Delving Deeper into Electronic Medical Records: A Quantitative Methodology Approach to Examining the Influence of Electronic Medical Records on Anesthesiology Provider Satisfaction

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MATTHEW DECOSSE

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Approval Page

Delving Deeper into Electronic Medical Records: A Quantitative Methodology Approach to Examining the Influence of Electronic Medical Records on Anesthesiology Provider Satisfaction

By

MATTHEW DECOSSE

Approved by the Doctoral Committee:

DocuSigned by: Dr. Carissa Smock 80F6732539864FF...	PhD, MPH	04/28/2020 | 08:55:54 MST
Dissertation Chair: Dr. Carissa Smock	Degree Held	Date
DocuSigned by: Cesar Aquino 0C6666FA787B4D2...	PhD, MBA	04/28/2020 | 13:22:00 MST
Committee Member: Cesar Aquino	Degree Held	Date
DocuSigned by: Leila Sopko 1F89B29081C9435...	Ph.D., MBA	04/28/2020 | 08:39:53 MST
Committee Member: Leila Sopko	Degree Held	Date

Abstract

Electronic medical record (EMR) systems have continued to lend support to healthcare providers as they deliver more high-quality patient care. However, there is a lack of research analysis that exists on the impact of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists in a multifaceted health care system. In this study, a survey was developed and deployed to 466 Anesthesiologists and Certified Registered Nurse Anesthetists to determine if eight key EMR features sustain an impact on satisfaction for providers of the Anesthesiology specialty. The design of this quantitative research study was established based on the System Theoretic Accidents Models and Processes (STAMP) theoretical framework. According to the logic of the STAMP theory, any system can be exhibited as a web of intertwined control loops, and each loop and control node in that loop has its own weaknesses. All statistical comparisons were performed using a two-sided test at the 5 percent significance level. P values that reported out as less than 0.05 ($P < 0.05$) were considered statistically significant and the data analysis was completed using SPSS software. The findings of this study generated results that have been frequently found in past and present research on the topic of healthcare provider satisfaction. The EMR functional variables of accuracy, communication, efficiency, access to online tools, remote or outside access to the EMR system, provider practice of medicine and speed all yielded a positive correlation to, and hence are related to the total satisfaction of the populace of Anesthesiology providers used for this study. As for the variable of perceived patient satisfaction, a weak and non-significant correlation was determined to exist when an attempted association was made with the total provider satisfaction scores. This is the first study to date that places a focus on provider satisfaction with EMR features from the perspective of

Anesthesiologist and Certified Registered Nurse Anesthetists. Future researchers interested in this topic area may benefit from conducting a cross-functional study that looks at both the functional features of an EMR and the technical functions of the actual information system infrastructure.

Acknowledgements

Pursuing a PhD has been an extremely challenging and tremendously rewarding process. None of this would have been possible without the support of my beautiful, strong, and loving wife and the support that our family has provided for me. Without Allison's willingness to preoccupy our young daughter Adeline on weekday evenings after returning from her tedious but rewarding career as a nurse, and on the weekends, and maintaining her unparalleled ability to remain patient, and steadfast during the last five years, I would have never made it this far. I am eternally grateful to Allison's immediate family: Phil, Beth, Bailey, Nicole and Evan, for all of the days and nights that you have taken care of our little one so that I was able to meet assignment deadlines. I love you all and appreciate all that you have done to assist me in reaching this milestone.

To my Grandmother Dixie June, who took a chance on me and took me in when times were rough as a 15-year-old young man. We reached our goal! She never discouraged my dreams for education and she fed my desire to learn. She provided me with tough love when I needed it and gave so much more that has helped me succeed in life. I truly have no idea where I would be if she hadn't given me a roof over my head, clothes on my back, food in my stomach and a family that truly knows what agape love means and looks like.

Finally, to all those who have been a part of me getting to this point in my academic career. To those that have supported me and doubted me, thank you! Without your words of encouragement and words that have fueled me to push myself harder, I would not have made it to this point in my life. To those that are in pursuant of their academic dreams, keep your chin up, keep your coffee pot full, and do what you need to do, in order to reach your mountain top.

Table of Contents

Chapter 1: Introduction 1
Statement of the Problem 2
Purpose of the Study 3
Theoretical Framework 3
Nature of the Study 5
Research Questions 8
Hypotheses 9
Significance of the Study 9
Definitions of Key Terms 10
Summary 11
Chapter 2: Literature Review 13
Theoretical Framework 15
Physicians and Their Adoption of the EMR 16
EMRs and Computer Literacy 19
EMRs and Focus Groups 21
EMRs and Their Impact on Patient Provider Relationships 24
EMR Use and Its Functional Impact 27
Limitations to the Success of the EMR System Platform 32
EMRs Introduce Greater Opportunities for Error 36
Summary 39
Chapter 3: Research Method 40
Research Methodology and Design 41
Population and Sample 43
Materials and Instrumentation 44
Operational Definitions of Variables 45
Study Procedures 47
Data Collection and Analysis 48
Assumptions 53
Limitations 55

Delimitations 56
Ethical Assurances 59
Summary 60
Chapter 4: Findings 62
Validity and Reliability of the Data 62
Results 63
EMR Accuracy 65
EMR Communication 65
EMR Efficiency 66
EMR Online Tools 66
EMR Practice of Medicine 67
EMR Speed 67
EMR Outside Access 68
EMR Perceived Patient Satisfaction 68
Evaluation of the Findings 69
Summary 75
Chapter 5: Implications, Recommendations, and Conclusions 77
Implications for Research Question 1 79
EMR Accuracy 79
EMR Communications 79
EMR Efficiency 80
EMR Online Tools 80
EMR Practice of Medicine 81
EMR Speed 82
Implications for Research Question 2: EMR Outside Access and Perceived Patient Satisfaction 82
Study Limitations 83
Recommendations for Practice 84
Removing Inconsequential Variables from Provider Satisfaction 84
Filtering the Focus to IT Infrastructure and its Challenges 85
Recommendations for Future Research 87
Conclusions 88

References 89
Appendices 107
AppendixA: Figure 1 108
Appendix B: Figure 2 109
Appendix C: EMR Satisfaction Survey 110
Appendix D: Site Permission from St. John's Hospital, Springfield, Illinois. 114
Appendix E: Site Permission from St. Mary's Hospital, Decatur, Illinois. 115
Appendix F: Site Permission from St. Francis Hospital, Litchfield, Illinois. 116
Appendix G: Site Permission from St. Elizabeth's Hospital, O'Fallon, Illinois. 117
Appendix H: Site Permission from St. Joseph's Hospital, Breese, Illinois. 118
Appendix I: Site Permission from St. Joseph's Hospital, Highland, Illinois. 119
Appendix J: Site Permission from St. Anthony's Hospital, Effingham, Illinois. 120
Appendix K: Site Permission approvals from St. Vincent Hospital (HSHS SVG), St. Mary's Hospital Medical Center (HSHS SMG), St. Clare Memorial Hospital (HSHS SCO) and St. Nicholas Hospital (HSHS SNS) in Wisconsin. 121
Appendix L: Northcentral University's Institutional Review Board's Approval Letter 122

List of Tables

Table 1. Search dates, database, keywords and search results on the Topic of EMR FunctionalSatisfaction…….....14

Table 2. Age demographics and EMR experience…….64

Table 3. EMR variables related to hypothesis1……...….....70

Table 4. EMR variables related to hypothesis2.....71

List of Figures

Figure 1. EMR Functional Impact retrieved from Chen et al (2006)……..... 84

Figure 2. The power of analysis test used to determine the sample size for the study……85

Chapter 1: Introduction

Electronic medical record (EMR) systems are a revolutionary and propitious tool that has been anticipated to bring heightened support to healthcare providers as they deliver more high-quality patient care. Per Bosserman, Patt, and Stella (2018), EMRs have continued to expand in functionality and usefulness. In the same respect, those enhancements have produced unintentional disruptions in care and gradual meaningless clinician workloads. The unfortunate fact of the matter is that concerns that have been identified today, consist of many of the same issues that were reported out on by health care professionals over the last three decades. Factors that have been identified in the past and are still of concern today include: response time, logical and efficient workflow, the ability to complete desired tasks, ease of correcting user errors, the effects that are experienced in regards to the time the user spends on data entry, and the necessary and proper training that is needed to successfully utilize all of the systems features correctly (Aaronson, Chop, Frey, & Murphy-Cullen, 2001; Kannry & Murff, 2001; Chin, Kirshner, & Salomon, 2004; Ajami & Bagheri-Tadi, 2013). Many scholars today, such as Adikey et al. (2018), allude to the notion that most studies propose that physicians find the loss of autonomy at work, reduced control over the work environment, inefficient use of time due to administrative requirements, and loss of support from colleagues, to be the chief factors that are associated with their dissatisfaction of EMRs.

