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Anton de Kom University of Suriname

Faculty of Social Sciences

Relation between Electronic Health Records and Healthcare Efficiency

The case of Suriname's healthcare sector

In partial fulfilment of the requirements for the degree of Master of Science in Accountancy

Field of study : Master Accountancy

Name : Madhavi Gangaram-Panday

Supervisor : Drs. Michiel Bilkerdijk

Paramaribo, November, 2021

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Madhavi A. Gangaram-Panday

Paramaribo, November, 2021

Abstract

Healthcare providers constantly aim to control healthcare costs while improving financial performance, operational performance, and quality. While most data are stored in hard copy form, the current trend changes from the storing of these data in hard copy form to the rapid digitalization of these large amounts of data. These massive quantities of data, known as big data, has the potential to improve the quality of healthcare delivery while decreasing the healthcare costs. Healthcare providers need efficient processes for the realization of big data's potential, where big data analytics is seen as a crucial sub-process with the potential to both improve care, and decrease healthcare costs using the potential big data technologies. The development of big data technologies ensures the cutting of time which was needed to process data while making it possible to deal with a large amount of and complex data, which was not possible years ago. Electronic Health Records (EHR) is seen as the potential big data technology in healthcare with potential benefits such as the decrease of healthcare costs, improvement of quality and safety. EHR refers to an advanced process-enabling information technology which makes it possible to streamline information-intensive workflow, remove manual hand-off of data and information, and facilitate coordination thus facilitating the execution of entire business processes rather than individual tasks. EHR can result in improved healthcare efficiency that is noticeable in the form of decreased costs, and a positive return on investment (ROI).

The purpose of this research is to investigate if EHR lead to healthcare efficiency. The study is conducted on thirty healthcare providers in Suriname. The different theories are examined which support a possible linkage between EHR and healthcare efficiency where healthcare costs decrease and a positive ROI is realized. EHR is measured by supplies & printing, transcription, and chart pull costs decrease. To measure healthcare efficiency the ROI is calculated. To test the developed hypotheses a regression model is applied in Statistical Package for Social Sciences (SPSS). The results suggest that there is a positive correlation between EHR and healthcare efficiency for the thirty healthcare providers in Suriname. With the results gained it can be concluded that EHR lead to healthcare efficiency with Surinamese healthcare providers.

Keywords: ***Big data, big data analytics, Electronic Health Records, healthcare costs decrease, healthcare efficiency, return on investment.***

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1 Introduction

1.1 Research objective

The subject of this study is to explore whether Electronic Health Records (EHR) lead to healthcare efficiency with Surinamese healthcare providers.

Healthcare firms, that are addressed as healthcare providers in this research, constantly aim to control costs while improving financial performance, operational performance, patient outcomes, and quality. All hospitals and clinics have expenses on advanced technology as a notable spending item (Bojja & Liu, 2020). Healthcare historically has generated large amounts of data. While most data are stored in hard copy form, the current trend changes from the storing of these data in hard copy form to the rapid digitalization of these large amounts of data. These massive quantities of data, known as big data, has the potential to improve the quality of healthcare delivery while decreasing the healthcare costs. Firms need efficient processes for the realization of big data's potential. In the overall process of insight extraction from big data, big data analytics is crucial where it can be seen as a sub-process of big data. Big data analytics has the potential to both improve care, and decrease healthcare costs, where significant value is being created in healthcare (Raghupathi & Raghupathi, 2014).

Big data analytics refers to the big data technologies that enable the possibility to collect, manage and analyze datasets that are too large and complex to be collected, managed, and analyzed by traditional databases (Tambe, 2014). Big data technologies facilitate information integration and provide fresh business insights to help healthcare providers meet the need of patients and future market trends, and thus improve quality of care and financial performance (Wang et al, 2016). Without the right big data technologies, the features of big data such as analytics tools, visualization approaches, workflows and insights are likely to be limited (Zakir et al, 2015). However, most health information technology systems still rely on data warehouse structures. That is why big data's success in creating value in healthcare may require changes in current polices (Roski et al, 2014).

1.2 Scope of the study

Since big data technologies is a broad and complex topic, this research will only focus on EHR as big data technology in healthcare. Literature review suggests that EHR is the most applied big data

technology in healthcare to decrease healthcare costs, achieve a positive financial performance (Grieger et al, 2007), and achieve a positive ROI (Wang et al, 2003). To measure the quality of firm's financial performance in healthcare firms, studies show that healthcare efficiency is the appropriate measurement. Literature review shows that a positive effect of a firm's financial performance is gained by employing efficiency initiatives on the firm. Efficiency is achieved by promoting aggressive cost decrease initiatives, developing and continuing sustainable efficiency programs (Ansari et al. 1997). Efficiency is seen as one of the most important goals of healthcare (James & Burgess, 2012). Healthcare efficiency is one of the most important dimensions of financial performance, where the healthcare providers try to measure the ROI in big data technology, and it is assumed that big data technology will translate into a positive ROI.

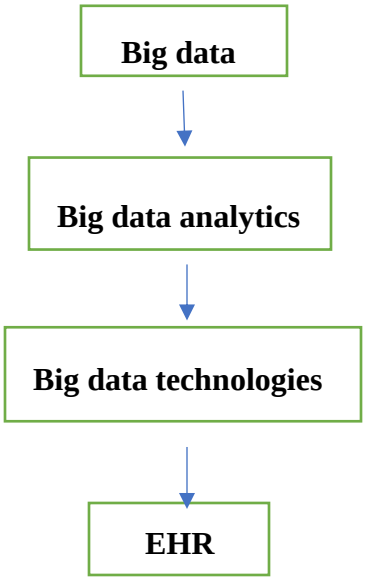
Ever since the outbreak of the Covid-19 pandemic there is worldwide a desperate need to manage the massive increase in healthcare costs. Even so, Suriname is struggling with the tremendous increase of costs in the Surinamese healthcare providers which are mainly subsidized by the government. In Suriname, as a less development country there has been a long-cried need for advanced information technology to improve the quality of financial performance in healthcare providers resulting in decreased healthcare costs (Eichler & Amanh, 1999). It is therefore interesting to study whether EHR as a big data technology, lead to quality of financial performance with the Surinamese healthcare providers, which can be measured by healthcare efficiency.

1.3 Problem statement and research question

The rapid development of big data technologies ensures the cutting of time which was needed to process data while making it possible to deal with a large amount of and complex data, which was not possible years ago (Bi & Cochran, 2014). If big data is not used effectively, healthcare will create risk in losing huge amounts in revenue and profits (Raghupathi & Raghupathi, 2014). Healthcare especially is under high pressure to decrease healthcare costs. Hereby the healthcare providers attempt to decrease healthcare costs, while there will be a lack in time spend on treatment processes. That is why, if healthcare providers want to decrease healthcare costs, they need to first innovate their business processes to create healthcare efficiency (Lee, 2015). One important consideration is about where the work can be done at the lowest cost (Watson, 2014). The healthcare providers can become more innovative with the adoption of big data technologies for the decrease of healthcare costs (Lee, 2015).

EHR is seen as the potential big data technology in healthcare with potential benefits such as the decrease of healthcare costs, improvement of quality and safety. EHR refers to an advanced process-enabling information technology which makes it possible to streamline information-intensive workflow, remove manual hand-off of data and information, and facilitate coordination thus facilitating the execution of entire business processes rather than individual tasks (Jang et al, 2014). Information of patients that is electronically available creates healthcare efficiency where many averted costs associated with EHR are the result (Menachemi & Collum, 2011). EHR can result in improved healthcare efficiency that is noticeable in the form of decreased costs and a positive ROI. Surinamese healthcare providers are in need for advanced information technology, such as EHR, to improve healthcare efficiency in the form of decreasing healthcare costs and achieving a positive ROI (Eichler & Amanh, 1999). Figure 1 gives an overview on how the concepts are related.

Figure 1 Overview concepts



Based on the information presented above the following research question is developed:

Does Electronic Health Records lead to Healthcare Efficiency with Surinamese healthcare providers?

To answer the main research's question the following four sub questions are formulated:

1. What is meant by big data, big data analytics, and big data technologies?

2. What is meant by EHR?
3. What is meant by healthcare efficiency?
4. How is healthcare efficiency measured?

1.4 Research methodology

This research can be classified as an exploratory study. Literature on big data, big data analytics, big data technologies, EHR, healthcare costs decrease, healthcare efficiency, and ROI was studied and is set out in chapter 2, 3,4, and 5 in this thesis. Quantitative data was collected through telephone survey where the participants, who are finance administrators, finance analysts and finance officers in Surinamese healthcare providers such as hospitals and clinics, were each asked to answer a questionnaire. The data examination period for this study is based on 5-years data collection from the respondents, from year 2015 to 2020. The data is based on unofficial annual reports (intern) supported by a telephone survey by the respondents.

1.5 Research motivation

Healthcare providers such as hospitals and clinics in Suriname are the selected population for this study, to provide data on costs decrease with EHR for the healthcare providers to create healthcare efficiency. Because there is a lack of research on this topic and the Surinamese healthcare providers are at present dealing with huge pressure due to the Covid-19 pandemic to manage and decrease healthcare costs, it is relevant to investigate the correlation between EHR and healthcare efficiency with Surinamese healthcare providers.

1.6 Relevance

1.6.1 Scientific relevance

This research contributes to the existing literature. This study is among the first to address EHR in relation to healthcare efficiency in Suriname. Lastly this study will be used as fulfilment of the Master Accountancy thesis at the Anton de Kom University of Suriname.

1.6.2 Empirical relevance

From a financial perspective, this study can provide some interesting insights. In particular, the support for a positive correlation between EHR and healthcare efficiency could be a relevant finding for the Surinamese healthcare providers on how to best anticipate on the creation of

healthcare efficiency, where it can be useful in their work in the future, especially during a pandemic, and where EHR can be useful to decrease healthcare costs. Also, this study is important to the health profession because documentation is the foundation to healthcare. The documentation quantity and quality are not only important to patient care but the foundation of the healthcare providers as well, where the patient information recording must be done on low healthcare costs.

1.7 Limitations

This research has one limitation. The limitation addresses a lack of access to hands on data. The data was collected from unofficial annual reports and telephone surveys (to support the obtained data) through questionnaires where answers were gathered from the participants of this study who work as finance administrators, finance analysts, and finance officers in Surinamese healthcare providers.

1.8 Structure

Chapter 1 focuses on the research objective, research question and sub questions, research methodology, motivation, relevance, limitations, and the structure of the thesis. Chapter 2 outlines the theoretical perspective of big data, big data analytics, and big data technologies in general and in healthcare. Chapter 3 describes the theoretical perspective of the big data technology EHR. Chapter 4 is about the theoretical perspective of healthcare efficiency and ROI as measurement for healthcare efficiency. Chapter 5 outlines the importance of EHR for Management accounting in healthcare. Chapter 6 describes the findings related to prior research. Chapter 7 outlines the healthcare system in Suriname. Chapter 8 contains the research methodology, where the research design, hypotheses, and data collection are discussed. Chapter 9 describes the results of this research. Chapter 10 describes the analysis of the findings of this research. Finally, in chapter 11 the conclusion, limitations, and suggestions are presented.

The thesis will continue with chapter 2 that discusses the theoretical perspective of big data and big data analytics, in general and in healthcare.

2 Literature review big data and big data analytics

2.1 Introduction

This chapter outlines the literature review of big data and big data analytics. In paragraph 2.2 and 2.3 big data in general and in healthcare are discussed, where the potential benefits, opportunities, challenges, and characteristics of big data are mentioned. Lastly, in paragraph 2.4 and 2.5 big data analytics in general and in healthcare are discussed, where the potential benefits, opportunities, and challenges of big data technologies are mentioned.

2.2 Big data in general

2.2.1 What is big data

Many firms are dealing with the collection, storage, and analyzation of massive amounts of data. This massive amount of data is known as big data (Watson, 2014). Big data refers to an aggregation of data sets where data sets are large and complex (Nwanga et al, 2015), and where a new generation is created to support decisions to be made for data management (Watson, 2014). The firms need to put the technologies, people, and processes in place to perceive the opportunities that can be unlocked with the potential value of big data (Watson, 2014).

2.2.2 Benefits and challenges of big data

Big data can result in several benefits such as (Kumar et al, 2014):

1. Accurate data; More accurate data can be achieved.
2. Assured business decisions; Business decisions that are being taken can be assured.
3. Better business strategies; Strategies that are mapped out for marketing purposes as well as targeting will be better mapped out.
4. Increase in revenue; There is going to be an increase in revenue due to increased customer, base, and decreased costs.

Big data can be confronted with the following challenges (Oquntimilehin & Ademola, 2014):

1. Heterogeneity; Information consumed by humans entails that a great deal of heterogeneity is comfortably tolerated. Valuable depth can be created by humans from the nuance and richness of natural language. However, machine analysis algorithms expect homogenous

data because it cannot understand nuance. In consequence, before performing the data analysis the data must first be carefully structured. This ensures that computer systems perform most efficiently if the storage of multiple items with all identical in size and structure is made possible.

2. Scale; The size of big data also matters, where managing large and rapidly increasing volumes of data is seen as a challenging issue for many decades. This requires us to think how to design, build and operate data processing components.

3. Timeliness; When dealing with the size of big data, speed also matters. The larger the size of the data to be processed, the longer it takes to analyze the processed data. Therefore, the design of a system that effectively deals with size can process a given size of data set faster.

4. Personal Privacy; It is a challenging task to protect sensitive and private data through technology. Personal information that is stored and transmitted through mobile network operators, supermarkets, local councils, hospitals, banks, insurance, and credit card agencies need to be protected. Information that is shared and stored on the social networks, by religious firms, by educational institutions and employers also need protection. For each firm it is a challenging to organize, secure, exploit and keep private their competitive data related to business, operations, and customers, through technological tools. In de next paragraph big data in healthcare will be discussed.

