ERP in Healthcare

Martin Mucheleka and Raija Halonen

University of Oulu, Oulu, Finland

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Abstract: Attempts to improve healthcare services have increased worldwide and the role of information technology (IT) is increasing to find solutions for various issues facing the healthcare sector. The purpose of this study was to find out how enterprise resource planning systems (ERP) have been used in the healthcare sector and how these systems could be used to improve healthcare services. The field of IT now encompasses all industries, including the healthcare sector, which is currently going through fundamental changes. Based on the literature reviewed in this study, the use of ERP systems in the healthcare sector has not been widely reported. However, some findings showed that ERP systems could be used in the healthcare sector to improve the quality of services. Based on these findings, if ERP systems were successfully implemented in healthcare organisations, they would promote significant changes in certain areas such as in finance, human resources and capacity, revenue and admission resources. ERP systems could also improve both the profitability and services of healthcare organisations. Because of the lack of research in this area, further studies should investigate the usage of ERP in healthcare organisations.

1 INTRODUCTION

Information is an important aspect of the healthcare industry. Sharing knowledge has become important in order to reduce costs and improve the services rendered to customers. Therefore, the healthcare system needs to be able to collect and share information amongst several entities, such as clinics and customers. It also needs to provide information about billing and medical knowledge within the healthcare organisation and to stakeholders. (Bose, 2003.) Moreover, the increased use of IT has been led by the desire to reduce costs, to increase competitiveness in the healthcare sector, and to improve personalised personal healthcare (Siau, 2003).

This study analyses ERP in the healthcare sector and seeks ways to improve healthcare services by implementing ERP systems. The literature review, as described by Kitchenham (2004), was applied.

In general, current business environments have taken different shapes, and ERP systems are essential in improving the efficiency of an organisation and its strategic decision-making. Therefore, healthcare organisations are not an exception to the new business changes currently taking place. Indeed, the many business challenges faced today can be tackled by the adoption of ERP. (Lee and Kwak,

2011.) However, implementing ERP in healthcare environments faces several challenges such as long time for implementation as described by Abukhader (2014).

The healthcare sector worldwide is facing challenges, such as the rising costs of healthcare services (Woodside, 2007). Population aging and increased disability is reflecting on the services requiring multiskilled services especially in middle and high income nations (Hirdes et al., 2008). Furthermore, the management of the healthcare industry involves several stakeholders, such as governments, clinicians, service providers and users (Soltan-Zadeh and Córdoba, 2014).

This study focuses on how ERP systems have been used in healthcare organisations and how they could be used to improve their efficiency. Traditional healthcare organisations use segregated information systems. Therefore, these organisations are challenged in sharing important information amongst different entities. The study also highlights the benefits of ERP for organisations that successfully implement and integrate this system.

2 RESEARCH METHOD

In this study a literature review was conducted, and it required the following: formulating a research question, planning the review, doing the review and finally reporting the review (see Kitchenham, 2004).

The literature review is also defined as a method of identifying, assessing and analysing published primary studies in order to answer research questions (Staples and Niazi, 2007).

Therefore, literature reviews are research studies conducted for many different reasons, such as determining how much is known about a topic and answering a research question about the existing research on the subject (Okoli and Schabram, 2010).

A literature review can also explain and find answers to research question, illustrate activities in different forms, such as pictures, graphs and so on, in order to make connections among and describe activities. A rigorous literature review identifies the most important aspects of the study and places the citations correctly. (Levy and Ellis, 2006.)

Regarding the conclusion to the literature review, Rowley and Slack (2004) observed that the literature review identifies the existing knowledge about a subject or research question, which serves to organise the relevant literature to be used in the study. Prior studies are scanned and examined for data that will serve to answer the research question. Digital libraries are used to find journals that are relevant to the study.

In this study, the followings digital libraries were used: ACM Digital Library, Emerald Insight, Google Scholar, IEEE, Science Direct, Web of Science, Inderscience, World Scientific and the Oulu University Library.

In this study, the first scientific search for articles was done in Google Scholar, using the search string "ERP systems in healthcare", which yielded only 42 hits, thus indicating that the specific topic has not received much attention so far. The search then was modified to individual words and narrowed to articles published from 2000 to 2014 and that included the following keywords: decision support systems, information systems, healthcare, knowledge management, public health, business processes and software. This search yielded 380 articles.

The search was then refined to obtain articles that addressed or contained phrases and information about ERP, healthcare, social science and medicine. This was further limited to the topics of healthcare, health service, health system, health insurance, health promotion, which yielded 80 articles. This paper is a limited version or those reviewed.