Many healthcare providers have mutually shared that augmented functionality has challenged team-based care that once existed to allow clinicians to think and engage with patients to develop and bring about optimal coordinated care plans and health outcomes (Katz & Wright, 2018).Moreover, end user involvement and support has been conjectured as being critical to the successful adoption and use of a new EMR system in a healthcare setting. Per

Bardoel and Drago (2016), systems that are implemented in conjunction with end user involvement and support, may yield greater outcomes when it comes to health care provider satisfaction. Previous research that has been conducted has also revealed that prior computer experience and computing skills have also been studied as potential predictors of EMR system acceptance (Alasmary, Househ & Metwally, 2014). Recent research conducted by Alawi et al.(2017),discloses that computer skills have a chief role in understanding an EMR system, as there exists a propensity for older generations to be slower in keying and learning the new system (Alawi et al., 2017).Alasmary et al. (2014) adds to the theory by sharing that EMR end-users with high computer literacy capabilities were more content with using the EMR than users with low computer literacy skills. As Chen et al. (2006) and Brady et al. (2018) imply, further research is crucial to exploring each specific aspect of EMR systems, their implementation, and the impact that it may have on health care professionals.

Statement of the Problem

The problem that will be addressed in this study is the lack of research analysis that exists on the impact of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists in a multifaceted health care system. End user functional satisfaction with an electronic medical record (EMR) system, upholds a pivotal role in its implementation and successive use (Chen et al., 2006). Previous research on the impact of EMR functionality on health care personnel or end-users of such systems, has been secluded to one individual health care center location, clinic, department, specialty and/or has focused on national surveys. The following research methodology has been constructed to delve deeper into how EMR system features associated with provider satisfaction fair within a more complex healthcare system. Specifically, this

proposed study design will be utilized throughout the four divisions of a medium-sized health care system that extends throughout the states of Wisconsin and Illinois.

Purpose of the Study

The purpose of this quantitative study is to identify the impact of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists in a multifaceted health care system. A medium-sized health care system that extends throughout the states of Wisconsin and Illinois and consists of four separate divisions (which encompass a total of 15 hospitals): The Eastern Wisconsin Division-(EWD), Western Wisconsin Division-(WWD), Central Illinois Division-(CID) and Southern Illinois Division-(SID). The implementation of the EMR system for this organization began back in 2012 with only EWD, and in 2015 the system approved a project that would bring the EMR to 11 of their hospitals over a four- and half-year period. Since the time of the project's approval, none of the data that has been collected, has been analyzed to determine the areas in which improvement is needed with their EMR. Moreover, no action plans have be created to address areas that appear to be bothersome to healthcare providers. The four divisions will, therefore, be surveyed with the hope of identifying features of the EMR that contribute to end user satisfaction from the perspective of Anesthesiologists and Certified Registered Nurse Anesthetists.

Theoretical Framework

The design of this quantitative research study has been established based on a system theory that was developed and introduced by Leveson (2011). Leveson (2011) describes a theory that she coined the System Theoretic Accidents Models and Processes (STAMP). The STAMP theory essentially proposes that when accidents ensue, it is not because of human blunder or even any single specific weakness in the system of contributors and interactions from which that

accident arose (Leveson, 2011). Leveson (2011) propositions that as an alternative, accidents occur due to consequences of the configuration of several weaknesses in the control structure that is envisioned to prevent them. Therefore, the theory deduces that any system, whether it be the manufacturing industry, the finance industry or the health care industry, can be exhibited as a web of intertwined control loops, and each loop and control node in that loop has its own weaknesses (Leveson, 2011). Leveson pronounces that the above identified control web, consists of exchanges and controllers that depend on procedure models to affect their control of processes in the system. Explicitly, Leveson (2011) presumes that weaknesses in control structures can exist in two primary forms, feeble or absent controllers, or feeble or absent control interactions.

According to Blakley and Weber (2013), there are numerous research scholars who have provided critical and significant support that pertains to the benefits of EMRs. The many tools that EMRs can provide have been prevalently advertised as the resolution to the tribulations that have arose in the health care industry (Aaronson, Chop, Frey, & Murphy-Cullen, 2001; Kannry & Murff, 2001; Ash et.al., 2004; Chin, Kirshner, & Salomon, 2004; Bates et. al., 2006; Ajami & Bagheri-Tadi, 2013). Blakely and Weber (2013), share that the mass media at certain periods of time have implied that with the use of EMRs medical errors and financial waste in health care would only be referred to in an historical context. However, several research scholars have provided valid and credible support that rejects that notion.

Scholars such as Doebbeling et al. (2009), Bardoel and Drago (2016) and Adikey et al. (2018), have identified that there is a sense of antipathy in medical practice against EMR tools. This bitterness is a response to the failure of the studied features to mollify the workflow of their users. Several scholars describe how certain technical variables of the EMR system operate in unison to provide care (Blakely & Weber, 2013). Furthermore, various studies including studies

performed by Anderson (1997) and Bardoel and Drago (2016), have revealed that healthcare providers commonly use a variety of paper workarounds when the EMR features do not support their daily workflows. To completely understand the true advantages that an EMR system can afford (a software unit that is used for collecting, storing, or manipulating clinical information about a patient's health care delivery process at a single facility level), one would need to comprehend all its components and the potential that one EMR system could attain (Blakely & Weber, 2013). EMRs possess the ability to become more enhanced by utilizing tools that would allow for the system to expand to facilities outside of the EMR's scope. The evolution of an EMR to a system known as an EHR, a software unit that is designed for extracting data about a patient's full health record that can be shared amongst different providers throughout various health care facilities, will quickly become a necessity in the not so distant future.

Nature of the Study

The validation for this quantitative study's design was established based on the recommendation of Chen et al. (2006). Chen et al. (2006) focused primarily on one clinical setting and represented only one view of the EMR that was functional in their research environment. Hence, explains the reason behind selecting a health care system that is comprised of 15 hospitals that are divided into four divisions across the states of Illinois and Wisconsin. From a health care industry business perspective, the operating room is the greatest generator of revenue (Lim & Najjarbashi, 2019), which led to the selection of the two occupations of focus when it comes to EMR functional satisfaction: Anesthesiologists and Certified Registered Nurse Anesthetists.

To govern the sample size that is essential for this research study to be worthwhile conducting, G*Power 3.0.10 software was utilized to run a correlation: point biserial model

statistical test with an a priori: compute required sample size-given α, power and effect size type of power analysis. Since effect size can only be calculated after data is collected for a study, an estimate for the power of analysis was used. Common practice is to use a value of 0.5, which in the case of this statistical test indicates a large effect size convention. Based on the results of the G*Power software's calculations, this study would require a total sample size of 42 healthcare providers, which would equate to roughly 10 providers from each of the four divisions: EWD, WWD, CID and SID (see Figure 2). The power of analysis test returned an actual power of 0.96. Since power is 1-beta, and the power of a hypothesis test is between 0 and 1, if the power is close to 1 the hypothesis test is very good at detecting a false null hypothesis (Jackson, 2012). Therefore, this study is one that could be deemed appropriate to conduct.