2.3 Big data in healthcare

2.3.1 What is big data in healthcare

With healthcare is meant a multi-dimensional system that has as role the prevention, diagnosis, and treatment of issues related to health of human beings (Dash et al, 2019). Big data in healthcare refers to electronic health data sets so large and complex that the managing of these data sets with traditional software and/or hardware is difficult or impossible (Raghupathi et al, 2014).

2.3.2 The 5 characteristics of big data in healthcare

Big data in healthcare can be described by 5 characteristics (Mehta & Pandit, 2018):

1. Volume; With volume is meant the quantity of big data in healthcare, where the data can increase dramatically.

2. Velocity; With velocity is meant the speed of data generation as well as data collection.

3. Variety; With variety is meant the different types of healthcare big data collected along with their heterogeneous characteristics, structured and unstructured nature of medical data.

4. Veracity; With veracity is meant the sources that influence accuracy such as inconsistencies, missing data, ambiguities, deception, fraud, duplication, spam, and latency. Veracity and data quality issues get the concerned attention in healthcare because decisions of life or death are dependable on the acquisition of the accurate information.

5. Value; With value is meant the representation of cost-benefit which helps the decision maker in taking meaningful actions that are based on insights derived from data.

2.3.3 Benefits and challenges of big data in healthcare

Big data in healthcare can result in several benefits such as (Pramanik et al, 2019):

1. Decrease in healthcare costs; The treatment procedures are recursive, time-consuming, and costly. With the information gained from big data, analysis and diagnosis of the patient is done correctly and further prediction of the correct treatment pattern is possible. Big data also ensures personalized profiling and hence personalized medicine for patient allowing accurate treatment, where through big data knowledge it is possible to reconcile the redundant costly treatment procedure.

2. Reduction in hospital re-admissions; The probability of patient returning back within a month after treatment at the hospital are getting high, which causes an increase of costs and resources for the hospital. Through big data information is achieved of the patient medical record, history, chart information, and the patient lifestyle, which can identify the patients who are at risk of having medical complications, need re-admission, and need additional care. The insights of the patient information can help in reducing the hospital re-admission rate.

3. Optimized workforce/workflows; Big data can predict the number of patients that would come on the daily and hourly basis. Big data delivers information that would allow the organization to optimize its workforce based on the future requirements. Healthcare data

enriched by multiple sources of data such as real-time patient data, medical records of patients, nursing information, laboratory data and machine status, helps to identify the current operational state of hospital and thus allow to take informed decision for better healthcare services by best utilization of resources.

Big data in healthcare can be confronted with the following challenges (Pramanik et al, 2019):

1. Expertise; Most of the hospital staffs are not trained to use big data.
2. Costly processing and analysis; The cost of data processing is huge due to the requirement of sophisticated equipment that is required to conduct the test, inclusive the processing charges for the additional analysis of the data to diagnose a specific disease.
3. Security & privacy; Digitalization of patient data can be difficult for the confidentiality of the data as well as the maintenance of the privacy to whom the data belongs to. In paragraph 2.4 big data analytics in general will be discussed.

2.4 Big data analytics in general

2.4.1 What is big data analytics in general

Big data's potential value is unlocked only when it is used to stimulate decision making. Firms need efficient processes to turn high volumes, high velocity and/or high variety of fast-moving and diverse data into meaningful insights for making evidence-based decisions. Big data analytics can be viewed as a sub-process in the overall process of insight extraction from big data (Gandomi & Heider, 2015). The five dimensions of big data, volume, velocity, variety, veracity, and value, can be managed, processed, and analyzed by big data analytics (Wamba et al, 2017). Therefore, big data analytics refers to the big data technologies to collect, manage and analyze, in real-time, the fast increase in both structured and unstructured data. The data that is achieved can be used for insightful and effective decision making (Nwanga et al, 2015). Also, the data achieved can be used to explore actionable ideas to create sustained value, measure performance and build up competitive advantages (Wamba et al, 2017).

2.4.2 Benefits and challenges of big data technologies

Big data technologies can result in several benefits such as (Lee, 2017):

1. Create new business; Great potential is ensured for firms to create new businesses.
2. Better decision making; Firms will experience better decision making.
3. New products and services; New products and services can be developed.
4. Improved business operations; There will be improvement in business operations.
5. Cost savings; There will be noticeable results in cost savings for the firm. Operational costs will be reduced for many firms.
6. Product and service quality; Higher product and service quality will be perceived.

Big data technologies can be confronted with the following challenge (Lee, 2017):

1. Difficulty in exploiting data; It is also noted that while managers realize that big data technologies have potential impacts on their firms, they still face difficulty in exploiting the data.
2. Low data quality; When using technology, it is possible that the analytics may send wrong signals of the data that can be fatal for patients.
3. Weak data security; Weak security can lead to financial losses and damage to the firm's reputation, because confidential information could be transmitted to unintended parties.
4. Lack of investment justification; The costs of big data technologies implementation are high, where firms are having difficulties in proving the value of these investments.
4. Privacy concerns; big data technologies collect a huge amount of personal data, which raises serious concerns for individuals and firms. These concerns may lead to the decision of individuals to not contribute personal data that can be analyzed later. In paragraph 2.5 big data analytics in healthcare will be discussed.

2.5 Big data analytics in healthcare

2.5.1 What is big data analytics in healthcare

Most of the highly valuable healthcare data has an unstructured or semi-structured form, at which it is difficult to extract useful information using traditional data analytical tools and techniques, due to the complex, dynamic and heterogeneous characteristics of the data. Also, there is a finite human ability to process this data without achieving effective decision support from the data. These bottlenecks create the need to implement big data technologies into healthcare (Mehta & Pandit, 2018).

2.5.2 Benefits and challenges of big data technologies in healthcare

Big data technologies in healthcare can result in several benefits that can be categorized in firm benefits, operational benefits, and financial benefits (Kruse et al, 2016):

Firms benefits:

1. Quick detection of issues; Issues can be detected more quickly with analytics than with traditional manual methods.

2. Improvement in communication; There will be an improvement in cross-functional communication and collaboration among administrative staffs, researchers, clinicians, and information technology staffs.

Operational benefits:

1. Healthcare efficiency and quality improvement; Health information systems show great potential in improving the healthcare efficiency and quality in the delivery of care. Improvement in data quality will be achieved, where data is structured and accessible for those authorized.

2. Data distribution; The possibility of an exponential distribution of data collection exists.

3. Better decision making; The improvement in data quality ensures better decision making by the firm.

4. Fraud detection; Fraud can be detected with the data and analytic tools available.

Financial benefits:

1. Decrease in operational costs; The Anticipation on the decrease in operational costs to the healthcare system exists.

2. Decrease in information technology costs; There will be a decrease in costs such as information technology maintenance costs regarding data storage.

Big data technologies in healthcare can bring various challenges such as (Kruse et al, 2016):

1. Heterogeneous data; Dealing with heterogeneous data in order to generate insights for improved healthcare outcomes.

2. Large and complex data sets; The electronic health data sets are so large and complex that they are difficult or even impossible to manage with traditional software and/or hardware.

3. Privacy and security; There are privacy and security concerns regarding big data technologies due to the fact, that data is freely available on open sources and is therefore highly vulnerable.

4. Confidentiality; There are confidentiality concerns due to the fact, that sensitive healthcare data is centralized and is highly vulnerable to attacks.

5. High costs; The data storage and transfer costs are expensive, which increase expenditures. Once data is generated which is not so expensive, the costs associated with securing and storing the data, analyzing the data, and transferring the data to other places remain high.

6. Skills healthcare workers; Due to the constant evolution of information technology and the fact that health workers are not up to date with the evolution, healthcare workers are lacking specific skills to use the changing advanced information technology, techniques and standard of care.

Chapter 3 discusses the literature review of EHR, which is seen as the potential big data technology in healthcare.

3 Literature review Electronic Health Records

3.1 Introduction

This chapter outlines the literature review of the Electronic Health Records (EHR) system. In paragraph 3.2 EHR is discussed, where in paragraph 3.3, 3.4 and 3.5 the benefits of EHR, barriers of EHR implementation and the EHR implementation costs are mentioned.

3.2 What is EHR

EHR is seen as the potential big data technology in healthcare and is widely recommended as an innovation enabler with potential benefits such as decreasing healthcare costs, improving quality of performance, and improving safety. Also, with EHR patient-centered healthcare is achieved, where EHR has been implemented within various healthcare settings and resulted in huge volumes of work examining the benefits of EHR (Jang et al, 2014). EHR is also known as Electronic Medical Record (EMR), Electronic Patient Record (EPR) and Computerized Patient Record (CPR) (Menachemi & Brooks, 2006). In this research the term EHR is used to represent the Electronic Health Records system.

With EHR the healthcare system can be transformed from a mostly paper-based system to one that utilizes clinical and other pieces of information. With such a transformation of the healthcare system the healthcare providers get assisted in delivering higher quality of performance (Menachemi & Collum, 2011). Out of an EHR system diverse data can be extracted such as demographics and medical history of patients, examinations and progress reports that are about health and illnesses, immunization records, laboratory test results, radiology images (X-rays, CTs, MRIs), photographs from endoscopy, laparoscopy or clinical photographs, allergy lists, medication information including side effects and interactions, evidence-based recommendations for specific medical conditions, records of appointments and other reminders, billing records, advanced directives, living wills and health powers of attorney, multi-media (video, audio) files, and so on (Devkota & Devkota, 2013). In paragraph 3.3 the benefits of EHR are discussed.

3.3 Benefits of EHR

The benefits that are gained from EHR are considered by clinical, organizational, and societal outcomes such as (Menachemi & Collum, 2011):

Clinical outcomes include benefits such as improved quality of care, improved communications with patients, patient safety, reduction in medical errors, decrease in transcription costs, support for decision making, and other improvements in patient-level measures that describe the appropriateness of care.

Organizational outcomes include benefits about financial and operational performance, as well as satisfaction among patients and clinicians. EHR can result in increased revenue, averted costs, decreased costs, and other benefits that are less tangible, such as improved legal and regulatory compliance, improved ability to conduct research, and increased job/career satisfaction among physicians. Averted costs are realized when an advanced information technology intervention creates a restructuring of workflows in such a way that some costs associated with the previous way of conducting business are eliminated, decreased, or replaced at a lower level with the new way of conducting business. Some of the averted costs include (Menachemi & Collum, 2011):

1. Improved utilization of tests; With EHR, the staff do not have to send hard copies of test results to physicians for review before adding the information to the patient's chart. This new workflow reduces lost and redundant information and assures that a result is posted to the medical record as soon as it becomes available.

2. Decreased supplies & printing costs; EHR decreases the costs relating to the creation and maintenance of medical records such as clerical supplies, cost of paper, and printing costs.

3. Decreased transcription costs; EHR decreases the costs related to medical transcription by utilizing structured flowsheets, clinical note templates, and point-of-care documentation.

4. Decreased chart pull costs; With chart pulls is meant the number of times a paper chart is retrieved for activities such as patient visits, patient phone calls, prescription refills, filing of results, and reports. EHR eliminates the need to pull, route, and refile paper charts. The staff do not have to put effort and time in creating, filing, searching for, and transporting

charts. Also, the providers frustrations associated with not being able to access a patient chart when needed is avoided.

5. Decreased cost for recruitment through improved clinician satisfaction; EHR decreases paperwork burden and creates additional time during the patient encounter for the delivery of care.

6. Improved productivity; EHR improves workflows by reducing redundancies and improving resource utilization. This results in more productivity of individuals because they do not have to postpone their own tasks while waiting for others to finish theirs. When there is an improvement in productivity, decrease in costs can be expected.

Societal outcomes include benefits such as improved ability to conduct research and achievement of improved population health. Providers who implement EHRs, will experience clinical data which was limited available before the implementation of EHRs. Data of patients that is stored electronically increases the availability of data. This may lead to more quantitative analyses to identify evidence-based best practices more easily. In paragraph 3.4 the barriers of EHR implementation are discussed.

3.4 Barriers of EHR implementation

According to several researchers the implementation of an EHR system can be confronted with barriers such as:

1. Time-consuming process; A patient's medical record which include handwritten notes, typed reports, and test results are historically stored in a paper file system. Thereafter, a separate file is created and stored at each healthcare facility. Also, there is an increase in the number of paper-based patient records over time. To switch from a paper file system to the capturing of the records in electronic format instead, would entail a very extensive and time-consuming process (Weeks, 2010).

2. Change in organization's culture; If the existing well-established values, beliefs, norms, and mental models of healthcare practitioners come in conflict with that required for EHR systems, the healthcare provider need to bring change in the culture

of the firm. This task can be challenging, because people like to hold on to whatever feels familiar, even if there are better alternatives available (Weeks, 2010).

3. Difficulty in adapting workflow changes; The implementation of EHR systems within care practices can be experienced as complex, which creates an obstacle for physicians and other staff in care practices to accept changes. It is difficult to adapt significant changes in workflow and time commitment that is required to learn to use the new software while prioritizing patient care (Jang et al, 2014).

4. Financial costs; The implementation of information technology is expensive for the healthcare providers in the beginning (Devkota & Devkota, 2013).

5. Data storage; In a EHR system data is stored in formats that are not compatible with all applications and technologies due to the lack of data standardization. This shortcoming causes problems in the transfer of the data (Kruse et al, 2016).

6. Limited computer skills; EHR is experienced as difficult, because of factors such as lack of typing proficiency, low or no understanding of how a computer is used, lack of knowledge on how the EHR system is used (Odekunle et al, 2017). In paragraph 3.5 the EHR implementation costs are described.

3.5 EHR implementation costs

The cost categories for an EHR implementation include (Menachemi & Brooks, 2006):

1. Cost of hardware: This category includes the costs of EHR installation, where the installation typically requires numerous pieces of interconnected hardware such as terminals, servers, network hardware, printers, scanners, and other related hardware.

