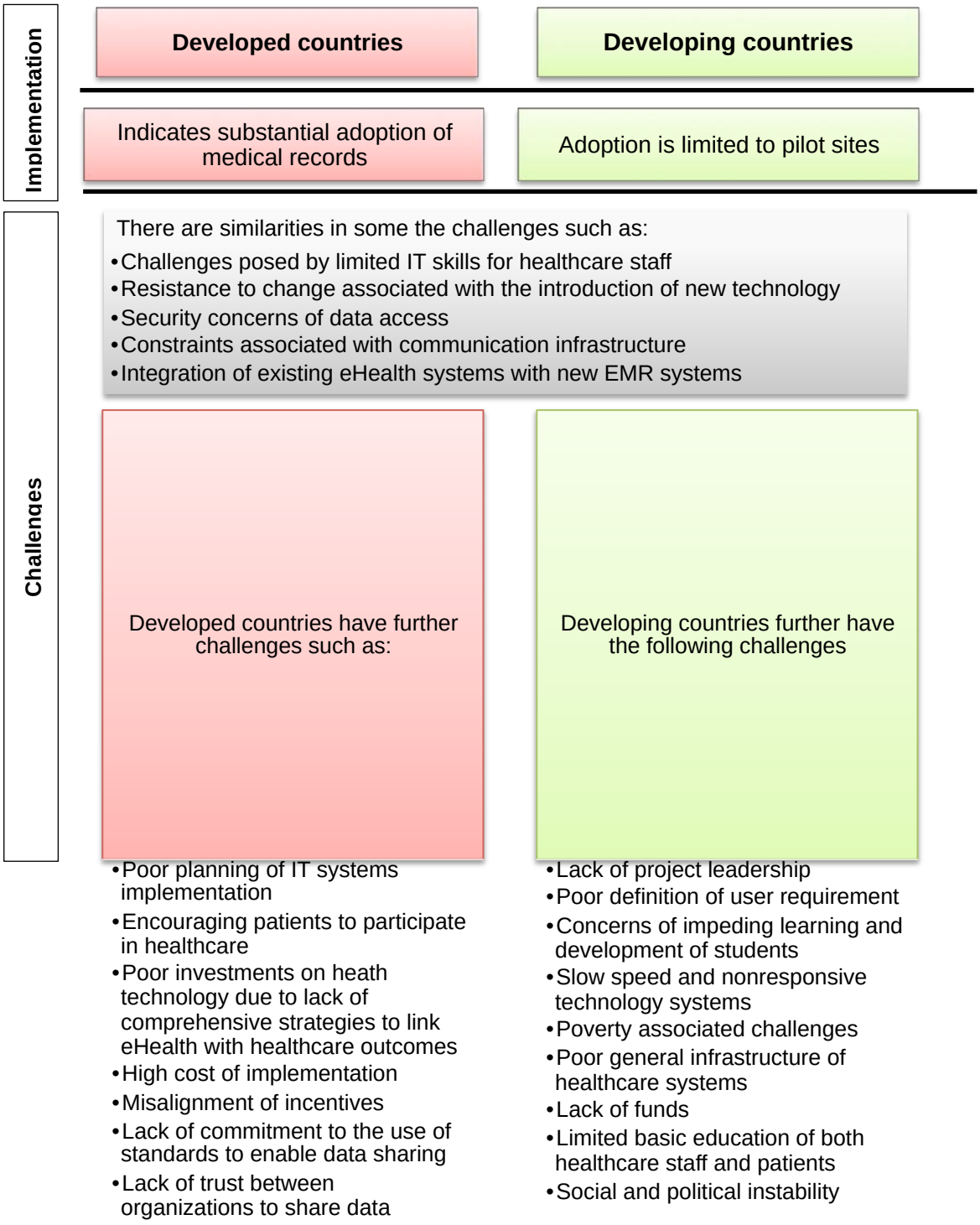
Due to the limited response from the interview; a brief overview of the pilot installation of technology in Khayelitsha will be done to establish further benefits of technology adoption in South Africa (Datacentrix, 2013:11):

- Reduction in the movement of physical files and decrease of lost patient files
- Viewing of documents in open text and allowing easy consultation between doctors
- Reduction in the need for large areas to store patients files in the admissions area
- The use of barcodes has increased
- Increase in the accuracy and efficiency of scanning, indexing and labelling

- Increased corporation between teams and increased functionality
- Enabling access of digital files through the use of Wi-Fi

EMR Comparison

For a comparative study, similar aspects of the scenarios of developed and developing countries are analysed. The analysis and comparison is subdivided into implementation; challenges associated with implementation and realised benefits as illustrated in figure 8.