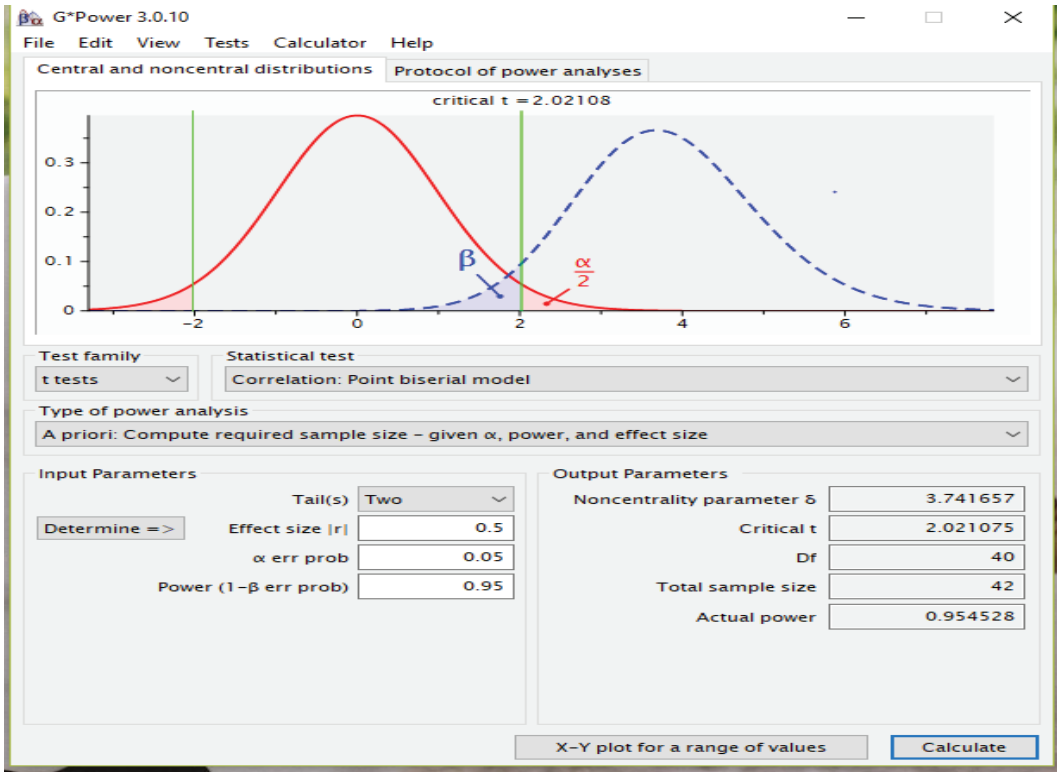

Figure 2. The power of analysis test used to determine the sample size for the study.

To explore the potential impact that the previously identified constructs have on healthcare provider satisfaction, a validated survey was developed and deployed to assist in identifying features of an EMR system that contribute to end user satisfaction for providers in a medium sized healthcare system in the midwestern part of the United States. The survey will consist of eight constructs, which were originally introduced by Chen et al. (2006): speed, accuracy, communication, efficiency, online tools, practice of medicine, perceived patient satisfaction and availability outside of the hospitals (see Figure 1).

As Currie and Guah (2007) reveals, information systems researchers have long studied the impact that technology has on healthcare and the challenges are complex in nature. According to Anderson (1997), some investigation at the individual level has found that clinicians have characteristically not embraced electronic healthcare systems and prefer to use paper records. Per Sykes, Venkatesh, and Zhang (2011), the previously mentioned idea is important to note because it is believed that benefits are in due course, reaped when individuals in critical roles in healthcare organizations embrace and utilize implemented systems and, if such distinct use transpires, subsidizes to constructive results. From the statistical analysis approach, any relationships that are found among the multiple responses that will be collected from the research participants and relate to provider satisfaction will be studied using an analysis of covariance (ANCOVA) that will be adjusted for covariates (Chen et al., 2006). Similar to the statistical model that was shown in the study conducted by Chen et al. (2006), all statistical comparisons will be performed using a two-sided test at the 5 percent significance level.

The provider functional satisfaction survey construct responses would be determined using a 5-Point Likert Scale. From a statistical analysis standpoint, the subscales of the overall scores would be evaluated for core consistency using standardized Cronbach's alpha

coefficients. The specific scores that are calculated from the survey will be derived directly from the raw data that is obtained in the survey. The survey questions were written to address each of the constructs (the independent attribute variables), to determine the potential impact that each has on the dependent variable, which is provider satisfaction.

All providers would be randomly selected from each of the four hospital divisions that use the exact same electronic medical system. Each participant would be encouraged to complete the EMR functional satisfaction survey that is designed to identify any association between the eight separate constructs and overall provider satisfaction when it comes to the utilization of their EMR system. The survey will be deployed to both providers that are hospital employees and those that are contracted in via third party organizations, using their direct professional email addresses. The survey questions will also address demographic data, experience in healthcare, experience with computers and experience using the EMR.

Research Questions

To address the absence of analysis that has not been conducted, as it pertains to the impact of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists, this proposed study will look to answer the question of how the health care system's EMR features (refer to the list of features above), impact their overall satisfaction with the EMR system.

Q1: Do the functional EMR variables of speed, accuracy, efficiency, communication, the use of online tools, or the practice of medicine have a statistical impact on provider satisfaction amongst Anesthesiologist and Certified Registered Nurse Anesthetist end users?

Q2: Do the functional EMR variables of outside access to the system or perceived patient satisfaction have a statistical impact on provider satisfaction amongst Anesthesiologist and Certified Registered Nurse Anesthetist end users?

Hypotheses

$H1_0$: The functional EMR variables of speed, accuracy, efficiency, communication, the use of online tools, and the practice of medicine will not have a statistical impact on provider satisfaction amongst Anesthesiologist and Certified Registered Nurse Anesthetist end users.

$H1_a$: The functional EMR variables of speed, accuracy, efficiency, communication, the use of online tools, and the practice of medicine will have a statistical impact on provider satisfaction amongst Anesthesiologist and Certified Registered Nurse Anesthetist end users.

$H2_0$: The functional EMR variables of outside access to the system and perceived patient satisfaction will not have a statistical impact on provider satisfaction amongst Anesthesiologist and Certified Registered Nurse Anesthetist end users.

$H2_a$: The functional EMR variables of outside access to the system and perceived patient satisfaction will have a statistical impact on provider satisfaction amongst Anesthesiologist and Certified Registered Nurse Anesthetist end users.

Significance of the Study

The validation for this quantitative study's design was developed based on the recommendation of Chen et al. (2006). Chen et al. (2006) focused primarily on one clinical setting and represented only one view of the EMR that was functional in their research environment. Hence, explains the reason behind selecting a health care system that is comprised of 15 hospitals that are divided into four divisions across the states of Illinois and Wisconsin. From a health care industry business perspective, the operating room is the greatest generator of revenue (Lim & Najjarbashi, 2019), which led to the selection of the two occupations of focus when it comes to EMR functional satisfaction: Anesthesiologists and Certified Registered Nurse Anesthetists. The proposed study has been designed to add breadth to the EMR functional

satisfaction topic, by investigating the impact that EMRs have in multiple clinical settings and from numerous views of medical staff, namely Anesthesiologists and Certified Registered Nurse Anesthetists.

Definitions of Key Terms

Functional satisfaction in terms of EMR use within the health care setting, is best defined as the fulfillment of an end user's needs and expectations, as it pertains to the electronic platform that is utilized for medical documentation and allows for providers to perform all duties that are required within their scope of practice. All eight of the variables: speed, accuracy, communication, efficiency, online tools, practice of medicine, perceived patient satisfaction and availability outside of the hospitals are ordinal in nature and thus, have been divided separately (Chen et al. 2006):

> **Accuracy:** This survey item is intended to determine the precision in which documentation can be found on the correct patient, whether documentation is more legible and presentable to review and seeks to reveal that patient records are more complete (Chen et al., 2006).
>
> **Communication:** This survey item is intended to determine how satisfied providers are with being able to send and receive messages electronically in order to communicate with their colleagues (Chen et al, 2006).
>
> **Efficiency:** This survey item is intended to determine whether less effort is taken to research web-based literature or review a patient's medical history (Chen et al, 2006). This items also will attempt to identify whether providers believe that less effort is exerted to communicate with their colleagues or if it takes less effort to review and interpret lab results for patients (Chen et al, 2006).

Online Tools: This survey item is intended to determine whether there is value to allow providers to access information online through the EMR system (Chen et al, 2006)., i.e. websites that house certain medical protocols.

Outside Access to the System: This survey item is intended to determine whether providers like having the ability to access their electronic messages while away from the hospital to review patient history and/or review lab results (Chen et al, 2006). This item also seeks to determine the impact that such access has on their life while away from the hospital.

Perceived Patient Satisfaction: This survey is intended to determine how patients observe the use of the EMR and whether the use of the EMR impacts the care that they provide (Chen et al, 2006).

Practice of Medicine: This survey item is intended to determine how well constructed the system is to allow for providers to deliver care that is within the scope of their medical practice (Chen et al, 2006).

Speed: This survey item is intended to determine the timeliness of completion of tasks that providers perform, i.e. test results are available for viewing sooner, patient summaries are more readily available for viewing and patient questions are addressed more-timely (Chen et al., 2006).