2. Cost of software: This category includes the costs of EHR designed and developed software, which will help the healthcare facility to interface with other existing systems such as registration, scheduling, pharmacy, laboratory, etc.

3. Cost of implementation: This category includes the costs related to workflow process redesign, initial training of personnel, and conversion of historical paper chart information into electronic data usable by the EHR.

4. Cost of training and support: This category includes the costs associated with the introduction of a new system, which will require both initial and on-going training of end-users.

Wang et al. (2003) did a research based on the healthcare in the United States, about the costs and benefits associated with EHR. The data collected about the costs and benefits associated with the EHR came from primary data collected from several clinics, other published studies and the opinions of experts. The 5-year EHR implementation costs per user are:

Table 1: Five-year EHR implementation costs per user

Cost categories	Initial Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Software license	$1600	$1600	$1600	$1600	$1600	$1600	
Implementation	$3400						
Support	$1500	$1500	$1500	$1500	$1500	$1500	
Hardware	$6600			$6600			
Productivity loss		$11,200					
Annual costs	$13,100	$14,300	$3100	$9700	$3100	$3100	$46,400
Present value annual costs*	$13,100	$13,619	$2812	$8379	$2550	$2429	$42,900

* Assumes a 5% discount rate (Wang et al, 2003).

Chapter 4 discusses literature review of healthcare efficiency, and ROI as measure of healthcare efficiency, which is an outcome of EHR.

4 Literature review healthcare efficiency

4.1 Introduction

This chapter outlines what is meant with healthcare efficiency, along with ROI as the measure of healthcare efficiency. In paragraph 4.2 diverse definitions of healthcare efficiency in relation to ROI are mentioned. At last, in paragraph 4.4 ROI is defined, the associated challenges when measuring ROI are discussed, and the standard ROI calculation are mentioned.

4.2 Healthcare efficiency

Healthcare efficiency is achieved by promoting aggressive cost decrease initiatives, developing and continuing sustainable efficiency programs. Healthcare efficiency can increase revenues, improve productivity and customer satisfaction, and at the same time improve the strategic position of the healthcare provider. In addition, going forward, healthcare providers practicing healthcare efficiency will decrease costs across the functional areas including operations, informational technology, human resource, finance and accounting, and procurement (Ansari et al. 1997).

Healthcare efficiency is one of the most important goals of a health system. Here are two of the common input- and output-oriented economic definitions of healthcare efficiency (James & Burgess, 2012):

1. Maximization of healthcare outputs that are produced from a fixed set of healthcare inputs and input quality, holding healthcare output quality constant.
2. Minimization of healthcare inputs (related to cost minimization) where a fixed set of healthcare outputs are produced, where input/output quality also are fixed.

Palmer & Torgerson (1999) defines efficiency as being concerned with the relationship between resource inputs and either intermediate outputs or final health outcomes with the ideal focus on the final health outcomes. With resource inputs is meant costs in the form of labor, capital, equipment, and supplies. With intermediate outputs is meant numbers of patients treated or access measures of care. With final health outcomes is meant working from lives saved to life years gained to quality-adjusted life years (James & Burgess, 2012).

Unless the process of the firm is efficiently assessed, the firm will not make an informed decision on whether or not to implement an information technology system, let alone what kind. Similarly,

the firm will not be able to evaluate when and if such an investment might return a profit. In this case, ROI comes in handy to make the right decision on whether or not to implement an advanced information technology system (Elbanowski, 2017). In paragraph 4.3 ROI is discussed.

4.3 Return on investment

4.3.1 What is ROI

The analyses of ROI for the examination of the financial performance, including potential benefits of big data technology, have been gaining popularity in healthcare (Menachemi & Brooks, 2006). In healthcare, there are no billable services and therefore no direct income. That is why the inherent benefit of an information system is indirect, where it can be seen as a tool to improve and record patient care. Dunbar (2000) states that the value of any technology lies in its ability to help accomplish a desired task, where in healthcare with desired task is meant the delivery of the highest quality care for the lowest cost, while meeting all regulatory and third-party payer requirements. To decide whether to invest in a new equipment has always been decided based upon ROI calculation. In other words, the decision must be based upon the thought if the new technology will pay for itself in terms of decreased expenses and/or increased profits. An increase in ROI has been found for providers who use big data technologies in their firm (Wamba et al, 2017). In healthcare the purchase of EHR can be subjected to the same cost scrutiny as other new technology (Chapin et al, 2001). The measurement and evaluation of ROI can address benefits such as cost decrease and improved healthcare efficiency with EHR (Grieger et al, 2007).

ROI (Meyer & Degoulet, 2008):

1. is also known as rate of profit.
2. can also refer to the monetary amount of gain or loss.
3. is the return on a past or current investment, or the estimated return on a future investment.
4. is the ratio of money gained or lost on an investment relative to the amount of money that is invested.
5. does not indicate how long an investment is held.
6. is most often stated as an annual or annualized rate of return, and it is most often stated for a calendar or fiscal year.

4.3.2 Challenges in measuring ROI

There are some challenges associated with measuring ROI when big data technologies are used, such as (Menachemi & Brooks, 2006):

1. There are many financial analytical tools available that can be used to conduct ROI analyses, but several challenges impede the use of these tools in information technology of healthcare. The benefits produced by information technology are not the same as benefits produced by other investments. The use of information technology does not necessarily lead to an additional direct income stream or a billable service, because most health information technology help improve or enable a new process instead of producing a new billable product or function. This makes measuring its financial impact challenging, especially when traditional methodologies are employed for the calculation of the ROI. On one side an accurate ROI is found essential due to the benefits it has for a new health information technology system, on the other side administrators who are used to deal with cost centers find it difficult to measure an accurate ROI.

2. Many of the benefits associated with health information technology are found difficult to measure due to the fact that the witnessed benefits do not all translate into financial terms. Improved quality of care or reduction in medical errors as benefits gained with an EHR system can be difficult to financially measure.

4.3.3 Measuring ROI

A standard ROI is defined as follow (Jang et al, 2014):

ROI = (Gain from investment - Cost of investment) / Cost of investment x 100%

The higher the ROI, the better. If the ROI is negative, it means that within a given period of time an investment is non-profitable (Elbanowski, 2017).

Chapter 5 discusses the importance of EHR for Management accounting in healthcare.

5 EHR in Management accounting perspective

5.1 Introduction

This chapter outlines the importance of EHR for Management accounting in healthcare. In paragraph 5.2 Management accounting in general and in paragraph 5.3 Management accounting in healthcare with an economics perspective is discussed.

5.2 Management accounting in general

Management accounting can be viewed as management-oriented accounting. Management accounting can also be seen as the study of managerial aspect of financial accounting, that is accounting in relation to management function. The accounting function can be re-oriented to fit within the framework of management activity, with the redesign of the entire accounting system as primary task so that it may serve the operational needs of the firm (Chapman et al, 2007).

5.3 Management accounting in healthcare: an economics perspective

Healthcare provides a rich setting in which to empirically examine many issues in managerial accounting research such as production and cost functions, contracting and performance measurement, and regulation and competition. Managerial accounting in healthcare can be classified into broad economic perspectives. One of the perspectives is production economics (Chapman et al, 2007).

Production economics perspective

The production economics perspective has considerable popularity in managerial accounting research, where the primary focus of this research is the interaction between management accounting system design and production and cost functions. Examples of research in this area include the examination of the structure and behavior of costs (including separability, linearity, and independence), cost drivers in various manufacturing or service environments (volume versus other drivers), design of cost allocation systems to improve decision making (traditional versus activity-based costing), and appropriate aggregation of costs. The emphasis of this stream of research is on the specification of costs. Two features make healthcare a popular context for examining cost structure, cost drivers, and cost behavior. Researchers can draw upon the health economics literature that includes comprehensive theoretical and empirical investigations into

hospital cost functions and cost behavior. Also, hospital regulatory databases provide huge amount of cost accounting data for empirical analysis (Chapman et al, 2007).

Cost structure and behavior

The estimation of hospital cost functions has a long history in health economics research, where there are concerns over the high healthcare costs in most developed nations. Economists, regulators, and policy makers have sought to better understand the behavior of hospital costs to determine strategies to control healthcare costs without jeopardizing the quality of care (Chapman et al, 2007).

Role of advanced information technology and issue in relation to management accounting

The healthcare industry has become quite technology intensive, where advanced information technologies that help physicians in choosing appropriate treatment options decrease treatment risk and can also decrease healthcare cost. In addition, because physicians often have incentives to overprovide care to reduce their outcome risk, hospital technology that helps trace costs and revenues accurately enables hospitals to develop performance measures (Chapman et al, 2007). Information technology is involved in most affairs in firms, where it is indispensable in relation to most tasks that involve the analysis and presentation of information. Important issues can be learned about management accounting as its relations to information technology is studied. Such relations are many times not only complex but also problematic, because information technology is seen as a challenge and a resource for management control. New advanced information technologies produce new images of what and how something can be modeled, and therefore also of how something can be calculated and accounted for. Management accounting and control can easily be seen to be dependent on information technology. The intermingling of information technology and accounting is therefore important, and yet, the benefits for accounting gained from information technology may materialize only in uncertain and surprising ways and typically only after long implementation barriers. There is thus a relation between management accounting and information technology, but it is one to be untangled rather than to be assumed (Chapman et al, 2007).

Chapter 6 discusses the findings of several studies where results of these studies shows that the EHR lead to several benefits in healthcare, as mentioned in chapter 3 literature review EHR.

6 Prior research findings

6.1 Introduction

This chapter outlines in paragraph 6.2 the findings of the various studies related to this research as mentioned in chapter 3 literature review of EHR.

6.2 The various studies and their findings

Many research studies illustrate that EHR results in benefits such as improved quality outcomes, improved safety, increased productivity, costs decrease, improved service delivery, and improved patient satisfaction (Wager et al, 2009).

Bates and colleagues (1999) witnessed an 80% decrease in documentation errors over their study period when an EHR system was set in place. More specifically, implementation of an EHR system has reduced errors in dispensing medications and improving patient safety (Bates, 2000).

In 2007, the Massachusetts Medical Society conducted a national survey of ambulatory care physicians. This survey reported a range of benefits from an EHR system, such as improving the quality of clinical decisions, communication with other providers and patients, prescription refills, timely access to medical records, avoidance of medication errors and others reported the positive effect of EHRs on delivery of long-term and preventive care (DesRoches et al, 2008).

EHR systems can also affect positively service provider and support staff satisfaction. EHR users such as nurses and support staff reported that the EHR improved their ability to respond to patient questions promptly. Support staff, who are usually responsible for filing paper reports, pulling paper records and processing bills, said that their time was more effectively and efficiently used through an EHR system. Physicians who have implemented an EHR system successfully in their practice have reported that it has improved the quality of record keeping, improved efficiency and had a positive impact on their job satisfaction and stress levels (Wager et al, 2009).

In the study of Jamoom et al. (2014) nationally representative survey data from 2011 are used for the comparison of the perspectives of physicians who have adopted EHRs with those that have yet to do so. A large proportion of physicians regardless of their EHR adoption agrees that EHR led to positive impacts on clinical care, practice efficiency and finances. Adopters of EHR compared to non-adopters of EHR had more clinical benefits (84% versus 69%), more efficiencies (75%

versus 65%), and more financial benefits (61% versus 52%). Specific financial benefits were gained such as cost savings associated with managing and storing of paperwork (Jamoom et al, 2014).

Ding et al. (2011) examined the effects of EHR on the clinical, financial, and operational outcomes of U.S. hospitals. They utilized publicly reported data on EHR adoption from year 2006 to year 2008. The focus of the study was to test the effects of EHR adoption over time within a hospital. Using simultaneous regression models, they found that EHR adoption has a positive and significant effect on cost and quality.

The studies of Grieger et al. (2007), and Wang et al. (2003), suggest a positive financial performance based on estimated savings with assumptions that EHRs would be interconnected, interoperable, adopted widely, and used effectively. A cost-benefit-analysis study performed by Wang et al. (2003) over a 5-year period by aggregating data from their installed EHR, other published studies, and from expert opinion demonstrated a positive ROI with the primary areas of savings including reductions in drug expenditures, improved utilization of radiology tests, improvement in charge capture, and decreased billing errors. Similarly, another study that examined the economic effect of EHR implementation showed that the system was associated with direct reductions in spending and increases in revenue during the study period. A first-year savings directly attributable to the EHR was reported. The savings were realized from decrease in transcription expenses, improved coding, elimination of need to develop new patient charts, lower space requirements and cost avoidance due to no increase in chart room full-time-employees while patient volume had doubled (Barlow et al. 2004).

In the study of Grieger et al. (2007) five ambulatory offices participated in a pilot project using an EHR to document the return on investment. Measurements of key financial indicators included chart pulls, new chart creation, filing time, support staff salary, and transcription costs. Also, patient cycle time, evaluation and management codes billed, and days in accounts receivable were evaluated to assess impact on efficiency and billing. The savings that are realized were compared with the first two years EHR costs to determine the return on investment. The results suggest annual savings are realized when EHR is used, where an EHR can rapidly demonstrate a positive return on investment.