3 LITERATURE REVIEW

This section first the context of the study opening concept of ERP and continuing to research about ERP in healthcare. After that, benefits due to ERP are summed followed by disadvantages due to ERP.

3.1 Context

Healthcare providers such as physicians can no longer entirely rely on their knowledge and memories to realise their scientific knowledge required for professional practice (Karsh, Holden, Alper, and Or, 2006). To respond this problem, Orzano, McInerney, Scharf, Tallia, and Crabtree (2008) introduced a knowledge management model. They believe that knowledge management processes and tools can be thought of as ways to organise and influence learning and decision making within practices to achieve overall health.

The healthcare industry is strongly depending on its customers and information relating to the customers, pharmacies and other service providers (Hung et al., 2010). Seeking ways to improve service quality is related to costs and higher demand in the services (Akbar, 2003). Because of competition amongst healthcare providers, healthcare organisations have changed rapidly in the last few years in the attempt to improve the effectiveness and efficiency of healthcare delivery (Helfert, 2009).

As hospitals have been transforming their organisational structures, van Merode, Groothuis and Hasman (2004) recommended a central planning and control system to manage the transformation and related processes. They note that the restructuring of healthcare sector and implementations of case-mix systems have forced hospitals to organise their services according to patients' needs. After that they question the type of information systems that could support the new healthcare delivery organisations. The role of knowledge management is significant. Their answer is an ERP system that is planned for healthcare delivery organisations. ERP systems have been known in manufacturing and service organisations since 1990's and later early 2000 they have been implemented also in healthcare sector (Botta-Genoulaz and Millet, 2006).

The concern of van Merode et al. (2004) was known already earlier as Berler, Pavlopoulos and Koutsouris (2001) described their best understanding about how to manage interoperability of a regional healthcare system. They introduced a framework that was based on Health Level 7 (HL7) and argued that their approach is pragmatic, achieves data inte-

gration and provides an acceptable solution. HL7 is widely used today in healthcare (see e.g. Nowak, 2014).

ERP systems are software packages that allow an organisation to view information about the entire organisation, as well as the power to influence the operations of an organization (Gargey and Brady, 2005). Amoako-Gyampah (2007, p. 1233) defines ERP as 'programs that provide single integrated software that aim to provide single integrated software to handle multiple corporate functions including finance, human resources, manufacturing, materials management, and sales and distribution ERP systems are programs'.

Sammon, Nagle, and Carlsson (2012) report in their review about early ERP that as there is no generally agreed definition for EPR systems they define that 'by design' an ERP is an operational-level system. On the other hand, Al-Saleem, Junaid Qayyum, Ziani, Mansoor, and Amin (2012) value EPR systems as the most groundbreaking progress in information technology.

Klaus, Rosenman and Gable (2000) noted that three types of ERP systems are commonly offered by ERP vendors:

- Generic form software targets specific industries and must be configured.
- Packaged software is preconfigured ERP software that is tailored according to the industry sector.
- Configured packaged software is the most often used in operational installations that have been individualised according to the client's specifications and requirements.

In addition, Kunkel, Rosenqvist and Westerling (2007) asserted that organisation observed that IT plays an important role and adds value to an organisation. Therefore, organizations have been acquiring IT systems in the last 20 years, and the healthcare sector has invested heavily in technology (Menon, Lee, and Eldenburg, 2000).

3.2 ERP in Healthcare

Clinicians, physicians, nurses and managers need quality tools in order to improve and cope with emerging medical technologies and methods to maintain quality healthcare services (Miller and Sim, 2004).

Recently Poonam and Divya (2014) asserted that previously the healthcare sector used IT mainly for billing and accounts. However, this trend has extended to include complex areas, such as reducing costs, improving efficiency, managing and caring for patients, and keeping track of inventory and supply chains.

Healthcare organisations handle huge amounts of information that they rely on to carry out their services (Grimson and Hasselbring, 2000). For example, a hospital handles data from many different departments, some of which must be shared in order to provide services. The information is used differently according to the function of departments, such as controlling and planning. Therefore, it is important to make this information accessible to the appropriate departments at the right time. (Stefanou and Revanoglou, 2006.)

Because information is an important part of the healthcare system, it is relied on to carry out the duties of physicians, patients' home care, and chronic care. Hence, the integration of different services and processes would benefit the healthcare organisation and eradicate the traditional segregation of processes, which has resulted in the reduced sharing of information. Integrated systems would allow the healthcare organisation to coordinate management and support the efficiency of patient care. (Bose, 2003.)