Summary

According to Austin and Leong (2006), individuals that participate in the conduction of research must create a research design that is well constructed and balanced. The research methodology that is outlined above for this potential dissertation topic, possesses the potential to add a solid contribution to the field of healthcare research. The purpose of this quantitative study

is to utilize a previously validated survey tool, to identify how EMR system features: accuracy, speed, efficiency, communication, the practice of medicine, online tools, availability of the system outside the hospital, and perceived patient satisfaction, impact end user satisfaction. End user satisfaction will be evaluated from the perspective of Anesthesiologists and Certified Registered Nurse Anesthetists throughout the four divisions of the medium-sized health care system that extends throughout the states of Wisconsin and Illinois. The results that stem from the proposed research method may confirm or reject previous reports that have been published in past scholarly literature. Chapter two will review publications from numerous scholars that have paved the foundation for the research design proposed within this manuscript.

Chapter 2: Literature Review

The purpose of this quantitative study is to exemplify the effect of EMR features on anesthesiology providers within a medium-sized health care system. There is an ample number of notable scholars that have shared critical pieces of information and perspectives on the benefits and hindrances of the use of electronic medical records (Blakely & Weber, 2013; Bardoel and Drago, 2016; Chen et al, 2006; Lim & Najjarbashi, 2019). It is crucial to note that there are various underpinnings that exist and contribute to the notable interest and exploration of EMRs. Countless authors have popularly flaunted that EMRs are the remedy to the tribulations that are experienced throughout the health care system (Blakely & Weber, 2013). However, there also exists support for the notion that EMRs create more adversity for those that such systems were designed to benefit. Table 1 includes a comprehensive list of search dates, database, keywords and search results that were performed and utilized during the generation of the literature review that follows.

Table 1.

Search dates, database, keywords and search results on the Topic of EMR Functional Satisfaction

Search Date	Database	Keywords	Search Results
01 December 2018 (8am-10pm)	Academic Search Complete	EMR Provider Satisfaction	25+
02 December 2018 (4pm-11pm)	ScienceDirect	EMR Accuracy	1246
05 February 2019 (6pm-12am)	Complementary Index	EMR Functional Satisfaction and the Operating room	25+
09 February 2019 (6am-6pm)	Academic Search Complete	Provider Functional Satisfaction	426
02 March 2019 (9am-7pm)	Business Source Complete	EMR Burnout; Functional Assessment	431
25 May 2019 (6pm-11pm)	MEDLINE Complete	EMR Adoption	328
02 June 2019 (4pm- 1am)	eBook Collection (EBSCOhost)	EMR use and quality assurance	25+
08 June 2019 (9pm-10pm)	Health Source: Nursing/Academic Edition	Satisfaction and Workgroup meetings	25+
16 July 2019 (9pm-12am)	Education Research Complete; Academic Search Complete	EMR Use; EMR System Adoption; Evaluating EMRs	25 +
27 July 2019 (3pm-11pm)	Business Source Complete	Understanding EMRs	25+
03 August 2019	Social Sciences Citation Index	EMRs and machine learning	25+
07 August 2019	Academic Search Complete	EMR Provider Satisfaction	25+
24 August 2019	Road Runner: All databases search	Health care physicians and Electronic health record computer literacy	60+
07 September 2019	All Source Types	Impact of EMR features	30+

**Search results indicate the number of relevant articles

Theoretical Framework

The proposal of this quantitative research study was constructed based off of a system theory that was industrialized and presented by Leveson (2011). Leveson (2011) outlines a theory that she formulated, known as the System Theoretic Accidents Models and Processes (STAMP). The STAMP theory principally propositions that when accidents arise, it is not because of human mistake or even any solitary specific weakness in the system of contributors and interactions from which that accident arose (Leveson, 2011). Leveson (2011) suggests that as an alternative, accidents occur due to consequences of the formation of numerous weaknesses in the rheostat structure that is intended to prevent them. The philosophy infers that any system, whether it be the industrial industry, the economics industry or the health care industry, can be unveiled as a web of tangled control loops, and each twist and control node in that loop has its own feebleness (Leveson, 2011). Leveson articulates that the above identified control network, comprises of exchanges and controllers that hinge on procedure models that affect their control of processes in the system. Overtly, Leveson (2011) deduces that weaknesses in control structures can occur in two key forms, weak or absent controllers, or weak or absent control exchanges.

Blakley and Weber (2013) state there are abundant research scholars who have provided critical and substantial support that pertains to the benefits of EMRs. The countless tools that EMRs can provide have been prevalently advertised as the resolution to the tribulations that have arose in the health care industry (Aaronson, Chop, Frey, & Murphy-Cullen, 2001; Kannry & Murff, 2001; Ash et.al., 2004; Chin, Kirshner, & Salomon, 2004; Bates et. al., 2006; Ajami & Bagheri-Tadi, 2013). Blakely and Weber (2013), share that the mass media has at certain periods implied that with the use of EMRs medical errors and financial waste in health care would only

be referred to in an historical context. However, several research scholars have provided valid and credible support that rejects that notion.

Scholars such as Doebbeling et al. (2009), Bardoel and Drago (2016) and Adikey et al. (2018), have identified that there is a sense of antipathy in medical practice against EMR tools. This bitterness is a response to the failure of the studied features to mollify the workflow of their users. Several scholars describe how certain technical variables of the EMR system operate in unison to provide care (Blakely & Weber, 2013). Furthermore, various studies including studies performed by Anderson (1997) and Bardoel and Drago (2016), have revealed that healthcare providers commonly use a variety of paper workarounds when the EMR features do not support their daily workflows. To completely understand the true advantages that an EMR system can afford (a software unit that is used for collecting, storing, or manipulating clinical information about a patient's health care delivery process at a single facility level), one would need to comprehend all its components and the potential that one EMR system could attain (Blakely & Weber, 2013). EMRs possess the ability to become more enhanced by utilizing tools that would allow for the system to expand to facilities outside of the EMR's scope. The evolution of an EMR to a system known as an EHR, a software unit that is designed for extracting data about a patient's full health record that can be shared amongst different providers throughout various health care facilities, will quickly become a necessity in the not so distant future.

Physicians and Their Adoption of the EMR

Although it is broadly believed that the adoption of an EMR can lead to improvement in clinical productivity, previous literature offers evidence relating to the failure of implementation of EMRs due to end user resistance (Abdekhoda, Dehnad & Zarei, 2019). According to Chen et. al. (2019), physicians are the most important users of an EMR in the hospital. Electronic medical

records have created a platform that allows for health care personnel to create, access, distribute and share patient information with other physicians, patients and other health care entities (Gur-Arie, 2011; Freudenheim, 2012; Chen et. al., 2019). Lack of physician support for EMRs is by far one of the major barriers to the prevalent adoption of EMRs. There exist previous studies that have attempted to identify the key factors that affect the adoption of EMRs by health care providers (Hossain, Rahman & Quaresma, 2019; Jaspers et al., 2019).

For example, Vitari and Ologeanu-Taddei (2018) considered factors as apprehension, self-efficacy, conviction, misfit and data security and revealed that those factors had an indirect but noteworthy effect on the intention to use an EMR by providers. Research conducted by other authors, such as Dobrzykowski and Tarafdar (2016) completed work that examined how data sharing, shared ideals, and provider performance influenced the use of an EMR. Multiple scholars such as Hsieh (2015) and Anderson et al. (2012), utilized previously developed behavioral models that investigated factors such as organizational trust and the perceived risk that is associated with the use of EMRs. Influences that relate to financial factors (Lehmann and Hsiung, 2012), demographics and performance expectation (Sykes, Venkatesh, & Zhang, 2011), as well as training, and computer sophistication have been identified as being influential factors for adopting an EMR (Brooks, Menachemi & Yeager, 2010).

An additional characteristic of an EMR system that has a substantial impact on the attitude of its end-users is the user interface (Hyun et al., 2012; Daim et al., 2019) Hyun et al. (2012) accentuated the importance of creating an interface that would be simple to utilize and circumnavigate, comprehensible and well harmonized to end user workflow. Work conducted by Handy, Hunter and Whiddett (2001) discovered that such system features contribute to the apparent ease of use for operator friendly interfaces, affluence of learning, as well as

convenience. Similar results were also buoyed by the research conducted by Wilkins (2009). Fathomable and clear communications with EMRs, their ease of knowledge transfer, and ease of accessibility, were all identified as being significant features affecting their professed ease of use (Wilkins, 2009). In addition to the features identified above, flexibility of an EMR systems user interface has also gathered support as a noteworthy factor when it comes to the impact on usability (Edwards et al, 2008).