The aim of the study conducted by Jang et al. (2014) was to get insights into the cost recovery concerns related to EHR investments by considering what the ROI from EHR will be when EHR is implemented in primary care practices. The research is conducted on community-based, primary care clinics meeting the following eligibility criteria were recruited for this study on ROI from EHR in primary-care settings. The focus of this study is on community-based primary care clinics, where specialty care clinics and walk-in clinics were excluded. The clinics were required to have implemented EHR systems. Also, clinics were required to have a paper-based system in the past, to compare the pre-EHR and post-EHR implementation performance for the ROI calculation. At last, clinics were required to provide operational and financial data necessary for the calculation of ROI, as well as the information on challenges and opportunities that they had experienced both during the pre-EHR and post-EHR implementation. This study used break-even-point analysis as an indicator of ROI, instead of standard ROI analysis. The clinics that were successful in realizing a positive ROI from EHR implementation were compared to those that were less successful, in an attempt to identify principal factors impacting the realization of positive ROI from EHR. The findings of the study shows that primary care clinics can realize a positive ROI from the implementation of EHR, where the investment in EHR will result in a reasonable cost recovery time frame and immediate opportunities for increased operational efficiency and the potential for further improvements in clinic performance and benefits realization from EHR. Also, the research conducted by Miller et al. (2005) showed that EHR can result in an increase in revenue, operational efficiency and a positive ROI is achieved (Grudin, 2004). It is clear to state that the literature supports the idea that EHR is very valuable to healthcare.

Chapter 7 discusses the healthcare system in Suriname, as the environment where this research is conducted.

7 Healthcare in Suriname

7.1 Introduction

This chapter outlines the healthcare system in Suriname. In paragraph 7.2 an overview of the delivery system is presented. Further on, in paragraph 7.3 the goals of the action plan by the Ministry of Health are presented. At last, the need for information technology systems and EHR in healthcare in Suriname are discussed in paragraph 7.4.

7.2 Delivery system overview

The people in Suriname receive medical services from an array of public and private healthcare providers. They can receive (Eichler & Amanh, 1999):

1. Primary care; Primary care services can be received from public clinics, private doctors, or from salaried general practitioners hired by private employers to serve employees and their families. Primary care services are provided through a network of health centers that are staffed by healthcare workers.
2. Hospital care; Hospital care can be received from public or private hospitals and consult specialists in private practice or employed by public hospitals. Public health doctors are consulted for difficult cases. In paragraph 7.3 The Ministry of Health is discussed.

7.3 The Ministry of Health

The main action plan of the ministry of Health in Suriname is to establish a universal, people-centered health system. In a health system adapted to this, goals are achieved such as (Wet Staatsbegroting, 2020):

1. A universal human-centered health system; There will be a full implementation of a primary healthcare approach to a health system that is people-oriented, ensures the right to health, is equal and, where necessary, provides the residents of Suriname, according to their ability, care and benefits according to their needs.
2. Equal, sustainable and universal health funding; There will be a system in which the financing of health and wellness services is universally adhered to. Also, the rational and efficient use of services, medicines and technology is realized.
3. Resources needed for an efficient and effective health system; The health system will attract competent health professionals and employees. Also, the staffing needs will be

addressed. At last, the access-to and use-of appropriate technologies will be ensured. The appropriate technologies will lead to performance improvement in the delivery of care, where necessary resources and transformation are continuously identified, safeguarded, and expanded. A health system where health service management is results-oriented and managers in the right numbers, with the right competencies, the right tools and in favorable environments, successfully ensure the efficiency and effectiveness of the health system. In paragraph 7.4 the need for information technology systems is discussed.

7.4 Need for information technology systems

The healthcare system in Suriname begins with the challenge of reforming the healthcare system. In Suriname, there is a higher degree of separation between financing and provision of services which makes it possible to introduce initiatives for the improvement of efficiency and the controlling of costs. Public hospitals operate with a reasonable degree of autonomy and have some control over revenues and expenditures. The most common problem of the healthcare system is that the received information is reported but is not systematically compiled and is not consistent. Much information exists on many separate pieces of paper and forms but is not compiled in a way that can be used. This creates the need for advanced information technology to improve healthcare efficiency while reducing healthcare costs (Eichler & Amanh, 1999).

In year 2019, the World Health Organization (WHO) supported the need for information systems for health, where a new solar-powered, web-based patient management information system has been developed by Medical Mission. This patient's management information system contains five modules: EHR, drug management, laboratory services, patient waiting room management and consolidated health reports. The EHR system provides the medical doctor, who in general is not on location, access to patient records whenever needed. Another function of the EHR is that the drug management module monitors drugs dispensed to each patient as well as overall stock at each clinic. Further on, patient data is linked through the laboratory module that shows the results from lab tests. At last, the patient waiting room module gives an overview of the number of patients in the waiting room and their average waiting time, while consolidated health reports for each clinic can also be retrieved from the information system. EHR creates opportunities to improve the healthcare service in Suriname such as the possibility to record patient data, the doctor can see more often what is going on at any time, a better view is achieved of how the delivery of medicines

is and how much medicines to order each month and to which outpatient clinic they should be sent, and a better management system is obtained where insights about lab tests can be achieved. In short, EHR helps the healthcare providers in Suriname to exterminate unwanted paperwork and to improve the clinical productivity with efficiency and boost up the patient's care processing. Its exceptional flexibility helps in creation, management and maintenance of the patient records in a digital way with high security and easy accessibility (PAHO/WHO, 2019).

Chapter 8 discusses the research methodology of this study, where the research design, the developed hypotheses, along with the data collection and analysis are discussed.

8 Research methodology

8.1 Introduction

This chapter outlines how the research was designed, how the data was collected, and how the variables will be utilized. In paragraph 8.2 the research design and purpose of this study are discussed. In paragraph 8.3 the Libby boxes are discussed along with the associated validity of this study. Further on, in paragraph 8.4 the regression model is defined, where in paragraph 8.5 the three hypotheses are developed and formulated. At last, in paragraph 8.6 the data collection and analysis of this study are discussed, where the population, data collection method and procedures, data analysis method, and the operationalized dependent and independent variables are described.

8.2 Research design and purpose

With a research design is meant a researcher's overall plan of answering the formulated research questions. A research design specifies the source of data, how the data will be collected, how the data will be analyzed and how ethical issues and constraints will be addressed (Saunders et al., 2012). A good research design should be adaptable, suitable, and effective. It should eliminate bias, promote the reliability of the data collected while at the same time yielding as much information as possible to answer the intended research questions (Priyadharshini, 2012).

Exploration, description, and explanation are the three most common and useful research purposes that social research is familiar for. Exploration involves familiarizing a researcher with a topic and satisfies the researcher's curiosity and desire for improved understanding. Exploration also tests the feasibility of undertaking a broader study. At last, exploration helps with development of the methods that can be used in any following study. Description involves describing situations and events through scientific observation. Explanation involves answering the questions of what, where, when, and how. Explanatory studies answer questions of why (Babbie, 2013). Looking at the nature of this research, this study can be classified as an exploratory study. The purpose of this research is to explore whether EHR lead to healthcare efficiency with Surinamese healthcare providers. In paragraph 8.3 the Libby boxes and their validity are discussed.

8.3 Libby boxes

A 'Predictive validity framework' that is better known as Libby boxes is a framework that captures the researcher's concept and illustrate the research process. The Libby boxes in this research

contain four boxes and four arrows, which explains the relations between the variables and clarifies the construct, the internal and external validity between these variables. The independent, dependent, conceptual and operational variables are mentioned in these boxes. The first and second boxes mention the theory domain. The third and fourth boxes mention the empirical domain (Maas, 2011).

The first arrow reflects the theoretical support for the predicted correlation between EHR, the independent variable, and healthcare efficiency, the dependent variable. The second and third arrow reflect the measurements of EHR and healthcare efficiency. This gives the construct validity. EHR is operationalized by supplies & printing, transcription, and chart pull. Healthcare efficiency is operationalized by ROI. The fourth arrow reflects the correlation that is tested between EHR and healthcare efficiency, which represents the internal validity in the framework (Appendix A).

8.3.1 Validity

The term validity can be distinguished as three types, internal-, external- and construct validity. The internal validity is a little bit harder to define. The internal validity refers to how well the study captures a causal effect between the operationalized dependent variable and the operationalized independent variable (Maas, 2011). The internal validity of this study is high because this study captures a causal effect between EHR and healthcare efficiency. The external validity is to generalize the results of the sample population and it refers to the extent that the results, based on the sample can be generalized to the general population (Maas, 2011). The general population of this study are the total of hospitals and clinics as healthcare providers in Suriname. The external validity of this study is high, because this study focuses consequently on the thirty selected healthcare providers in Suriname, where respondents are chosen within the same group of professions. The results can be generalized to the population outside the thirty healthcare providers. The construct validity refers to the extent to which a measurement captures the construct that it supposes to measure. A high construct validity means that the abstract idea was better measured (Maas, 2011). The focus of this research is to investigate the relation between EHR and healthcare efficiency. The sample of this research is low, which implies that the result has to be valid and reliable. Finally, the construct validity is high in this study according to the used operationalized measurements for the dependent variable and independent variable. The ROI measures the healthcare efficiency of the thirty healthcare providers. The supplies & printing,

transcription, and chart pull costs decrease measures EHR. In paragraph 8.4 the regression model is discussed.

8.4 Regression model

To answer the research question, a regression analysis will be conducted. In this study one dependent variable is used for measuring healthcare efficiency. In the regression model the ROI is used to measure healthcare efficiency.

The regression model has the following form:

$$ROI = B0 + \beta 1\ SUPPRINT + \beta 2\ TRANS + \beta 3\ CHPULL + E$$

Where: ROI = the return on investment; B0 = intercept, the estimated value of ROI; SUPPRINT = supplies & printing costs decrease; TRANS = transcription costs decrease; CHPULL = chart pull costs decrease; and E = error term. In paragraph 8.5 the developed hypotheses are discussed. Further on, in paragraph 8.6 the data collection and analysis are discussed.

8.5 Hypotheses development

For years, patient medical information has been maintained in paper-based records, what are usually handwritten and kept in files. (Ajala, Awokola et al. 2015). The general cost of providing healthcare is on the increase partly because of the inefficiencies of paper-based work (Cisco Systems Inc, 2005). Thought the initial costs of EHR implementation may be costly, the day-to-day healthcare costs can be greatly decreased with EHR (Agrawal, 2002). As mentioned earlier in chapter 2, many decreased costs associated with EHR such as costs of supplies & printing, transcription, and chart pulls lead to healthcare efficiency (Menachemi & Collum, 2011). That is why this study focusses on the relation between EHR and healthcare efficiency with Surinamese healthcare providers, if supply &printing, transcription, and chart pull costs decrease will lead to healthcare efficiency with Surinamese healthcare providers. This leads to the development of the hypotheses for this study.

8.5.1 Hypothesis 1

For many healthcare providers the introduction of EHR has resulted in a decrease of supply & printing costs. In a work done by Ewing and Cusick (2004), a health facility reported a sketchy 90% decrease in the paper backlog after a few months of implementing an EHR system which

resulted in the decrease of paper and supply costs (Menachemi & Brooks, 2006). Supplies & printing costs such as copy paper ordering decreased to 26.6% in the study of Zlabek et al (2011), where copy paper and paper forms were eliminated and annual savings are achieved. This leads to the development of the first hypothesis.

Ha1: Supplies & printing costs decrease lead to healthcare efficiency with Surinamese healthcare providers.

8.5.2 Hypothesis 2

In the study of Dara et al, transcription costs were decreased dramatically by 37% to 100% by using the electronic documentation module which is a possible feature of EHR. Also, in the study of Zlabek et al (2011), a decrease in transcription costs resulted in savings in the year post-EHR. This leads to the development of the second hypothesis.

Ha2: Transcription costs decrease lead to healthcare efficiency with Surinamese healthcare providers.

8.5.3 Hypothesis 3

The study of Adler (2004) shows that an EHR system saves staff time otherwise used searching for charts, entering charges manually, and so forth. This found time can contribute to other value-added activities or it can be eliminated, thereby reducing overtime charges. The results show that through an EHR system, productivity is increased because of improved office efficiency (Lorenzi et al, 2009). Further on, the study of Dara et al, shows that there is 79% decrease in chart pulls during a six-months period after the implementation of EHR. This percentage increased to 96% decrease in chart pulls during a period of 2 years. The decrease in costs of chart pulls resulted in annual savings at 2 years period (Grieger et al, 2007). This leads to the development of the third hypothesis.

Ha3: Chart pull costs decrease lead to healthcare efficiency with Surinamese healthcare providers.

8.6 Data collection and analysis

8.6.1 Population

With population is meant a group, usually a group of people, about who the researcher wants to draw conclusions in the research being done (Babbie, 2013). The population that is selected for this research are the healthcare providers in Suriname. All the hospitals and clinics were chosen to participate in the study, where healthcare workers from the finance departments of the selected thirty healthcare providers were identified, who have considerable experience and knowledge about the daily healthcare costs and has finance administrator, finance analyst, and finance officer as profession. In Appendix C is presented the participants of the study. The data is based on unofficial annual reports (intern) supported by a telephone survey by the respondents.

8.6.2 Data collection method and procedures

McNiff (2002) contend that, the method used to collect the data must always be appropriate to the type of the research being conducted and that, the method used must be able to collect data to answer the research questions and to achieve the research goals.

Data collection method

The gathering of data for this study started with a literature review, searching for related studies that had been done before for the gathering of the basic information about big data, big data analytics, big data technologies, EHR, EHR costs, healthcare costs decrease, healthcare efficiency, and ROI. More articles on the internet were searched and read to be familiarized with the research topic about EHR in other countries, which updated the background knowledge about the EHR system. The main search engines that were used are the Google search, Google Scholar, and Elsevier. Also, the book literature list that was used for a specific field of the course were used. Search phrases such as big data in healthcare, big data technologies in healthcare, EHR, healthcare costs, EHR costs, healthcare costs decrease, healthcare efficiency, and ROI measurement were entered on the search engines. Each research method has its own strengths and weaknesses. Some research methods are more relevant than other methods for the study of certain concepts. Survey research is in today time the frequently used mode of observation in social sciences, where the researcher provides the selected participants of a standardized questionnaire (Babbie, 2013). For this research a survey, in this case filling out a questionnaire by the participants of this study who

are healthcare workers in the hospitals and clinics, is the most appropriate quantitative research method. The empirical data in this study were collected from January to April 2021 through survey done by telephone call. The data was collected from unofficial annual reports and telephone surveys (to support the obtained data) through questionnaires where answers were gathered from the participants of this study who work as finance administrators, finance analysts, and finance officers in healthcare of Suriname. In a survey, the raw observations are in the form of standardized questionnaires with boxes-checked, answers that are written in spaces, and so forth (Babbie, 2013). In collecting the empirical data from the healthcare providers in Suriname, a standardized questionnaire was formulated. The prepared questions were based on the discussed theories in the previous chapter, consisting mainly of four parts: introduction and general, EHR for the healthcare providers and healthcare costs that can be decreased with EHR, and a section where the respondent can add additional information. Additional questions can also be asked spontaneously during the survey, in response to the answers from the interviewees. A more detailed list of the prepared questions can be found in Appendix B. The period of examination contains data collection from the respondents of a five-year period, from year 2015 to 2020.