Furthermore, Handayani, Rahman, and Hidayanto. (2013) emphasised that healthcare organisations need to have automated information systems, such as an ERP system in order to meet the demands for the quality of healthcare services. In addition, Chen, Dolan, and Lin (2004) pointed out that the healthcare sector has lagged behind other sectors in making these changes. Currently, several different systems are used in the healthcare sector in order to help conduct daily work and manage resources effectively.

Lee and Kwak (2011) argued that many business environments have changed, including also the healthcare sector. Therefore, ERP could help the healthcare sector by improving the integration of processes and services. They suggested that if ERP was successfully implemented in a healthcare organisation, it would promote significant change, especially in finance, human resources and capacity, revenue, and admission resources.

Furthermore, Tarn, Yen, and Beaumont (2002) noted the importance of information technology as a key factor in organisations. Therefore, technologies such as ERP systems could play a major role in facilitating organisations in meeting their goals. The benefit of technologies such as ERP systems is the integration of the organisational processes, data and organisational elements. Tarn et al. concluded that combining all elements into a single system has many benefits, such as improving the operational

efficiency of an organisation.

Healthcare systems rely on information from different sources and entities to carry out duties, such as physicians' diagnoses, patients' home care and chronic care. Hence, the integration of different services and processes would benefit the healthcare organisation and eradicate the traditional segregated processes, which result in the reduced sharing of information. Integrated systems would allow the healthcare organisation to coordinate management and ensure the efficiency of healthcare provided to patients. (Bose, 2003.)

Integrated systems are an important aspect of every service organisation; the healthcare sector is no exception (Reay and Hinings, 2005) and integrated electronic information systems can effectively transform the healthcare sector (Haux, Ammenwerth, Herzog, and Knaup, 2002). For example, the use of telemedicine is increasing, allowing for the administration of healthcare to remote patients (Connell, 2006).

Huq, Huq, and Cutright (2006) reported that the delivery of services is complicated and depends heavily on information. Hence, healthcare organisations depend on information about individual patients, care providers, results and the science of care. Furthermore, today, patients are managed by different physicians, unlike the days when a single physician was responsible for a patient's health.

Based on Schnayder, Chen, Lorincz, Jones, and Welsh (2005) and Padhy, Patra, and Satapathy (2012), the rough architecture of an ERP is shown in Figure 1.
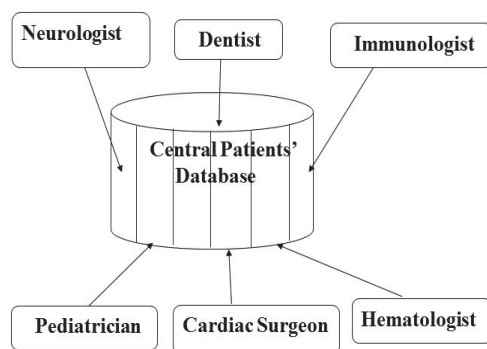

Figure 1: Physicians and Central Patients' Database.

Figure 1 illustrates a central database of patients in a healthcare organisation, which is accessed by several physicians. In this case, all physicians are able to access specific information regarding a patient.

Because many physicians collaborate in the management of a single patient, it is important that they have access to readily available information

about that patient (Shnayder et al., 2005). ERP systems may help healthcare organisations to facilitate the administration of their services through accessing various ERP information systems in different locations. Being able to access medical information is vital to the health fraternity because it helps them to be efficient and effective. (Padhy et al., 2012.)

Grimson et al. (2000) observed that although healthcare organisations handle large amounts of data, the inability to share these data has led to their inefficiency, preventing them from operating effectively or reducing costs. This further affects the time taken to handle and share various data within the organisation and with stakeholders. Gupta and Kohli (2006) noted that every organisation aims to improve its services and operations. Therefore, ERP systems have been used to improve the internal operations of organisations. Business dynamics require an organisation to have a more prudent system for decision-making, as well as monitoring and controlling information.

In addition, Grimson et al. (2000) argued that healthcare organisations handle large amounts of data and information. However, the inability to share this data and information has led to the inefficiency by most healthcare organisations to operate effectively and reduce costs. This further affects the time taken to handle and share various data and information within the organisations and with stakeholders.

A case study conducted by Stefanou and Revanoglou (2006) revealed that implementing a simple system in a healthcare organisation can have a tremendous impact. Therefore, there is no doubt that implementing an entire ERP system can have a positive effect throughout an entire organisation.