Improved quality of care has also been recognized as an important indicator that an EMR system is accepted and utilized accurately (Daim et. al., 2019). Quality of care is described as a rate of effective treatments and diagnosis made by clinicians (Daim et. al., 2019). An advanced quality of care can be achieved with a more convenient system and a more optimistic approach to the EMR usage (Cho et. al., 2010). Daim et al. (2019) also shares that previous studies have articulated that satisfaction of nurses and physicians largely depended on computer experience, discernment regarding the practicality of EMR and EMR's effects on quality of care. Improving the eminence and efficiency of care has also been acknowledged as one of the most central motivators to adopt an EMR system by Basoglu et al. (2016).

Researchers such as Hayrinen et al. (2008) and Basoglu et al. (2008) have postulated that the quality of the information warehoused in an EMR system maintains a dynamic role, as physicians base their conclusions off of the data provided by such EMR system data sets, and thus ought to have full confidence in its accuracy. Erroneous and incomplete data could lead to ineptitude and poor acceptance of an EMR system (Abbott et al., 2010). Possessing the ability to store and retrieve vital characteristics of EMR systems, such as that of the correct information about medicine dosages for each patient according their specific health state or condition (Anderson et al., 2004; Daim et al., 2019), is a prime example. The accessibility that EMRs hold

permits physicians to evade issues that could be encountered, such as polypharmacy and possibly adversative drug events and side effects, and more successfully allows them to manage their patient's treatment (Daim et al., 2019). There are situations where an electronic medical record is the only source of information on a patient's past and present-day medications (Bates et al., 2008). It is absolutely vital to preserve precise and exact information about medications and their dosages and the history of other medical aliments, to guarantee the safety of a patient and improve clinical care (Daim et al., 2019).

EMRs and Computer Literacy

A study method that was utilized in the work conducted by Alawi et al. (2017), was derived from the example that was discussed in research conducted by Morae (2009). Morae (2009) produced a purposive sampling strategy that was used to assist in recruiting the provider participants of the study. Overall, providers that were involved with the study spoke auspiciously about the EMR system and its implementation and it was alleged that computer skills had a chief role in understanding the EMR as it was mentioned that the older generations were slower in keying and learning the new system (Alawi et al., 2017). Research conducted by Alasmary et al. (2014) adds to the theory by sharing that EMR end-users with high computer literacy capabilities were more content with using the EMR than users with low computer literacy skills.

Similar to the above conversation on computer literacy, other scholars have shared the importance of training health care providers beyond just the basics of EMRs. A study conducted by Awad et al. (2013) provided strong evidence for the need of monitoring and conducting post-go live training for providers, as the results of their study expressed improved use of their EMR. Brady et al. (2018) also provides sound evidence that supports the concept of holding more comprehensive training sessions that teach more than just what a provider “must” know, by

sharing that personalized training methods reduce the time spent with EMRs and they may also yield improved self-confidence for providers when using an EMR. Perhaps one of the most effective methods for reducing the number of instances that have been reported on the topic of computer literacy, is to address the issue earlier on for the younger generation of medical personnel. In a study conducted by Caldwell et al. (2018), the results supported the premise that residency managers believe it is important that incoming residents have a rudimentary understanding of EMRs. While comprehensive knowledge is not anticipated because of the high number of EMR systems that are available, many managers did mention that some degree of EMR experience or training in medical school be probable, at the very minimum to include fundamentals of health information.

Bastian et al. (2018) also suggests that electronic health care records are becoming common in academic healthcare settings. Clinical reasoning, which is defined as the cognitive method that health care providers use to care for their patients, is constructed on data, information and evidence (Bastian et al., 2018). Put simply, EMRs are a new method of documenting the data and the information that can be used to drive the clinical reasoning process of health care providers (Bastian et al., 2018). Statistical data that relate to the use of EMRs, have revealed a prevalent upsurge in the use of electronic medical records amongst healthcare providers and organizations over the past several years (Charles, Gabriel & Searcy, 2015; Heisey-Grove & Patel, 2015), which also includes the rise in the use of EMRs in medical training. In the medical education sector, numerous advantages and disadvantages of increased EMR use have been acknowledged. Advantages consist of ease of reviewing notes, accessibility to information, medical support tools, ease of organizing notes, and the possible use of patient registries (Christner et al., 2012). Disadvantages consist of increased time expended charting, the

effect on clinical reasoning, the impact on the growth and development of the student/patient relationship, and data overload (Christner et al., 2012; Bastian et al., 2018). Per Bastian et al. (2018), in order to take full advantage of EMRs in patient care and clinical education, tools such as educational guiding principles and model assistance must be established to guide faculty and students throughout the coaching and erudition process.

Amaya et al. (2015) have also provided support for the importance of training and education in the successful result of EMR use in the health care environment. Amaya et al. (2015) incorporated several teaching approaches into an educational plan that was developed and executed in a study that was conducted. Those strategies included items such as computer skills valuation assessments, an EMR aptitude tool, web-based training units, clinical (or specialty) situations, and hands on learning laboratories (Amaya et al, 2015). Amaya and his colleagues found that incorporating various teaching approaches into the process of assisting healthcare providers in learning to be proficient in the use of an EMR, yielded sound results as it effectively allowed for the accommodation of various levels for computer literacy in members of the medical workforce (Amaya, et al., 2015). Although there are obvious benefits to constructing training plans that accommodate for various learning styles, it is necessary to note that there are limitations to creating successful training or educational plans. For instance, limitations that pertain to budgetary concerns, training resources and provider availability due to heavy workloads are all key limitations that require attention and planning efforts (Amaya et al., 2015).

EMRs and Focus Groups

Electronic medical record systems are a new and promising tool that has been anticipated to provide enhanced assistance to healthcare providers as they deliver more high-quality patient care (Brown, Denomme, & Terry, 2011). In a study conducted by Alawi, Baloushi, Dhaheri,

Dhaheri, and Prinsloo (2017), significant variables emerged from their descriptive qualitative study that was designed to focus on three separate group interviews that were performed amongst physicians using open ended questions. According to Alawi et al. (2017), the key variables were categorized as provider problems, patient issues and system issues. The groupings of main variables were derived from a consensus during analysis of the focus group transcriptions after the meetings where the study participants frequently mentioned or stated these variables during their discussions (Alawi et al., 2017). As Alawi et al. (2017) alludes to in their research manuscript, the utilization of focus group discussions is becoming progressively popular in healthcare research to explore the opinions, frame of mind, attitudes and behavior of individuals.

The use of an EMR in the health care setting necessities the direct clinical input from those that interact with the system to complete their daily work tasks. Technology integration is best delineated as the degree to which the full potential of a revolutionary invention has been implanted within a person's or organizational work system (Apple & Zmud, 1992; Campeau & Meister, 1992). In essence, infusing technology into health care focuses on how an individual (or organization) uses the contributions and benefits of a system, how integrated the EMR is with existing or developing processes, and by what means tasks are addressed with the technology (Basoglu et al., 2019). Numerous studies have shown that EMR systems that are designed shorn of attention to end user needs, and consequently are perceived by end users as problematic to use and are tiresome to learn, which leads to a state of inefficiency, workflow workarounds and low amalgamation with standing processes (Basoglu et al., 2019). The full potential of an EMR system should be implanted into a healthcare organization only if the electronic documentation tool and its features simplifies the tasks being performed by end users, betters their performance and improves effectiveness (Hayes, Liu, Shih, 2011).

Various research scholars have studied the impact of direct medical staff involvement in the design of an EMR system. For instance, such inclusion of medical staff in the design of an EMR system has led to smarter and more clinically relevant computer automated EMR alerts being generated. The inclusion of medical staff in the design of their individual EMR systems has allowed EMRs to become smarter in defining persons or populations in which infectious diseases are more likely to be discovered, such as HIV, MRSA h and VRE (Jo, 2016). To aid in defining the importance of end-user involvement in the design of an EMR system, scholars such as Kepka et al. (2018) were able to leverage input from medical personnel and their EMR system to yield an improvement in human papillomavirus (HPV) initiation rates amongst a population of persons. Health care facilities have also begun to use functionality and clinical input to develop more advanced clinical support systems that are created with the intent of identifying life-threatening illness, such as sepsis by integrating established treatment protocols and nursing interventions into the building of such alert systems (Arnold et al., 2018).