Data Collection Procedures

The questionnaire was answered by telephone calls to the thirty selected healthcare workers who represented the healthcare providers. The questionnaire contains an explanation about the research in order of their understanding of my research's motive. At first, the targeted selected hospitals and clinics, each represented by their financial worker who got on the telephone call were asked if they are willing to participate in this research. After agreement of participation, the participants received a call by appointment where the questions were asked to the participant. Follow up phone calls were made if no response was received from participants within a two-week period. After that time, if still no response was received, for the last time contact was made via telephone calls to the participants to make sure they still wanted to participate in the survey and to make sure that the phone call was made to the correct person. From some of the targeted participants no response was received and they were excluded from the sample. From the participants that responded, the received answers were noted on each questionnaire per participant.

Drawbacks during surveys

The draw backs of this study stems from the researcher experiences relating to the difficulty in booking an appointment with various participants. From days to weeks waiting for response from the requested interview the questionnaires were filled in. Out of the thirty selected healthcare providers only twenty-eight respondents responded, where among this number three of them couldn't make it to their appointment. So, there was need to carry out five alternative interviews with some of the healthcare workers outside the list and this was difficult to deal with it at last moment.

8.6.3 Data analysis method

Once the obtained data is in suitable form, the data needs to be interpretated to draw conclusions that reflect the interests, ideas and theories that initiated the inquiry (Babbie, 2013). After the data is obtained through the questionnaire that was presented to and answered by the participants, it is utilized for further analysis and ultimately for building theory. Further, the results of the completed questionnaires are transcribed in order to analyze the data. For the results gained from the completed questionnaires the coding is done on the transcriptions. The program SPSS was used to analyze the empirical data collected by the healthcare providers in Suriname. The analysis is focused on the correlation between EHR and healthcare efficiency. Subsequently, the result of the analysis can be used further to develop theories regarding EHR in relation to healthcare efficiency, as mentioned in the research question.

8.6.4 Operationalized dependent variable

Healthcare efficiency is one of the most important dimensions of healthcare performance. Healthcare financiers including governments, insurers, and households are interested in knowing which systems, providers, and treatments contribute the largest health gains in relation to the level of resources they consume. The study of efficiency should be the central objective of all parties invested in a high-functioning, healthy society, and state. To achieve this goal, the study of healthcare efficiency is essential and, to that end, better instruments for measuring and understanding efficiency are absolute necessities (Cylus, 2016).

Healthcare providers try to measure the ROI in technology. In addition, making work easier with technology, it is assumed that advanced information technology will translate into a positive ROI.

ROI is almost inevitably a focus of firms that advocate technology adoption. Acquiring and adopting new technologies is usually expensive for the firm. The firms who use new technologies want evidence that they will benefit from it. This can result in a focus on identifying a positive ROI that can become obsessive (Grudin, 2004). The operationalized dependent variable of this study is ROI, where ROI is calculated to measure healthcare efficiency.

ROI is a common approach to measuring rates of return on money invested, in terms of increased profit attributable to the investment (Jang et al, 2014). A standard ROI is defined as follow (Jang et al, 2014):

ROI = (Gain from investment - Cost of investment) / Cost of investment x 100%

8.6.5 Operationalized independent variables

In prior research, EHR is seen as the potential big data technology in healthcare that has the decrease of healthcare costs and a positive realized ROI as its potential benefits. Patient information that is electronically available creates healthcare efficiency where many averted costs associated with EHRs are the result, such as decreased costs of supplies & printing, transcription, and chart pull.

The operationalized independent variables of this study are supplies & printing, transcription, and chart pulls. *SUPPRINT*, *TRANS*, and *CHPULL* are defined as follow:

1. *SUPPRINT* = supplies & printing costs decrease, which represents value 1 if the respondent states that with EHR supplies & printing costs can decrease with ± $ 20,000.00, value 2 if the respondent states that with EHR supplies & printing costs can decrease with ± $ 40,000.00, value 3 if the respondent states that with EHR supplies & printing costs can decrease with ± $ 60,000.00, value 4 if the respondent states that with EHR supplies & printing costs can decrease with ± $ 80,000.00, value 5 if the respondent states that with EHR supplies & printing costs decrease with ± $ 100,000.00. The choice to define SUPPRINT by supplies & printing costs decrease is based on literature research. According to the literature, supplies & printing costs decrease lead to healthcare efficiency. This research aims to verify the opinion of the respondents on supplies & printing costs decrease with EHR. Based on the answers, this can indicate if supplies & printing costs decrease lead to healthcare efficiency with Surinamese healthcare providers or not.

2. *TRANS* = transcription costs decrease, which represents value 1 if the respondent states that with EHR transcription costs can decrease with ± $ 20,000.00, value 2 if the respondent states that with EHR transcription costs can decrease with ± $ 40,000.00, value 3 if the respondent states that with EHR transcription costs can decrease with ± $ 60,000.00, value 4 if the respondent states that with EHR transcription costs can decrease with ± $ 80,000.00, value 5 if the respondent states that with EHR transcription costs can decrease with ± $ 100,000.00. The choice to define TRANS by transcription costs decrease is based on literature research. According to the literature, transcription costs decrease lead to healthcare efficiency. This research aims to verify the opinion of the respondents on transcription costs decrease with EHR. Based on the answers, this can indicate if transcription costs decrease lead to healthcare efficiency with Surinamese healthcare providers or not.
3. *CHPULL* = chart pull costs decrease, which represents value 1 if the respondent states that with EHR chart pull costs can decrease with ± $ 20,000.00, value 2 if the respondent states that with EHR chart pull costs can decrease with ± $ 40,000.00, value 3 if the respondent states that with EHR chart pull costs can decrease with ± $ 60,000.00, value 4 if the respondent states that with EHR chart pull costs can decrease with ± $ 80,000.00, value 5 if the respondent states that with EHR chart pull costs can decrease with ± $ 100,000.00. The choice to define CHPULL by chart pull costs decrease is based on literature research. According to the literature, chart pull costs decrease lead to healthcare efficiency. This research aims to verify the opinion of the respondents on chart pull costs decrease with EHR. Based on the answers, this can indicate if chart pull costs decrease lead to healthcare efficiency with Surinamese healthcare providers or not.

Chapter 9 presents the results of this research.

9 Results

9.1 Introduction

This chapter provides the results of this research. The regression results, namely the descriptive statistics are presented in paragraph 9.2. Paragraph 9.3 discusses the Pearson correlation, and the multivariate regression is presented in paragraph 9.4. Appendices D till F contain SPSS output of descriptive statistics, correlation and regression tables.

9.2 Descriptive statistics

Before determining the descriptive statistics, the normality of the distribution of supplies & printing, transcription and char pull costs decrease on healthcare efficiency is checked. One of the relevant histograms is about the calculated ROI of each healthcare provider to measure healthcare efficiency. This shows an approximately normal distribution. Other histograms are about the gender, age, type of healthcare provider the respondent is working, profession, how patient information is recorded at present, EHR familiarity, EHR for the healthcare providers, how many EHR users will be needed, supplies & printing / transcription / chart pull costs decrease with EHR, and whether the thirty respondents wanted to add extra information to the interview (Appendix D). The histograms are made with a focus on possible outlier detection of the calculated ROI by supplies & printing, transcription, and chart pull costs decrease. The results in the tables as mentioned in Appendix D shows that out of the thirty respondents, 60 % were female respondents and 40 % were male respondents. Also, 30 % of the total respondents are aged between 15 – 30 years, 33.3 % are aged between 31 – 45 years, and 36.7 % are aged between 46 – 60 years. 76.7 % of the total respondents are finance administrators, 6.7 % are finance analysts, and 16.7 % are finance officers. Two types of healthcare providers represent the respondents, where 20 % are hospitals and 80 % are clinics. Further on, 70 % of the respondents were familiar with EHR, where 30 % were not familiar with EHR. 40 % of the respondents stated that the healthcare provider has traditional paper-based records, and 60 % has traditional paper-based records and other information systems. All of the respondents stated that the healthcare provider want to have EHR to create costs decrease. 70 % of the total respondents stated that 2 users will be needed for EHR, 6.7 % stated that 3 users will be needed, 13.3 % stated that 4 users will be needed, and 10 % stated that 5 users will be needed. At last, none of the respondents added extra information to the survey.

Table 2: Descriptive statistics

	N	Mean	Std. Deviation
ROI	30	34.4217	12.52138
Supplies & printing costs decrease	30	2.6667	1.53877
Transcription costs decrease	30	2.5000	1.40810
Chart pull costs decrease	30	2.5333	1.07425
Valid N (listwise)	30		

Table 2 shows the descriptive statistics of this research, where it provides a statistical overview of the frequencies of the dependent variable and independent variables that are used in the research. The sample size for the main test represents thirty respondents.

The operationalized dependent variable is *ROI*.
According to the results in Appendix D, the frequency table, the mean of *ROI* is 34.4217. The value of ROI explains that majority of the selected healthcare providers has a ROI of 34.42 %.

The operationalized independent variables are *SUPPRINT*, *TRANS*, and *CHPULL*.
According to the results in Appendix D, the frequency table, the mean of *SUPPRINT*, measured by supplies & printing costs decrease, is 2.6667. This means that 30 % or 9 respondents stated that with EHR supplies & printing costs can decrease with ± $ 20,000.00, 23.3 % or 7 respondents stated that with EHR supplies & printing costs can decrease with ± $ 40,000.00, 16.7 % or 5 respondents stated that with EHR supplies & printing costs can decrease with ± $ 60,000.00, 6.7 % or 2 respondents stated that with EHR supplies & printing costs can decrease with ± $ 80,000.00, and 23.3 % or 7 respondents stated that with EHR supplies & printing costs can decrease with ± $100,000.00.
According to the results in Appendix D, the frequency table, the mean of *TRANS*, measured by transcription costs decrease, is 2.5000. This means that 26.7 % or 8 respondents stated that with EHR transcription costs can decrease with ± $ 20,000.00, 36.7 % or 11 respondents stated that with EHR transcription costs can decrease with ± $ 40,000.00, 13.3 % or 4 respondents stated that with EHR transcription costs can decrease with ± $ 60,000.00, 6.7 % or 2 respondents stated that

with EHR transcription costs can decrease with ± $ 80,000.00, and 16.7 % or 5 respondents stated that with EHR transcription costs can decrease with ± $100,000.00.

According to the results in Appendix D, the frequency table, the mean of *CHPULL*, measured by transcription costs decrease, is 2.5333. This means that 6.7 % or 2 respondents stated that with EHR chart pull costs can decrease with ± $ 20,000.00, 60 % or 18 respondents stated that with EHR chart pull costs can decrease with ± $ 40,000.00, 16.7 % or 5 respondents stated that with EHR chart pull costs can decrease with ± $ 60,000.00, 6.7 % or 2 respondents stated that with EHR chart pull costs can decrease with ± $ 80,000.00, and 10 % or 3 respondents stated that with EHR chart pull costs can decrease with ± $100,000.00. In paragraph 9.3 the Pearson correlation results are discussed.

9.3 Correlation

A Pearson correlation measures the strength of the relationship between two variables, where the value of the correlation provides information about the nature and the strength of the relationship (DeCoster & Claypool, 2004). Table 3 presents the Pearson correlations between the operationalized dependent variable *ROI* (return on investment) and the operationalized independent variables *SUPPRINT*, *TRANS* and *CHPULL* (supplies & printing, transcription, and chart pull costs decrease). The correlation values in the table are significant at the 1% and 5 % level. Supplies & printing costs decrease is significant at the 1 % level. Transcription costs decrease and chart pull costs decrease are significant at the 5 % level (see Appendix E).

The Pearson correlation between ROI and supplies & printing costs decrease is 0.821 (82.1 %) and is significant ($p = 0.000$) ($0.000 < 0.01$). The positive Pearson correlation indicates that supplies & printing costs decrease lead to healthcare efficiency.

The Pearson correlation between ROI and transcription costs decrease is 0.388 (38.8 %) and is significant ($p = 0.034$) ($0.034 < 0.05$). The positive Pearson correlation indicates that transcription costs decrease lead to healthcare efficiency.

The Pearson correlation between ROI and chart pull costs decrease is 0.402 (40.2 %) and is significant ($p = 0.027$) ($0.027 < 0.05$). The positive Pearson correlation indicates that chart pull costs decrease lead to healthcare efficiency. In paragraph 9.4 the multivariate regression results is discussed.