Although ERP systems are recommended as a solution to several challenges, Gupta (2000) claimed that these systems are costly and that they change the operation of an organisation. Organisations that have successfully implemented an integrated an ERP system may face resistance from employees (users) that are required to shift to the new systems Because of the resistance to embracing change, it therefore could take a long time for the organisation to realise the benefits of the new system, which might result in budget overruns.

3.3 ERP Benefits

This section reports the benefits of implementing ERP in four departments in a hospital.

Front Office

The front office, often called Front Desk, is one of

the most important components of every hospital because provides patients and their families with updated information. People working at the front desk have access to information about - for example - appointments, bed availability, specialised services, and schedules of doctors. ERP software greatly assists in the efficient organisation and smooth operation of the front desk.

Financial Management

ERP software can help identify solutions to cut costs, improve managerial reports, reduce risks and anticipate results. It allows a hospital to integrate numerous financial processes and manage them in an improved manner. Many industry experts think that no tailor-made ERP solution is available for the healthcare industry. Nonetheless, there is no doubt that the healthcare industry can benefit tremendously from ERP software in many ways. (Shang and Seddon, 2000; Stefanou and Revanoglou, 2006.)

Inventory Management

Inventory management is one of the most prominent features of ERP systems. It has also proven to be important in the healthcare industry. Hospitals find it difficult to manage inventories on a daily basis. Therefore, an ERP software can offer significant help in this regard, such as, for example, coordinating the purchase and maintenance of instruments, keeping track of the expiry period and reorder status, finding economical suppliers. (Stefanou and Revanoglou, 2006). Furthermore, a single computer system promotes transparency and access to the organisation's database, which allows the managers to make informed decisions and report on the performance of the organisation (Kumar, Maheshwari, & Kumar, 2003; Klaus, et al., 2000.)

In addition, Shehab, Sharp, Supramaniam, and Spedding (2004) pointed out that implementing an ERP system in an organisation brings significant changes, such as the following:

- Having automated and integrated business processes within the organisations
- Sharing of information and practices within the organisation and reducing repetition and error
- Ability to access organisational information in a real-time environment, which makes it easier to make quality decisions

Therefore, it would be difficult and time consuming for management to make decisions without having access to vital information. However, with a single computer system, management would have access to information, thus enabling them to make decisions that further reduce administrative costs.

Operational Costs

According to Stefanou and Revanoglou (2006), ERP systems significantly reduce human interference in various tasks because information transfer is raped and completely automated. ERP systems also reduce the workforce needed to manage patients' registration, billing, discharge, and transfer. Therefore, healthcare organisations saving such costs will improve efficiency and productivity.

In addition, Gattiker and Goodhue (2005) asserted that organisations implement and integrate ERP systems for various reasons, such as reducing costs, having centralised data storage accessible by various departments, integrating business, and providing the opportunity to redesign business practices. In his literature review of 79 journal articles Moon (2007) pointed out that even if ERP systems are not the major decision support systems they are usable also in that function.

In summary, ERP systems, such as web applications, may help the healthcare organisation to carry out its processes effectively, such as filling orders. Furthermore, both academicians and practitioners consider ERP systems are considered an important part of technology and vital to the improvement of business processes (Hendricks, Singhal, & Stratman, 2007).

3.4 ERP Disadvantages

Despite their advantages, ERP systems have some drawbacks. Lengnick-Hall et al. (2004) asserted that ERP systems follow strict routines, which does not encourage other options. On the other hand, this promotes the transparency of an organisation, as the information is shared and accessed through the central database. They continue that ERP systems have defined processes that allow for no alternatives. Furthermore, Gupta (2000) claimed that ERP systems change how organisations operate. Organisations that have successfully implemented and integrated an ERP system may face resistance by the employees (users) who are required to shift to the new systems. Because of the resistance to embracing change, it therefore takes a long time for the organisation to realise the benefit of the new systems, thereby causing budget overruns.

In addition, Gupta (2000) pointed out that in an ERP system, errors are not usually detectable, and there is always a chance that errors are carried all the way through the single ERP system without being noticed. Furthermore, ERP systems are very costly to acquire.

On the other hand, Shehab et al. (2004) pointed

out that organisations that successfully implement an ERP system will require sufficient data storage, networking capability and overhead needs, such as training staff on in using the ERP system.