Perhaps the most important consideration to keep in mind when it comes to the creation of an EMR system by information technology departments and their medical care personnel, is the fact that without clinically relevant tools being in place, technology such as automated alerts can become more of a burden, rather than a blessing (Beasley, 2018). One of the most commonly reported issues with the use of EMRs in the health care setting is provider burnout. According to a national survey that was conducted in 2018, there exists a great concern for doctors becoming burned out from the debasing burden of governing and administrative requirements and the use of electronic medical records in modern medicine (Khuntia, Tanniru & Weiner, 2015; Ancker et al., 2017; Beasley, 2018). Health care providers have increasingly reported that EMR features, such as alerts, do hold merit (Beasley, 2018). However, providers want to have features available

in the system that have a demonstrated efficacy and in order to ensure that, their input in the design on EMR systems are vital.

EMR enabled intercessions, have displayed promising outcomes for enhanced clinical guidance and documentation of health standings, such as that of the smoking status of a patient (Fernandez et al., 2016). The Health and Human Services Health Information Technology for Economic and Clinical Health Act (HITECH) of 2009, has offered a chance to converse, create, and endorse advanced ways of incorporating tobacco cessation support to patients in health care settings through the requirement of health care systems receiving Medicare and Medicaid reimbursements to use EMRs (Fernandez et al., 2016). Additional benefits produced by EMRs include improved patient consumption efficiency, enhanced access to patient information, reduced form-filling documentation effort and errors, simpler prescription systems synchronization among corresponding services and effectual billing and insurance procedures (Fernandez et al., 2016). EMRs can also be utilized to share huge quantities of population-based data and make available protected patient health information when applied across health care systems (Gorman, Goodman & Herrick, 2010; Engstrom et al., 2014; Duquaine, et al., 2014). All of the previously mentioned benefits of an EMR system are only advantageous when the information that is available for selection and stored in the EMR, is clinically relevant to those that are extracting the information and actually using that data to provide patient care.

EMRs and Their Impact on Patient Provider Relationships

In addition to the importance of computer literacy and provider involvement in an EMR systems development, is the perception from the provider perspective regarding the patient-provider relationship (Alawi et al., 2017). Per the findings presented by Alawi et al. (2017), providers were initially irritated due to the thought that the use of the system disrupted the

patient-provider relationship and that the waiting time for patients was increased due to data entry, which caused more frustration on the patient end of the spectrum. It was reported that providers thought that the waiting time was increased due to the time it took for patients to get registered and the nursing assessments that needed to be performed (Alawi et al., 2017). Alawi et al. (2017) ventured on to mention that although the opinion was expressed by various providers, the providers also believed that the benefits of the system overshadowed the waiting time issue and they encompassed beneficial matters as enhanced patient care, patient education and the health maintenance plans. The research participants stated that the patient flow was at first reduced, but in due course returned to the same previous level that was seen prior to the implementation of the EMR system (Alawi et al., 2017).

There currently exists minimal research on the impact that EMRs and their many features have on the direct contact between specific health care specialties and their interactions with patients. However, work conducted by authors such as Kharkar, Salamon and Vijayasarathi (2019) has yielded support for use of web based EMR platforms and their potential ability to improve communication between patients and providers such as those in the radiology specialty. As Kharkar, Salamon and Vijayasarathi (2019) suggest that information is the main currency in the specialty of Radiology, which is also true for the industry of medicine as a whole. Heightening the communication between health care providers and their patients can produce great benefits such as reducing the number of documentation errors experienced, decreasing patient-care postponements, greater patient compliance with recommendations, and potentially improved patient satisfaction (Kharkar, Salamon and Vijayasarathi, 2019). Kharkar, Salamon and Vijayasarathi (2019) indicate that communication within an EMR is more intricate than merely conveying a report statement to a referring physician. Rather, it is multidirectional with

numerous chances for meaningful interactions with patients, other providers and the general community (Kharkar, Salamon and Vijayasarathi, 2019).

As mentioned previously, there are a number of benefits to direct provider-patient interactions. However, allowing access to online tools that aid in educating and sharing information with patients has become a more commonly reference tool (Doshi, Somberg & Rosenkrantz, (2016). There are been multiple studies that were previously conducted that demonstrate that patient prefer to access their health care information, such as radiology images online (Chorny, Raza & Rosen, 2001; Easterling, Johnson & Williams, 2009; Ching, Henshaw & Okawa, 2015; Elmore, Langlotz & Lee, 2016; Abujudeh, Bruno & Gefen, 2017; Kharkar, Salamon and Vijayasarathi, 2019). Patient online portals offer a variation of opportunities for health care professionals to meet to the growing needs of their respective patient bases (Kharkar, Salamon and Vijayasarathi, 2019). For example, computerized portal-based cues can be established for patient specific screenings and/or preemptive services and compliance with follow up procedures (Kharkar, Salamon and Vijayasarathi, 2019). Such prompts can be carried through protected emails, text communications or in-application processes, and can provide support by allowing a patient to be more involved in the care that they receive (Kharkar, Salamon and Vijayasarathi, 2019).

Many EMR systems have evolved to the point of allowing patient portal platforms to integrate with their exclusive systems (Kharkar, Salamon and Vijayasarathi, 2019). According to Kharkar, Salamon and Vijayasarathi (2019), the particulars of the patient portal should be modified to meet the requirements of an organization's patient base and ought to also consider the preferences of other health care providers that may be reviewing or referencing the information. The fact of the matter is that there is no all-purpose solution for the implementation

of an online portal, and the capabilities of an online portal are expected to expressively develop in the years to come (Kharkar, Salamon and Vijayasarathi, 2019). Along with the development of online features, EMRs are projected to continue their evolution towards becoming even more of a high-quality tool to aid in patient care within the health care setting.

EMR Use and Its Functional Impact

Research conducted by Chen et al. (2006) revealed even greater support for the implementation and utilization of EMR systems. Chen et al. (2006) conducted their study in an ambulatory primary care and urgent care center in an academic hospital with 25 practicing providers and roughly 70 residents. The EMR system that was investigated was implemented in 2002 and was live in just under a years' time (Chen et al., 2006). Per Chen et al. (2006), the system contains admittance to all internally created notes, reports, lab values, and scanned documents, while all external documents and letters are scanned and added to the EMR system. An electronic messaging system also is incorporated into the EMR.

Chen et al. (2006) conducted private interviews with hospital staff, where all were asked about what they personally thought about the EMR system that they were live with. Moreover, the research investigators stimulated dialogue to detect aspects of the EMR system that induced a positive or negative response from the research participants (Chen et al., 2006). The responses that Chen et al. (2006) provoked were then evaluated and used to construct a basis for describing features in which the EMR system would have an influence on provider satisfaction. Chen et al. (2006) designated the following eight variables to categorize positive or negative thoughts from providers regarding provider satisfaction: accuracy, availability of the system outside the clinic, communication, efficiency, practice of medicine, online tools, perceived patient satisfaction, and speed. Out of the hospital staff members that participated in the study, 99 comments were

collected, 85 of those comments were assigned a variable, and 10 of the comments did not have a significant influence on provider satisfaction (Chen et al., 2006).

According to Chen et al. (2006), all the survey questions were written to address each of the abovementioned variables and additional questions were prompted to reveal demographic information about the providers such as their experience in healthcare and with computers as well as their gender and age. The survey that was developed was distributed within the healthcare clinic and many emails were sent to prompt their return from the participants, which out of the 70 subjects that were sent the survey 46 (or 66 percent) of the hospital staff members returned the survey for analysis (Chen et al., 2006). From a statistical analysis standpoint, the subscales of the overall scores were evaluated for core consistency using standardized Cronbach's alpha coefficients. Chen et al. (2006) studied the associations between the multiple replies and satisfaction was determined using analysis of covariance (ANCOVA) that was adjusted for covariates. Furthermore, the outcomes of tailored models for all pre-specified dependent variables were stated and all statistical evaluations were completed using two-sided tests at the 5% significant level (Chen et al., 2006). Chen et al. (2006) conducted said analysis with the use of the Statistical Analysis System (SAS), version 8.2 (where P values less than 0.05 were considered statistically significant).

The results from the study that was conducted by Chen et al. (2006) yielded that hospital staff members that participated in the research study, were satisfied with the number and location of computers, the reliability of the EMR system and customer support. Results from the previously mentioned study also revealed that a mere 53 percent of the respondents thought that the EMR system operated far too slow, while 76 percent of the participants felt that training on the new system was adequate and that there was always help available to those that needed it

most (Chen et al., 2006). Per Chen et al. (2006), satisfaction with the implementation was abstemiously correlated with self-disclosed contribution in development and was not associated with perceived patient satisfaction. Additionally, the researchers gauged the functional impact that the EMR placed on daily activities (Chen et al., 2006). Chen et al. (2006) found that most providers either concurred or strongly agreed, that the EMR system gave rise to gains in efficiency, comparative to the previous environment with computer-retrievable lab results, and warehoused notes and other forms.