Table 3: Pearson correlation of *ROI* and *SUPPRINT, TRANS* and *CHPULL*

		ROI	Supplies & printing costs decrease	Transcription costs decrease	Chart pull costs decrease
ROI	Pearson Correlation	1	.821**	.388*	.402*
	Sig. (2-tailed)		.000	.034	.027
	N	30	30	30	30
Supplies & printing costs decrease	Pearson Correlation	.821**	1	.716**	.697**
	Sig. (2-tailed)	.000		.000	.000
	N	30	30	30	30
Transcription costs decrease	Pearson Correlation	.388*	.716**	1	.638**
	Sig. (2-tailed)	.034	.000		.000
	N	30	30	30	30
Chart pull costs decrease	Pearson Correlation	.402*	.697**	.638**	1
	Sig. (2-tailed)	.027	.000	.000	
	N	30	30	30	30

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

9.4 Multivariate regression

To test the developed hypotheses, the multivariate equations will be regressed. The most important advantage of multivariate regression / ANOVA is that it helps in understanding the relationships among the variables, which will further help in understanding the correlation between the dependent and independent variables (DeCoster & Claypool, 2004). The equation contains three operationalized independent variables *SUPPRINT*, *TRANS* and *CHPULL* (supplies & printing costs decrease, transcription costs decrease, and chart pull costs decrease), which will explain the operationalized dependent variable *ROI* (return on investment) (see Appendix F).

Table 4: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.884[a]	.782	.756	6.18029

a. Predictors: (Constant), Supplies & printing costs decrease, Transcription costs decrease, Chart pull costs decrease

In table 4 model summary, the value of R (0.884) shows the multiple correlation between the predictor and the outcome. The value of R^2 shows that 78.2 % of ROI is explained by the three independent variables supplies & printing, transcription, and chart pull. This means that the relationship strength has an effect size of 78.2 %.

Table 5: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3553.669	3	1184.556	31.013	.000[b]
	Residual	933.094	26	38.196		
	Total	4546.763	29			

a. Dependent Variable: ROI

b. Predictors: (Constant), Supplies & printing costs decrease, Transcription costs decrease, Chart pull costs decrease

Table 5 ANOVA shows that the residual is 933.094, the degrees of freedom is 29 and the mean square is 1184.556. The table also shows that the F-ratio is 31.013. This means that the model is significant (0.000 < 0.01) (0.000 < 0.05).

Table 6: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	22.296	2.960		7.531	.000
	Supplies & printing costs decrease	9.891	1.179	1.230	8.386	.000
	Transcription costs decrease	-3.037	1.215	-.342	-2.500	.019
	Chart pull costs decrease	-2.758	1.551	-.237	-1.778	.087

a. Dependent Variable: ROI

The intercept B_0 for this model is positive 22.296. The first regression coefficient for supplies & printing costs decrease is positive 9.891. The second regression coefficient for transcription costs decrease is negative 3.037. The third regression coefficient for chart pull costs decrease is negative 2.758. These results show that the direction of the correlation between supplies & printing, transcription, and chart pull costs decrease on healthcare efficiency is positive (constant regression coefficient is 22.296), where for supplies & printing costs decrease the regression coefficient is positive, and for transcription and chart pull costs decrease the regression coefficients are negative. The results show that:

1. Supplies & printing costs decrease results in an increase of 9.891, which results in an increase of ROI for 9.891. This variable is significant ($0.000 < 0.01$), this means that supplies & printing costs decrease lead to healthcare efficiency.
2. Transcription costs decrease results in a decrease of 3.037, which results in a decrease of ROI for 3.037. This variable is significant ($0.019 < 0.05$), this means transcription costs decrease lead to healthcare efficiency.
3. Chart pull costs decrease results in a decrease of 2.758, which results in a decrease of ROI for 2.758. This variable is not significant ($0.087 > 0.05$). This means chart pull costs decrease does not lead to healthcare efficiency.

Chapter 10 discusses the analysis of the results as described in chapter 9.

10 Analysis

10.1 Introduction

This chapter outlines the analyses of the results gained in chapter 9. In paragraph 10.2 the results are analyzed by the developed hypotheses. The analyses in relation to prior research is described in paragraph 10.3. At last, in paragraph 10.4 the contribution to the literature is mentioned.

10.2 Analyses hypotheses

According to the multiple regression results that is presented in paragraph 9.4, the outcome presents the direction of the association between respectively the operationalized dependent variable *ROI* (return on investment) and the three operationalized independent variables *SUPPRINT*, *TRANS*, and *CHPULL* (supplies & printing, transcription, and chart pull costs decrease). All the three operationalized independent variables show correlation with healthcare efficiency.

The developed hypotheses for the analysis are presented below:

1. ***SUPPRINT***

Ha1: Supplies & printing costs decrease lead to healthcare efficiency with Surinamese healthcare providers.

Ha1 is concerned about the positive relation between supplies & printing costs decrease and healthcare efficiency. The results indicate a positive correlation between supplies & printing costs decrease and healthcare efficiency, which is based on the answers received from the thirty respondents. The positive relation Ha1 is significant, because this analysis supported the alternative hypothesis ($p = 0.000$) ($0.000 < 0.01$). The Ha1 is accepted and H01 is rejected. This means that supplies & printing costs decrease lead to healthcare efficiency with Surinamese healthcare providers.

2. TRANS

Ha2: Transcription costs decrease lead to healthcare efficiency with Surinamese healthcare providers.

Ha2 is concerned about the positive relation between transcription costs decrease healthcare efficiency. The results indicate a positive correlation between transcription costs decrease and healthcare efficiency, which is based on the answers received from the thirty respondents. The positive relation Ha2 is significant, because this analysis supported the alternative hypothesis ($p = 0.034$) ($0.034 < 0.05$). The Ha2 is accepted and H02 is rejected. This means that transcription costs decrease lead to healthcare efficiency with Surinamese healthcare providers.

3. CHPULL

Ha3: Chart pull costs decrease lead to healthcare efficiency with Surinamese healthcare providers.

Ha3 is concerned about the positive relation between chart pull costs decrease and healthcare efficiency. The results indicate a positive correlation between chart pull costs decrease and healthcare efficiency, which is based on the answers received from the thirty respondents. The positive relation Ha3 is significant, because this analysis supported the alternative hypothesis ($p = 0.027$) ($0.027 < 0.05$). The Ha3 is accepted and H03 is rejected. This means that chart pull costs decrease lead to healthcare efficiency with Surinamese healthcare providers (see table 7). In paragraph 10.3 analyses of the hypotheses in relation to prior research is discussed.

Table 7: Hypotheses

Hypothesis	**Accepted / Rejected**
H01: Supplies & printing costs decrease does not lead to healthcare efficiency with Surinamese healthcare providers.	Rejected
Ha1: Supplies & printing costs decrease lead to healthcare efficiency with Surinamese healthcare providers.	**Accepted**

H02: Transcription costs decrease does not lead to healthcare efficiency with Surinamese healthcare providers.	Rejected
Ha2: Transcription costs decrease lead to healthcare efficiency with Surinamese healthcare providers.	**Accepted**
H03: Chart pull costs decrease does not lead to healthcare efficiency with Surinamese healthcare providers.	Rejected
Ha3: Chart pull costs decrease lead to healthcare efficiency with Surinamese healthcare providers.	**Accepted**

10.3 Analyses related to prior research

The relation between supplies & printing, transcription, chart pull costs decrease and healthcare efficiency is based on prior research. The outcomes regarding *SUPPRINT*, *TRANS*, and *CHPULL* is that supplies & printing, transcription, chart pull costs decrease lead to healthcare efficiency. These results are consistent with prior research such as:

1. Ibid (1998) reported that the cost that incur in initiating and maintaining paper health records including clerical supplies, cost of paper, and printing costs are squashed or decreased with EHR.

2. Agrawal (2002) reported that EHR make utilization of structured flow sheets, clinical notes, and point-of-care documentation, which lead to a decrease in costs of medical transcription.
3. Barlow et al. (2004) reported that there was a transcription costs decrease, elimination of need to develop new patient charts due to no increase in chart room full-time-employees.
4. Grieger et al. (2007) reported that chart pull and transcription costs decrease resulted in a positive ROI.

10.4 Contribution to the literature

This research studies the relation between EHR and healthcare efficiency. According to the studied literature, supplies & printing, transcription and chart pull costs can decrease with EHR, which will lead to a positive ROI for the healthcare providers. Healthcare providers in Suriname do not have EHR at present to record patient information, that is why the focus of this research is based on whether supplies & printing, transcription, and chart pull costs decrease will lead to healthcare efficiency, where healthcare efficiency is measured by calculating the ROI.

This research show that supplies & printing, transcription, and chart pull costs decrease lead to healthcare efficiency with Surinamese healthcare providers. These results are consistent with prior research. This research contributes to the existing literature, where it is the first to address EHR in relation to healthcare efficiency with Surinamese healthcare providers. Also, this research gives its contribution to the healthcare providers in Suriname where EHR can be useful on how to record patient information in the future while realizing averted costs to so create healthcare costs decrease and a positive ROI, which will lead to healthcare efficiency.

Chapter 11 discusses the conclusion of this research, achieved from the analyses of the results as described in chapter 10.

11 Conclusion

11.1 Research conclusion

The purpose of this study is to explore whether Electronic Health Records (EHR) lead to healthcare efficiency with Surinamese healthcare providers. This following main research question was formulated:

Does Electronic Health Records lead to Healthcare Efficiency with Surinamese healthcare providers?

For the answering of the main research question four sub questions were formulated and are discussed in the chapters. The sample of this study contains the healthcare providers in Suriname. The data examination period for this study is based on 5-years data collection from the selected thirty healthcare providers, from year 2015 to 2020.

Also, to answer the main research question, three hypotheses are developed. Further on, the outcome is regressed by the multivariate regression. The findings demonstrate the relation between EHR and healthcare efficiency with Surinamese healthcare providers.

The first hypothesis is about, whether supplies & printing costs decrease lead to healthcare efficiency with Surinamese healthcare providers. The findings show that there is a positive relation between supplies & printing costs decrease and healthcare efficiency. This correlation is significant and means that supplies & printing costs decrease lead to healthcare efficiency with Surinamese healthcare providers.

The second hypothesis is about, whether transcription costs decrease lead to healthcare efficiency with Surinamese healthcare providers. The findings show that there is a positive relation between transcription costs decrease and healthcare efficiency. This correlation is significant and means that transcription costs decrease lead to healthcare efficiency with Surinamese healthcare providers.

The third hypothesis is about, whether chart pull costs decrease lead to healthcare efficiency with Surinamese healthcare providers. The findings show that there is a positive relation between chart pull costs decrease and healthcare efficiency. This correlation is significant and means that chart pull costs decrease lead to healthcare efficiency with Surinamese healthcare providers.

The findings of this study provide evidence that EHR lead to healthcare efficiency with Surinamese healthcare providers, and therefore suggest that for the selected thirty healthcare providers in Suriname, there is a positive correlation between EHR and healthcare efficiency. With the results gained it can be concluded that EHR lead to healthcare efficiency with Surinamese healthcare providers.

11.2 Research limitations

This research has one limitation. The limitation addresses a lack of access to hands on data. The data was collected from unofficial annual reports and telephone surveys (to support the obtained data) through questionnaires where answers were gathered from the participants of this study who work as finance administrators, finance analysts, and finance officers in healthcare of Suriname.

11.3 Suggestions for future research

The suggestion for future research would be the possibility to measure healthcare efficiency by another measurement instead of using ROI as the operationalized dependent variable to measure healthcare efficiency. Also, instead of using the standard ROI formula, a cost-benefit analysis can be performed to measure healthcare efficiency. Future research must also consider the different types of variables and the independence of the data values to generalize the conclusions based on the sample to a wider population of interest. To start, the first one would be to use a larger sample of the healthcare providers or use other type of healthcare providers along with hospitals and clinics, as the sample. Also, instead of or along with supplies & printing, transcription and chart pull costs decrease as operationalized independent variables to measure EHR, the researcher can use other variables also to measure EHR in relation to healthcare efficiency. The other measurements and operationalized variables can result in other or additional conclusions that can also give useful insights from another perspective. Another suggestion for future research is to include precise information instead of estimates that are obtained from the respondents. Because this subject is new being conducted in Suriname it was difficult to write much precise about, but still interesting.

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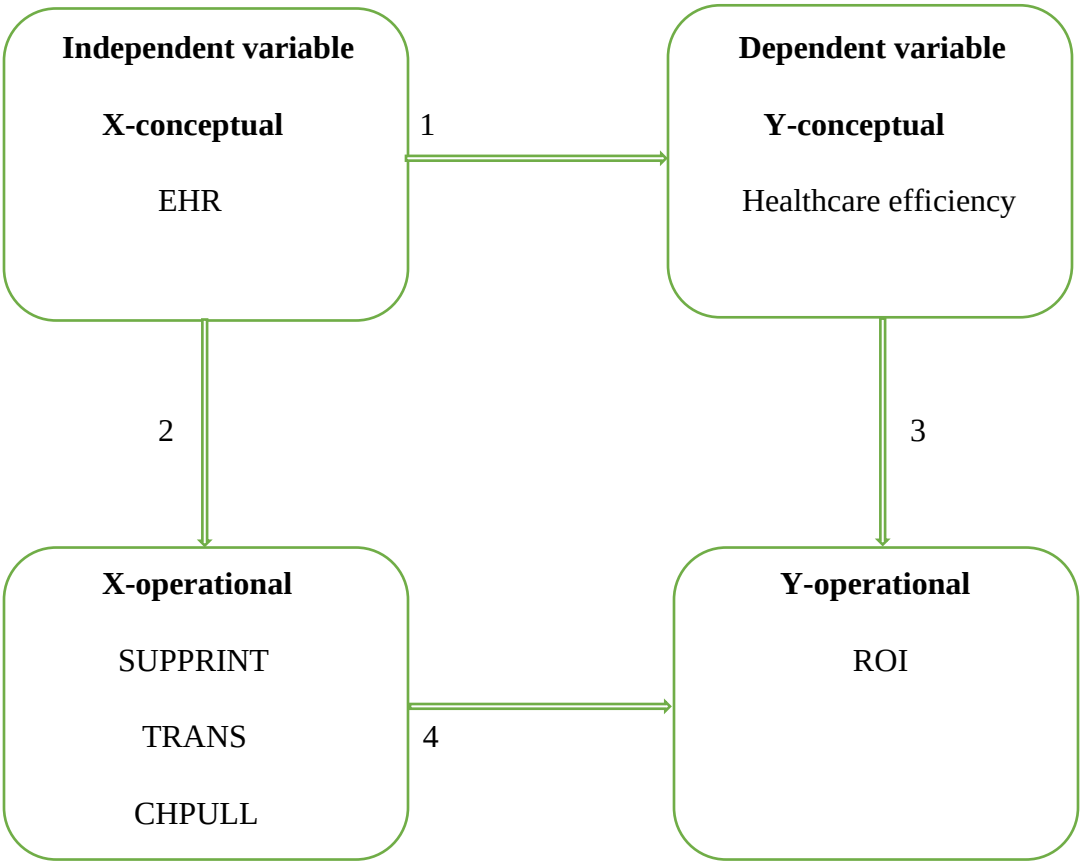
Appendix A Libby boxes



Appendix B Survey

Introduction

Dear respondent,

First of all, I would like to thank you very much for participating in this study. I am a student in Master Accountancy at the Anton de Kom University of Suriname. For my graduation thesis I am doing research about the correlation between Electronic Health Records (EHR) and healthcare efficiency in Suriname.