In conclusion, Wailgum (2008) claimed that ERP systems have several hidden costs that are caused after the successful implementation and integration of the systems. Hidden costs include staff training, testing the integrated software, in addition to the possible customisation of the system by add-ons if the integrated system does not fit well with other systems and components of the organisation.

Table 1: ERP system—advantages vs. disadvantages.

Advantages	Disadvantages
Operations – this helps to *reduce costs and cycle time*, which results in improved customer services	ERP systems may have *too many features and modules* that users need to consider, thus implementing only the most important ones.
Finance – ERP can *help to identify solutions to cut costs, improve managerial reports, reduce risks and anticipate results*. It allows a hospital to integrate numerous financial processes and manage them in an improved manner	Implementation – ERP systems are *expensive to implement* and may result in unsuccessful implementation, costing the organisation money and resources. *Maintenance is expensive* because it requires the entire system to be maintained as a single unit.
IT infrastructure – Build *business flexibility for current and future changes* in the organisation, IT costs reduction and increased IT infrastructure capability.	Organisations often *depend on the ERP vendor* that implemented and integrated the system for maintenance and future upgrades, unless they decide to change the system.
Central database – Every department and business unit of an organisation *will have access to the information readily available* when needed.	Reliability – Organisations using ERP systems risk breaks in their services when their ERP systems break down, thereby causing interruptions in various services.

Table 1 summarises some advantages and disadvantages of ERP systems, as discussed in the literature review. The table provides examples on how an organisation may benefit from specific advantages and indicates how disadvantages can affect the organisation that has implemented or intends to implement an ERP system.

In conclusion, ERP systems are expensive to implement and integrate into an organisation, as noted by Abukhader (2014), Shehab et al. (2004), and Rashid, Hossain, and Patrick (2002). Moreover, ERP systems are dependent on the vendors for future maintenance. (Rashid et al., 2002).

4 DISCUSSION

This study conducted a literature review with the objective of gaining knowledge about using ERP to improve the healthcare sector. The review focused on the advantages and benefits of the ERP system for healthcare services. Eighty articles were examined.

ERP could help healthcare organisations to improve their decision-making processes, which are critical for both the organisation and its managers. Having access to a single database would allow managers to make informed decisions and report on the performance of the organisation. (Kumar et al. 2003.) As pointed out by Shehab et al. (2004), ERP systems allow all organisational activities to be automated into a single computer system, thereby improving the access and sharing of organisational information and reducing repetition and errors.

Stefanou and Revanoglou (2006) noted the different types of ERP system integration, including the healthcare-specific process, as follows:

- Business process integration (BPI) or best-breed ERP: serves the computerised process systems of the administration, financial and clinical functions
- Non-ERP applications: integration of patient relationship management systems, picture archiving and communication systems, laboratory information systems, operation theatre systems and clinical decision support systems
- ERP as a web-based application and system integration: systems, E-procurement of medical supplies, information integration among several different hospitals (healthcare organisations), physicians, medical suppliers, insurance, telemedicine, pharmaceutical industries and e-learning
- ERP as a mobile device integration, which takes into consideration mobile healthcare systems and telemedicine.

Huq et al. (2006) pointed out that having access to information in healthcare organisations is important as they depend on information to provide services. ERP systems bring various changes and benefits to healthcare organisations. Therefore, ERP

systems help to streamline the processes of an organisation. This helps the healthcare organisation manage and control various departments, as the information is immediately available. Furthermore, ERP systems are known to help organisations reduce operational costs. (Bose, 2003.)

According to Stefanou and Revanoglou (2006), healthcare organisations handle huge amounts of data that often is also sensitive, and information in different departments on the different information systems currently being used. This information is meant for various departments, and it must be shared if it is processed and used by various stakeholders. Each department collects data intended for processing and planning their work. This information is shared among the departments according to need.

Padhy et al. (2012) demonstrated the need for the connectivity of healthcare organisations, such as those in urban and rural areas, in order to provide quality service and share vital information that might be lacking in remote healthcare centres. Therefore, ERP systems and other integrated technologies would be important in meeting such challenges because they can be used through web technologies that promote connectivity, such as WAN technologies. Figure 2 illustrates a solution that enables connectivity within an organisation.
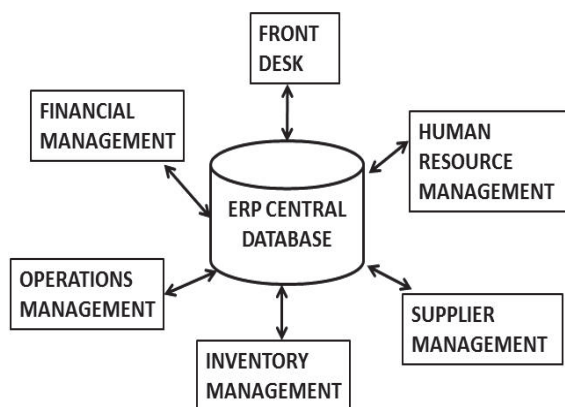

Figure 2: ERP integration in a healthcare organisation.