In regard to how participants felt about having outside access to the EMR system, 80 percent of them liked having outside access and the use of such functionality attributed to a 93 percent approval rating from providers that agreed that the functionality improved communication (Chen et al., 2006). Chen et al. (2006) also reported that more than 85 percent of the respondents thought that communication within the hospital setting was a more convenient and faster method of communication. Additionally, 84 percent of participants enjoyed access to the virtual messaging capability while 20 percent of all participants felt that the remote access abilities encroached on their life while they were away from the hospital (Chen et al., 2006). Per Chen et al. (2006), the results that were discovered as the research pertains to EMR system speed, correlated positively to the research participant's perception, which the same correlation was found regarding outside access and EMR efficacy. However, there was no correlation among EMR accuracy or communication (Chen et al., 2006). According to the research findings reported by Chen et al. (2006), the participants in the research that was conducted discovered that there was a positive correlation between the implementation and use of the EMR system and its functional impact versus hospital staff satisfaction. Chen et al. (2006) also found that female

participants and those that possessed more computer skills tended to be more satisfied with the EMR system and its functional impact.

The current healthcare landscape is not sustainable (Coiera & Hovenga, 2007; Grain & Hovenga, 2015). Studies such as those published by Chen et al (2006) and various others, provide sound evidence for the fact that information technology in the form of EMRs has progressively become the focal point in the attempt to advance information availability and flow to support the delivery of healthcare and outcome enhancement (Grain & Hovenga, 2015; Bagshaw et al., 2018). According to Grain and Hovenga (2015) EMRs from a functional perspective, are at the mercy of incongruent third-party vendors that have their separate information structures and that are designed to benefit those organizations directly. Namely, through retaining their standing structure, it makes their systems inimitable and inspires the adoption of accompanying products from the same vendor (Grain & Hovenga, 2015). Although Grain and Hovenga (2015) are correct in noting that those organizations with their unique product structures call for the acceptance of add-on products from the same vendor, there is no true evidence provided that supports the previous claim. Grain and Hovenga (2015) share that such structure from the functional perspective of such vendors, impact the depiction of EMR data in an inconsistent manner between products and the EMR systems themselves.

Scholars such as George et al. (2014) and Grain and Hovenga (2015) support the notion that the ostensible inconsistencies that exist between EMRs and third-party vendors provide reason for the introduction of a disruptive technology. Although scholars such as George et al. (2014) and Grain and Hovenga (2015) postulate that such variations in third party organization system structures cause the sharing of erratic data between EMR systems and external technologies, there are numerous scholars that provide support for EMR systems that possess the

ability to advance and graduate to a full EHR system from an EMR (Blakely & Weber, 2013; Bardoel and Drago, 2016). Healthcare is a team crusade that necessitates frequent usages of the same data by innumerable personnel of a medical treatment team or facility throughout different phases of care, for an assortment of purposes (Grain & Hovenga, 2015). Within some of the most popular EMR and EHR systems to date, current external technology vendors that provide support for EMRs and EHRs alike, by making their technologies more integrated through various alternative technologies. For instance, organizations that allow for the automated dispensing of medications can now be utilized to scan medications directly into a patient's chart in various EMR modules. Technologies such as the one previously stated, compete against the notion that many information technology applications concentrate on singular functionalities or singular representations of multiple data uses and opportunities (Grain & Hovenga, 2015).

According to Doupi et al. (2014) and Grain and Hovenga (2015), healthcare technology software vendors have customarily controlled the network and representation of data in healthcare systems, and seemingly consider those data structures to be exclusive. Doupi et al. (2014) and Grain and Hovenga (2015) propose that such consideration has given rise to data representation and electronic systems that do not share mutual connotation and involves energy to share such data with others, and to manage said data over a period of time. In opposition to the previously stated claim, many scholars have postulated that those same controlled networks have given rise to successful data sharing (Adler-Milstein et al., 2018; Gupta & Gupta, 2019). Grain and Hovenga (2015) suggest that by allowing information technology software organizations to make their data structure their proprietary property, that it dejects healthcare electronic system procurers to alter their systems in order to lessen disruption and cost. As a result of the aforementioned notion, scholars such as Grain and Hovenga (2015) express that the use of those

services and technologies exponentially raise costs, due to snowballing maintenance expenses with theoretically adverse impacts on care, and the capability to charge effectively, reasonably and comprehensively denote data transversely through the healthcare continuum.

Limitations to the Success of the EMR System Platform

According to PricewaterhouseCoopers (1999), one of the main blockades to the success of electronic medical system is the convenience of suitable training and support. Per PricewaterhouseCoopers (2005), EMR healthcare systems are inflicted on healthcare providers with miniscule or no training or process alteration support, and as a result it takes much longer than expected for the benefits of the electronic healthcare system to be appreciated. Due to the imperfect process that is associated with the lack of healthcare provider buy in, it is assessed that only between a fourth or a third of all healthcare providers use the technology solutions that are available to them, and fewer than 5% of all clinicians use all of the influential features offered in said solutions (Sykes, Venkatesh, & Zhang, 2011; Abdullah et al., 2016; Kuo, 2018).

In addition to the lack of provider buy in into the use of EMR systems, it is important to note that providers that are not on board with the utilization of more modern technologies rely more heavily upon means of older documentation while providing care to patients. Most Doctors of Medicine habitually rely on paper records that are commonly incorrect or outdated (O'Brien, 2008). Sykes, Venkatesh, and Zhang (2011) state that even in healthcare organizations that have successfully deployed healthcare electronic systems, healthcare staff and administrative personnel regularly do not utilize the system as intended. For example, during times of interaction with the patients, providers enter data into the system later, which significantly weakens the benefits of the system at the point of care and key touchpoints with patients (Sykes, Venkatesh, and Zhang, 2011; Babbott et al., 2016; Colligan et al., 2016; Arnold et al., 2018;

Baker et al. 2018; Beck et al., 2018). A lack of proper use of electronic medical systems by healthcare staff may add to the negative impact of the system on the attitudes and morale of those that it is intended to benefit the most.

For health care clinicians, an absence of proper EMRs exposes them to the hazard of missing vital clues in treating patients (Kohli & Tan, 2016). As the capacity of patient data rises, health care providers are ever more troubled about the safety, confidentiality, and correctness of patient data (Grain & Hovenga, 2015). Structural organization problems such as discordant EMR data standards are an area of apprehension to providers because of postponements in sharing data with other providers (Kohli & Tan, 2016). According to Kohli and Tan (2016), such delays make it problematic to create a comprehensive and accurate EMR resultant in the quandary faced by physicians (Zakaria and Meyerson, 2009). Although the concerns that physicians have in regard to the security of patient information, the pure size of the amount of information that exists, and accurateness are worth noting, electronic data is still more secure and comprehensive than legacy documentation systems, such as paper charting, as they require end user credentials to access such data. Information system vendors have created system structures that are massively protected by the highest-grade information technologies and the fact that patients' files are stored electronically reduces the amount of paper used in the health care setting, in addition to reducing the amount of medical errors that occur due to illegible hand-writing in patient charts.

Kohli and Tan (2016) share support for the fact that doctors of medicine accept the chief responsibility for the correctness and comprehensiveness of EMR data because a patient record commences to take form in the medical facility of a primary care doctor. EMRs impose that provider records be populated with a primary diagnosis, test results, and treatment therapy necessitating connection with pharmacy information systems and laboratory data systems

(Zimmerman, 2009; Kohli & Tan, 2016). Although EMRs have made hospitals and provider workplaces safer, negligence lawsuits involving EMRs have seen a rise over the last few years (Allen, 2015). Longitudinal statistics over numerous visits allow preventive care such as immunizations and sensible diagnoses (Kohli & Tan, 2016). EMRs are able to track allergies and disease circumstances for which a patient is at-risk over time (Jo, 2016; Kepka et al., 2018). From the collective population-level perspective, EMRs have made it possible for health care providers to establish best practices for patient care that provide support in process changes essential to attaining efficient and high-quality healthcare (Kohli & Tan, 2016). Providers are also concerned about who is responsible for fashioning standards for EMR integration and who will accept the cost of EMRs, if EMRs are to be combined to account for population-level analysis (Kohli & Tan, 2016). The previously mentioned concerns are sound. However, federal and state laws in harmony with governing bodies such as CMS (Centers for Medicare and Medicaid Services), have and will continue to ensure that digitalized health care platforms are promoting best practices for health care providers and the organizations that they work within (Alder-Milstein et al., 2018).