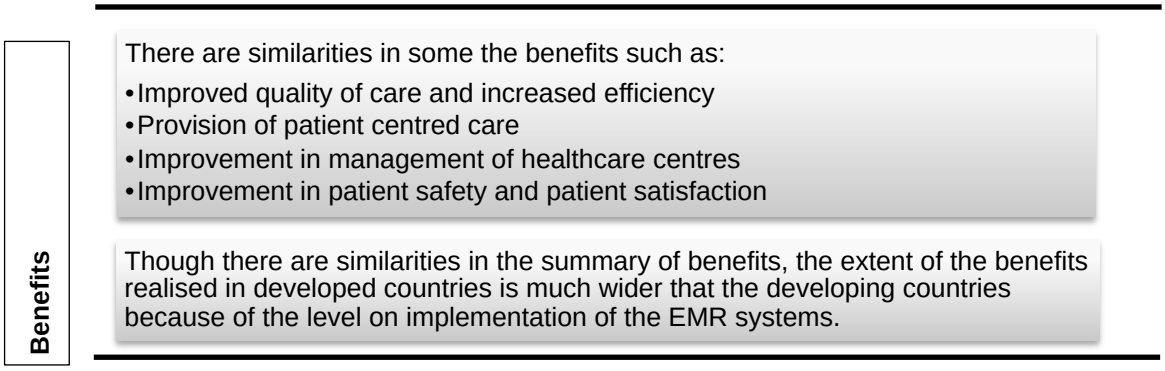


Figure 8. Comparison of EMR systems in developed and developing countries

Conclusions and future studies

Conclusion

As noted from the results of the study, that is, the analysis of both developing and developed countries; EMR systems are important in healthcare delivery. Both scenarios indicates benefits in health services. Though there are challenges with the implementation as discussed, the challenges can be mitigated and thus increasing the implementation of EMR systems. Developing countries have very limited adoption of EMR systems because of challenges associated with limited resources. Several examples of pilot implementation of EMR systems demonstrate the feasibility of EMR systems. As noted by Boren (2008:142); EMR systems are feasible and important in developing countries; even though there are challenges with the implementation and maintenance of the systems; as long as the EMR systems are designed to accommodate the limited infrastructure and resources. In collusion, EMR systems in developing countries are feasible as long as the EMR systems are designed to accommodate the limited infrastructure and resources.

South Africa is no different from the rest of the resource restricted countries where EMR systems pilot projects have been successfully implemented. The new eHealth Strategy that has been proposed aims at setting guidelines towards a well-functioning electronic health system. Though there are challenges to be overcome with the adoption and rolling out of technology; as noted in the study and in pilot clinics and hospitals; means to mitigate this challenges can be implemented. As noted in the example for Khayelitsha, the implementation of the ECM system in Khayelitsha significantly increased the efficiency and effectiveness of the hospital.

Summary of EMR Implementation recommendations

From the literature; it has been established that there is compelling argument on the benefits associated with the adoption of electronic medical records in the healthcare industry and its potential to improve the efficiency and quality of healthcare delivery. Table 4 provides key recommendations for adoption of EMR systems

Table 4: Key recommendation for EMR implementation

For vendors	For End-users	For Organization
• Explain how the system helps manage care giving and can increase efficiency. • Use cost-effective systems. • Continue to innovate and establish more user-friendly systems.	• Ensure that the requirement of the systems are comprehensively communicated to the vendors. • Be open to learn new ways of operation. • Develop understanding of the big picture that EMR systems will bring with regards to quality of care	• When communicating the benefits of EMR systems, keep the focus on key physician concerns such as time, money and patient care. • Provide extra support to doctors and other staff during the transition period. • Teach EMR system starting with basic clinical functions. • Implement a reward system for clinics with the best use of EMR. • Make available implementation strategies, challenges and benefits of EMR systems to promote awareness of all stakeholders.

Future studies

The study indicates that EMR systems are feasible in developed and developing countries. From reviewing EMR systems in developed countries and pilot projects in developing countries, certain trends of implementation procedures surfaces, and can be used a reference for future implementation of EMR systems.

In this study of EMR systems in South Africa, limited benefits were recognized. This is because of the fact that at the time of the narrative enquiry, the EMR systems implementation was still at its early stages. Further analysis and studies of the realised benefits is required at a later stage of the implementation. The challenges encountered are also related to early stages of implementation, and a study to review the challenges of a mature system is required. A measure of performance of the EMR system should also be considered in future for South Africa and other developing countries.

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