Figure 2 shows an example of connectivity among integrated healthcare departments that share information for different purposes through the ERP central database, as suggested by Huq et al. (2006), Stefanou and Revanoglou (2006) and Padhy et al. (2012).

Furthermore, the ERP system shown in Figure 2 integrates various business units connected to the central database, thereby giving each one access to the information from other business units in the organisation and promoting transparency. In addi-

tion, Stefanou and Revanoglou (2006) stated that ERP systems support several critical functions related to clinical, administrative, financial, and daily processes, such as patient flow, versatile reorders at clinics, and billing. They also pointed out that the implementation of ERP in a healthcare organisation may result in the organisational reengineering of the organisational processes and applications, leading to organisational change.

Despite the assertion that ERP systems promote transparency (Kumar et al. 2003; Klaus et al., 2000), Stefanou and Revanoglou (2006) stressed that ERP systems cannot entirely be integrated and used in the healthcare sector because healthcare organisations, such as hospitals, are complex and have several specialised clinical systems, such as the EAI technologies used in operating theatres and laboratories, which seemingly can only be integrated with ERP systems.

5 CONCLUSIONS

The focus of the study was to find out how ERP systems have been used in the healthcare sector and how they could be used. This was done by applying literature study.

The results of the literature review showed some aspects of what has been done in the healthcare sector with regard to ERP systems. For example, Stefanou and Revanoglou (2006) described how hospitals started to implement SAP's R/3 ERP software. Stefanou and Revanoglou (2006) also asserted that improving the availability and quality of information in the healthcare organisation may lead to better decision making processes, thereby improving the quality of healthcare.

Healthcare organisations are knowledge-based and depend on information to execute their services (Bose, 2003). Healthcare organisations tend to be complex and have become more complex in recent decades, now handling huge amounts of data. Healthcare providers depend on these data to attend their patients. Thus, it is important for healthcare organisations to manage data and share them with stakeholders. This could help them to reduce costs and the duplication of tasks and improve the healthcare services offered to patients.

The study further found that ERP systems could help healthcare organisations improve their services. Tarn et al. (2002) asserted that technologies play an important role in organisations and have the capacity to improve services. Hence, ERP systems could have a positive effect on healthcare organisations because

they integrate various organisational systems and processes into a single computer system that allows accessing and sharing information.

Nonetheless, ERP systems are expensive to implement into an organisation and they also induce changes in the operations of the organisation. Moreover, organisations that successfully implement and integrate an ERP system will further depend on the vendor for maintenance and upgrades of the system (Gupta, 2000). On the other hand, Brehm et al. (2001) argued that in tailored ERP, vendors provide free support, such as help desks and fixing bugs. However, the adopters have the responsibility for the maintenance of the system, such as configuration.

This study reviewed studies published from 2000 to 2014. The studies were collected from various and electronic libraries that were accessible through the University of Oulu, Finland.

It is recommended that further research be conducted in this this subject area. To date, only a few case studies have examined how ERP systems have been used to produce quality results, such as streamlining the operations and reducing the costs of the healthcare organisation.

ERP systems need further exploration in relation to the healthcare industry. Empirical research could be supplemented by further case studies that examine the potential use of ERP systems, as well as how they have been practised in healthcare organisations. Conducting such research would provide scholars and researchers with the opportunity to create knowledge. This would in turn help organisations that offer ERP services to gain reliable information regarding what they need to know and what the healthcare expects from ERP vendors. This information would also contribute to the existing knowledge of the use of ERP systems in the healthcare sector.

Despite the recommendations about ERP systems accepted as viable solutions, most authors argued that implementing the ERP systems is expensive and that it requires millions of dollars to implement. Moreover, it has hidden costs such as staff training and maintenance of the ERP system (see e.g. Rashid et al., 2002; Shehab et al., 2004).

Although much of the relevant literature favours ERP implementation in healthcare and public service organisations, it could be argued that previous research has focused on the implementation of ERP systems, not their potential to improve healthcare services and reduce operational costs. Future research should work to fill this gap in the earlier knowledge.

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