The aim of my research is to gain insights into the costs of the healthcare providers and for how much supplies & printing, transcription, and chart pull costs can decrease with EHR. With this information being obtained, I will further calculate the return on investment (ROI) which will lead to the conclusion if EHR lead to healthcare efficiency in Suriname.

The financial data needed, about the costs decrease, is based on a 5-years period, from year 2015 to 2020. The survey will take approximately 15 minutes of your time. Your data will be handled in a reliable way and the results will be processed completely anonymously.

If you have any questions or comments about the study, please contact me at (+597) 8760300 or madhavi_gp10@hotmail.com.

Thank you again for participating in this study.

Sincerely,

Gangaram – Panday Madhavi

Questions

A. General

1. What is your gender?
    - Woman
    - Men

2. What is your age?
    - 15 – 30 years
    - 30 – 45 years
    - 45 – 60 years

3. Where are you working?
    - Hospital
    - Clinic

4. What is your profession?
    - Financial administrator
    - Finance analyst
    - Finance officer

5. How is patient information recorded at present?
    - Traditional paper-based records
    - Other information systems
    - Traditional paper-based records and other information systems

B. EHR in healthcare

An electronic health record (EHR) is a digital version of a patient's paper chart. EHRs are real-time, patient-centered records that make information available instantly and securely to authorized users. EHR is thus seen as the potential technology in clinical settings and is widely recommended as an innovation enabler with potential benefits such as decreasing

healthcare costs, where averted costs are realized such as costs of supplies & printing, transcription and chart pull.

6. Are you familiar with EHR?
    - Yes
    - No

7. Does the healthcare provider want healthcare costs decrease with EHR?
    - Yes
    - No

8. According to the literature, a study about EHR implementation was done in the United States. The result of this study shows, that the EHR implementation costs per user are $ 42,900 over a 5-year period. Is that plausible according to the standards of Suriname?
    - Yes
    - No

9. How many EHR users will be needed for EHR?
    - 1
    - 2
    - 3
    - 4
    - 5

10. By how much can supplies & printing costs decrease with EHR?
    - ± $ 20,000.00
    - ± $ 40,000.00
    - ± $ 60,000.00
    - ± $ 80,000.00
    - ± $ 100,000.00

11. By how much can transcription costs decrease with EHR?
    - ± $ 20,000.00
    - ± $ 40,000.00
    - ± $ 60,000.00
    - ± $ 80,000.00
    - ± $ 100,000.00

12. By how much can chart pull costs decrease with EHR?
    - ± $ 20,000.00
    - ± $ 40,000.00
    - ± $ 60,000.00
    - ± $ 80,000.00
    - ± $ 100,000.00

13. Would you like to add some information that could be relevant for this study?
    - Yes
    - No

    If yes, please write your information below.

Thank you for your participation.

Kind regards,

Gangaram-Panday Madhavi

Student Master Accountancy

Appendix C Interviews and duration

Interviewee	Department	Duration
Finance administrator	Administration	14 minutes
Finance administrator	Administration	15 minutes
Finance administrator	Administration	13 minutes
Finance administrator	Administration	10 minutes
Finance analyst	Finance	15 minutes
Finance administrator	Records & Finance administration	15 minutes
Finance administrator	Administration	12 minutes
Finance administrator	Records & Finance administration	15 minutes
Finance administrator	Records & Finance administration	15 minutes
Finance administrator	Administration	15 minutes
Finance officer	Finance	13 minutes
Finance administrator	Administration	13 minutes
Finance analyst	Finance	15 minutes
Finance administrator	Administration	15 minutes
Finance administrator	Administration	13 minutes
Finance officer	Finance	15 minutes
Finance administrator	Administration	15 minutes
Finance administrator	Administration	14 minutes
Finance officer	Finance	12 minutes
Finance administrator	Administration	10 minutes
Finance officer	Finance	12 minutes
Finance administrator	Administration	14 minutes
Finance administrator	Administration	12 minutes
Finance administrator	Administration	13 minutes
Finance officer	Finance	12 minutes
Finance administrator	Administration	15 minutes
Finance administrator	Administration	13 minutes
Finance administrator	Administration	13 minutes
Finance administrator	Administration	11 minutes
Finance administrator	Administration	15 minutes

Appendix D Descriptive statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Gender	30	1.00	2.00	1.4000	.49827	.248	.430	.427	-1.950	.833
Age	30	1.00	3.00	2.0667	.82768	.685	-.129	.427	-1.530	.833
Profession	30	1.00	3.00	1.4000	.77013	.593	1.572	.427	.716	.833
Healthcare_provider	30	1.00	2.00	1.8000	.40684	.166	-1.580	.427	.527	.833
EHR_familiarity	30	1.00	2.00	1.3000	.46609	.217	.920	.427	-1.242	.833
Patient_information_recording_present	30	1.00	3.00	2.2000	.99655	.993	-.430	.427	-1.950	.833
EHR_use_future	30	1.00	1.00	1.0000	.00000	.000	.	.	.	.
EHR_costs_future_per_user	30	1.00	1.00	1.0000	.00000	.000	.	.	.	.
EHR_users_future	30	2.00	5.00	2.6333	1.06620	1.137	1.364	.427	.322	.833
Supplies_and_printing_costs_decrease	30	1.00	5.00	2.7000	1.55696	2.424	.422	.427	-1.327	.833
Transcription_costs_decrease	30	1.00	5.00	2.5000	1.40810	1.983	.754	.427	-.674	.833
Chartpull_costs_decrease	30	1.00	5.00	2.5333	1.07425	1.154	1.249	.427	.901	.833
Add_information	30	2.00	2.00	2.0000	.00000	.000	.	.	.	.
ROI	30	16.55	51.52	34.4217	12.52138	156.785	-.539	.427	-1.137	.833
Valid N (listwise)	30									

Frequency tables

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	18	60.0	60.0	60.0
	Male	12	40.0	40.0	100.0
	Total	30	100.0	100.0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15 - 30 years	9	30.0	30.0	30.0
	31 - 45 years	10	33.3	33.3	63.3
	46 - 60 years	11	36.7	36.7	100.0
	Total	30	100.0	100.0	

Profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Finance administrator	23	76.7	76.7	76.7
	Finance analyst	2	6.7	6.7	83.3
	Finance officer	5	16.7	16.7	100.0
	Total	30	100.0	100.0	

Healthcare provider

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Hospital	6	20.0	20.0	20.0
	Clinic	24	80.0	80.0	100.0
	Total	30	100.0	100.0	

EHR familiarity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	21	70.0	70.0	70.0
	No	9	30.0	30.0	100.0
	Total	30	100.0	100.0	

Patient information recording present

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Traditional paper-based records	12	40.0	40.0	40.0
	Traditional paper-based records and other information systems	18	60.0	60.0	100.0
	Total	30	100.0	100.0	

EHR future

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	100.0	100.0	100.0

EHR costs per user future

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	100.0	100.0	100.0

EHR users future

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2 users	21	70.0	70.0	70.0
	3 users	2	6.7	6.7	76.7
	4 users	4	13.3	13.3	90.0
	5 users	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

Supplies & printing costs decrease

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	± USD 20,000.00	9	30.0	30.0	30.0
	± USD 40,000.00	7	23.3	23.3	53.3
	± USD 60,000.00	5	16.7	16.7	70.0
	± USD 80,000.00	2	6.7	6.7	76.7
	± USD 100,000.00	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

Transcription costs decrease

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	± USD 20,000.00	8	26.7	26.7	26.7
	± USD 40,000.00	11	36.7	36.7	63.3
	± USD 60,000.00	4	13.3	13.3	76.7
	± USD 80,000.00	2	6.7	6.7	83.3
	± USD 100,000.00	5	16.7	16.7	100.0
	Total	30	100.0	100.0	

Chart pull costs decrease

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	± USD 20,000.00	2	6.7	6.7	6.7
	± USD 40,000.00	18	60.0	60.0	66.7
	± USD 60,000.00	5	16.7	16.7	83.3
	± USD 80,000.00	2	6.7	6.7	90.0
	± USD 100,000.00	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

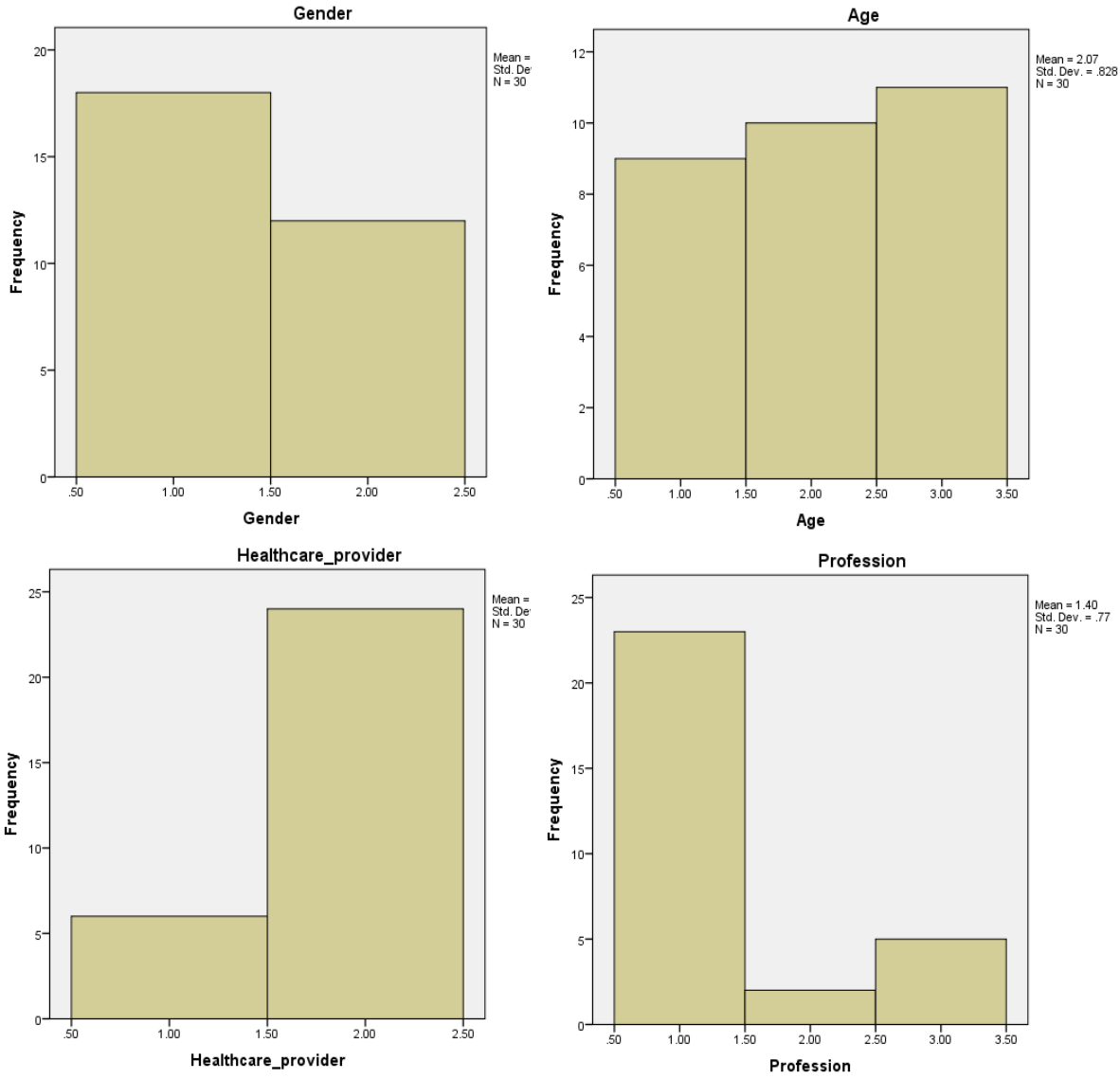
Add information

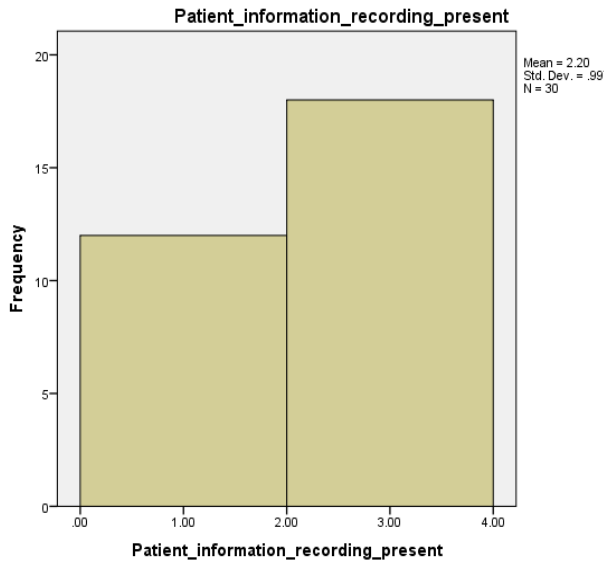
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	30	100.0	100.0	100.0

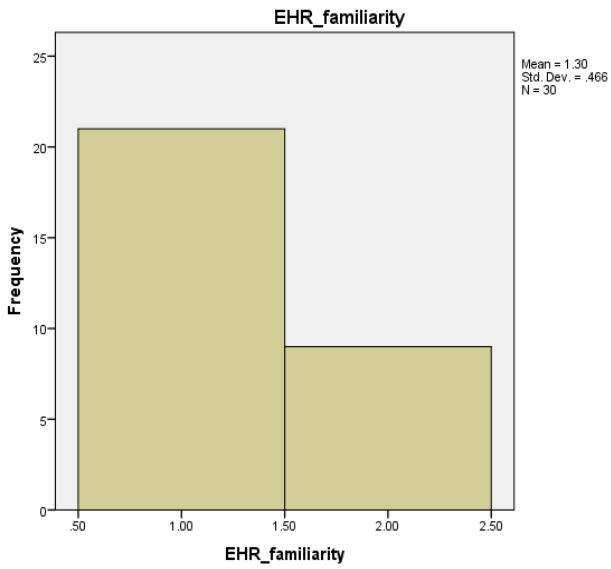
ROI

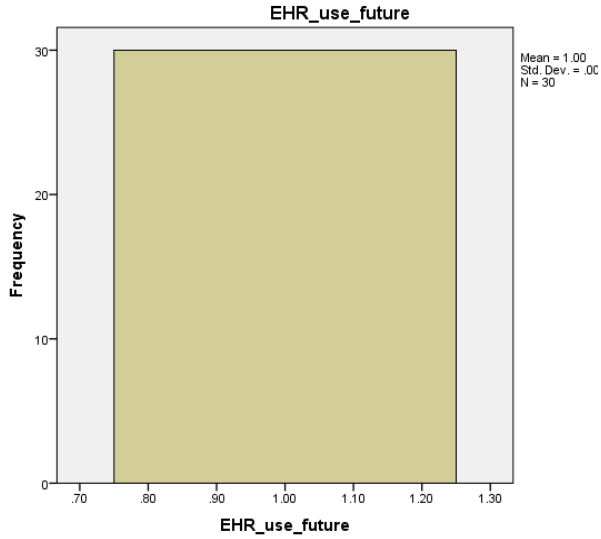
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	16.55	9	30.0	30.0	30.0
	39.86	17	56.7	56.7	86.7
	51.52	4	13.3	13.3	100.0
	Total	30	100.0	100.0	

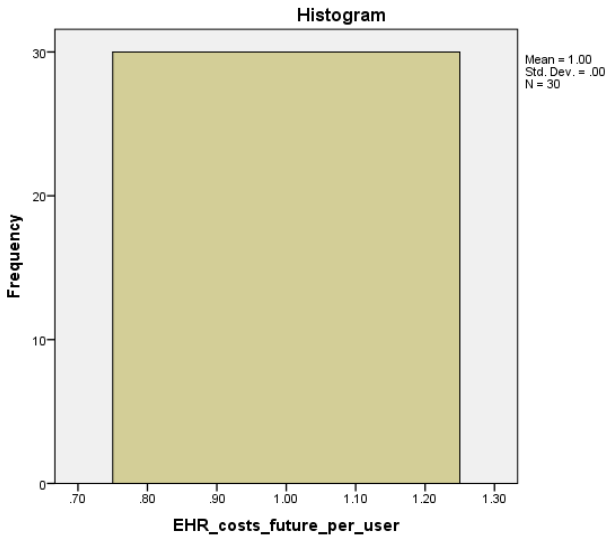
Histograms

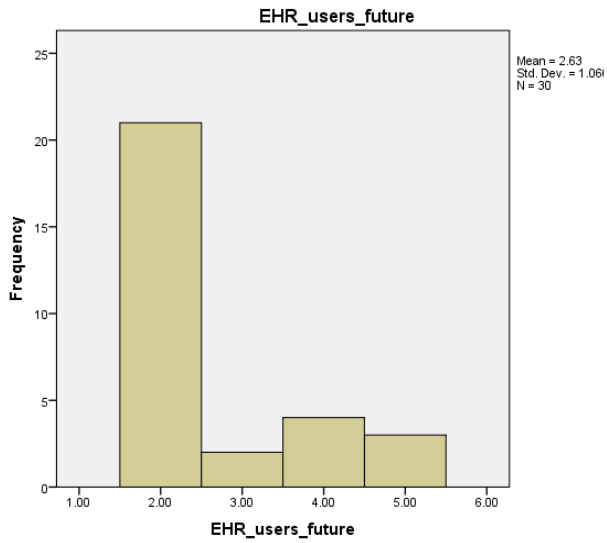


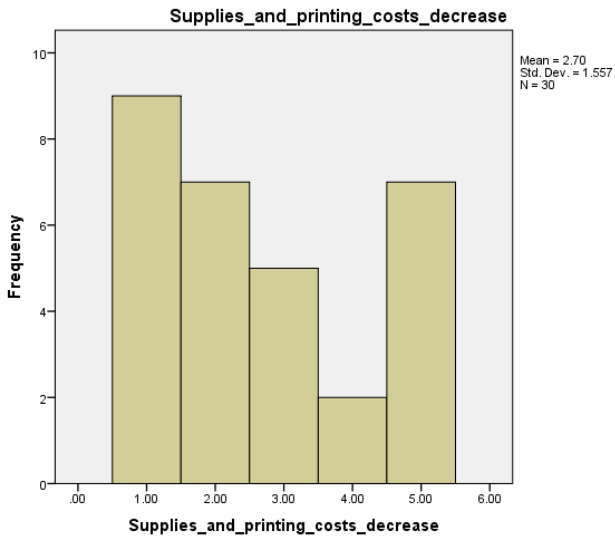

Patient_information_recording_present
Mean = 2.20
Std. Dev. = .99
N = 30
Frequency
Patient_information_recording_present


EHR_familiarity
Mean = 1.30
Std. Dev. = .466
N = 30
Frequency
EHR_familiarity


EHR_use_future
Mean = 1.00
Std. Dev. = .00
N = 30
Frequency
EHR_use_future


Histogram
Mean = 1.00
Std. Dev. = .00
N = 30
Frequency
EHR_costs_future_per_user


EHR_users_future
Mean = 2.63
Std. Dev. = 1.06
N = 30
Frequency
EHR_users_future


Supplies_and_printing_costs_decrease
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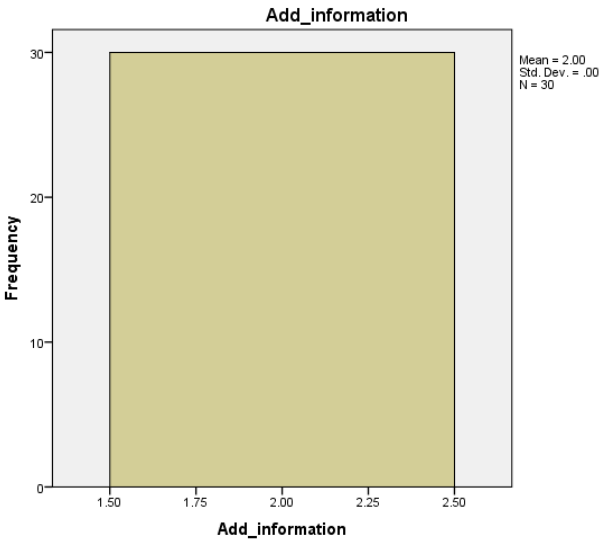
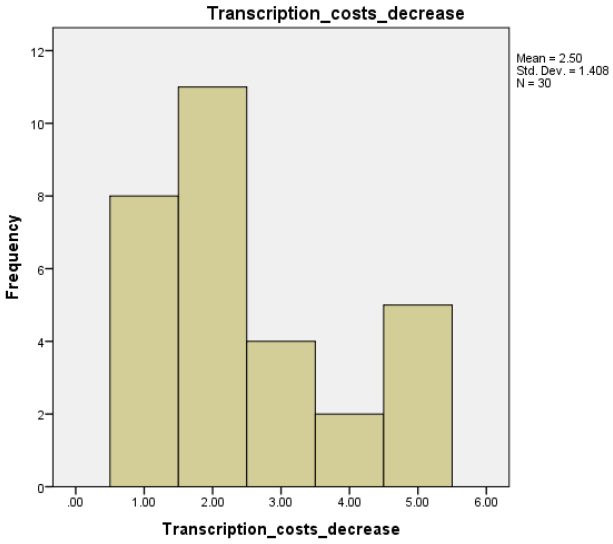
Std. Dev. = 1.557
N = 30
Frequency
Supplies_and_printing_costs_decrease


Add_information
Mean = 2.00
Std. Dev. = .00
N = 30
Frequency
Add_information


Transcription_costs_decrease
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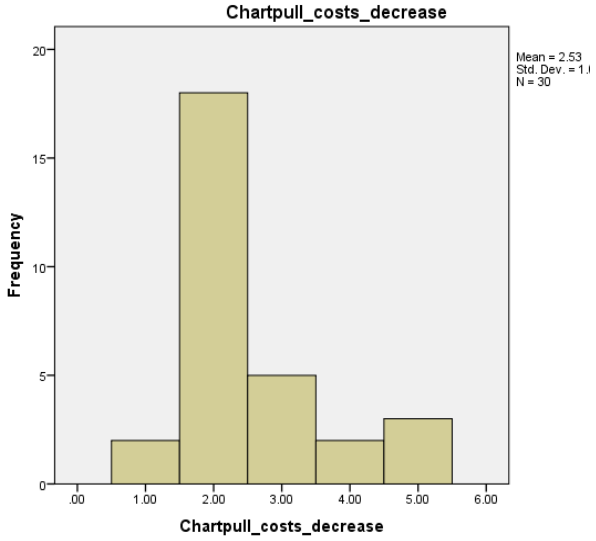
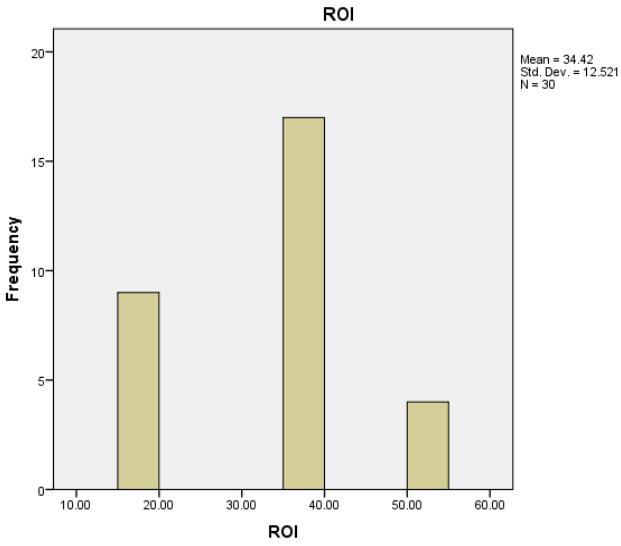
Std. Dev. = 1.408
N = 30
Frequency
Transcription_costs_decrease


Chartpull_costs_decrease
Mean = 2.53
Std. Dev. = 1.
N = 30
Frequency
Chartpull_costs_decrease


ROI
Mean = 34.42
Std. Dev. = 12.521
N = 30
Frequency
ROI

Appendix E Correlation

Descriptive Statistics

	N	Mean	Std. Deviation
ROI	30	34.4217	12.52138
Supplies & printing costs decrease	30	2.7000	1.55696
Transcription costs decrease	30	2.5000	1.40810
Chart pull costs decrease	30	2.5333	1.07425
Valid N (listwise)	30		

Correlations

		ROI	Supplies & printing costs decrease	Transcription costs decrease	Chart pull costs decrease
ROI	Pearson Correlation	1	.821**	.388*	.402*
	Sig. (2-tailed)		.000	.034	.027
	N	30	30	30	30
Supplies & printing costs decrease	Pearson Correlation	.821**	1	.716**	.697**
	Sig. (2-tailed)	.000		.000	.000
	N	30	30	30	30
Transcription costs decrease	Pearson Correlation	.388*	.716**	1	.638**
	Sig. (2-tailed)	.034	.000		.000
	N	30	30	30	30
Chart pull costs decrease	Pearson Correlation	.402*	.697**	.638**	1
	Sig. (2-tailed)	.027	.000	.000	
	N	30	30	30	30

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix F Regression

Variables Entered/Removed [a]

Model	Variables Entered	Variables Removed	Method
1	Supplies & printing costs decrease, Transcription costs decrease, Chart pull costs decrease [b]	.	Enter

a. Dependent Variable: ROI

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.884[a]	.782	.756	6.18029

a. Predictors: (Constant), Supplies & printing costs decrease, Transcription costs decrease, Chart pull costs decrease

ANOVA [a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3553.669	3	1184.556	31.013	.000[b]
	Residual	993.094	26	38.196		
	Total	4546.763	29			

a. Dependent Variable: ROI

b. Predictors: (Constant), Supplies & printing costs decrease, Transcription costs decrease, Chart pull costs decrease

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	22.296	2.960		7.531	.000
	Supplies & printing costs decrease	9.891	1.179	1.230	8.386	.000
	Transcription costs decrease	-3.037	1.215	-.342	-2.500	.019
	Chart pull costs decrease	-2.758	1.551	-.237	-1.778	.087

a. Dependent Variable: ROI