Beyond the scope of health care provider use, exists stakeholder concerns from the patient perspective. Privacy fears drive patients' intent to take part in managing, contributing to, and using EMRs (Agarwal & Angst, 2009). Automation of patient health records has also elevated safety questions for patients who are concerned that typographical mistakes or improper selections from cascading menus can lead to administering incorrect dosage amounts or even an erroneous medicine (Allen, 2015). Further, patients assume EMRs to be easy to use so they can view their examination results, track their health status, and allow for them to add to the EMR by including diet and physical isometric information (Kohli & Tan, 2016). Patients have also raised

concerns around the notion that merging of EMRs might lead to deviations in medication or treatment that works for them if nationwide authorities find such medications and treatments to be largely less effective for other patients (Kohli & Tan, 2016).

A study conducted by Matthews and Stanhope (2019), provides additional insight into perhaps the greatest concern that currently exists in regard to the use and limitations of EMRs: aligning an EMR with a patient centered approach. In the study completed by Matthews and Stanhope (2019), 95 health care providers participated in the focus groups and interviews that explored how an EMR and its development influenced the implementation of patient-centered care development in public mental health clinics. According to the findings of Matthews and Stanhope (2019), limitations to the implementation of the EMR system in their study revealed limitations such as the system not being able to allow for providers to individualize service plans and providers experienced technical difficulties, including cascading boxes or menus and pre-determined outcomes that may not have been fully clinically relevant. In essence, the work completed by Matthews and Stanhope (2019) demonstrates the need for EMRs to be even more highly customizable with direct input from health care providers to ensure and improve the provider experience and the quality of care that is provided to patients.

A vital limiting factor in decision making and project management in health informatics as it pertains to the use and acceptance of EMRs amongst health care providers, is a lack of understanding on the part of healthcare managerial and executive leaders (Grain & Hovenga, 2015; Matthews & Stanhope, 2019). Numerous healthcare administrators according to Grain and Hovenga (2015), neither know vital components that are needed for providers to provide care, nor do they hold the skills required to support their decisions and plans. Per Matthews and Stanhope (2019), there is a resistance to start new with EMR systems due to current investment

plans that may be in place. However, many times when large new investments are made, the longstanding vision is often deficient. Conversion plans to move in the direction of apprehending a long-term vision are not always in place (Matthews & Stanhope, 2019). Such changeover necessitates the use of existing EMR systems in a way that permits a broadminded move on the road to a defined vision (Matthews & Stanhope, 2019). A dearth of understanding of such a voyage is a consistent issue, as confirmed by the current focus of health care organizations on projects of implementation, rather than of gradual development of data, systems and the people that give life to the health care sector. Therefore, as specified by Sykes, Venkatesh, and Zhang (2011) and Matthews and Stanhope (2019), understanding the issues influencing the success or lack thereof, of electronic healthcare systems is of major practical importance.

EMRs Introduce Greater Opportunities for Error

Contrary to the various scholarly articles that have been published and express sound support for the use of EMRs, there are research works that oppose the use of EMRs in systems, especially when a health care organization is labeled as being poorly organized to begin with (Zimmerman, 2009). Zimmerman (2009) specifically calls out that the use of EMRs with respect to functionality that is specific to specialized areas, such as the laboratory typically experience implementation issues as such areas are often implemented much later than other areas. Christensen and Oldenburg (2009) also supports the notion that EMRs introduce greater opportunities for error, by sharing that not all patients have access to a computer or other electronic based means of communication. Ultimately, Christensen and Oldenburg (2009) suggest that healthcare organizations must also make note of patients that may fall into this population of “electronic free” patients and must continue to offer an “offline” means of notifying patients of their health care results.

Based on an editorial published by Kelley (2014), there is additional support for the notion that EMRs do not reap as many benefits as those that are widely published state. Per Kelley (2014), it is suggested that EMRs yield an end product that is worthless, as it pertains to the amount of information that can be viewed, but also devoid of useful information. Moreover, Kelley (2014) shares a view from the perspective of a physician. Kelley (2014) shares the same outlook on EMRs as various health care providers, not only those that are practicing surgeons. What many providers share in their criticism of EMRs is that it was projected to transform the manner in which medical documentation could be completed. But in many instances, EMRs have increased provider workload and increased expenses. Therefore, there exists a greater need for research on the topic of EMRs and provider satisfaction, beyond the work that has been published to this point in time.

A fundamental assessment of EMRs is that they have not been constructed with the desires of providers or patients as the highest priority (Adler-Milstein et al., 2019; Ratwani et al., 2019). Such disparagement spans throughout the EMR user interface configuration (the manner in which end user screens are constituted) and choices about how to integrate EMRs into medical workflow (Adler-Milstein et al., 2019). There are clear guiding principles regarding what constitutes good design (Adler-Milstein et al., 2019; Office of the National Coordinator for Health Information Technology, 2019). However, in the same respect, many scholars share that there is still a considerable amount of vagueness, inadequate evidence, and intricate adjustments that are needed to configure EMRs with more clinically relevant information and less clinically insignificant clutter.

From a technical perspective, a recent study has revealed another opportunity for error that exists with the use of electronic records in the health care setting. Adelman et al. (2019),

conducted a study in a large integrated health care system with two groups of randomly selected providers (one group was comprised of 1687 providers and the other was comprised of 1669). The primary focus of the study was to examine the number of wrong-patient orders between the two groups, with one group being granted the security to have up to 4 patient records open at a time and the other group that was allowed to keep only 1 patient record open at a time. From an initial review of the findings, it appeared as though there was data that provided unambiguous support to a policy of permitting users to keep 4 patient records open concurrently. However, the post hoc analysis conducted by Adelman et al. (2019), revealed that orders that were completed with more patient records open were more susceptible to errors then the group that was granted the security to have 1 patient record open. The study conducted by Adelman et al. (2019) highlights the fact that EMRs can be and should be configured from a security perspective, in a manner in which providers can be protected from erroneous documentation on the wrong patient, that costs both time as it pertains to chart clean-up and money if a medical case us taken to court and such an error is discovered.

It is clear that many providers are dissatisfied with the use of electronic medical documentation systems in the health care setting. It is the responsibility of health care scholars and administrators, to protect those that have dedicated their life to saving others. Thus, it is crucial that evidence-based research continues to focus on providing research results that will assist in enhancing the features of EMR systems that are outraging our medical staff population. Studies such as the one performed by Adelman et al. (2019), highlight the path to the formation of a digital knowledge health system, in which the outcomes of the communications between health care provider and their EMRs are evaluated to assist in guiding the strategies that lead to the highest value and utmost nourishing care.

Summary

There exists an abundant number of distinguished scholars that have shared important fragments of information and outlooks on the benefits and burdens of the use of electronic medical records (Blakely & Weber, 2013; Bardoel and Drago, 2016; Chen et al, 2006; Lim & Najjarbashi, 2019). It is key to note that there are various underpinnings that exist and contribute to the protuberant interest and exploration of EMRs. The innumerable tools that EMRs can afford have been readily publicized as the resolution to the plights that have arose in the health care industry (Aaronson, Chop, Frey, & Murphy-Cullen, 2001; Kannry &Murff, 2001; Ash et.al., 2004; Chin, Kirshner, & Salomon, 2004; Bates et. al., 2006; Ajami & Bagheri-Tadi, 2013; Adler-Milstein et al., 2019). The number of topics that have been associated with the concept of EMRs is vast and is comprised of subtopics as unostentatious as EMR adoption and as complex as satisfaction. Previous research has placed a primary focus on the impact that an EMR system has on clinical settings or facilities and represented views from a smaller pool of the medical personnel population. Therefore, the purpose of this quantitative study is to illustrate the effect of EMR features on anesthesiology providers within a medium-sized multifaceted health care system that is comprised of 15 hospitals. Chapter 3 will present the research methodology that will be executed for the proposed research study.

Chapter 3: Research Method

The problem that will be addressed in this study is the lack of research analysis that exists on the impact of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists in a multifaceted health care system. End user functional satisfaction with an electronic medical record (EMR) system, upholds a pivotal role in its implementation and successive use (Chen et al., 2006). Previous research on the impact of EMR functionality on health care personnel or end-users of such systems, has been secluded to one individual health care center location, clinic, department, specialty and/or has focused on national surveys. The following research methodology has been constructed to delve deeper into how EMR system features associated with provider satisfaction fair within a more complex healthcare system. A medium-sized health care system that extends throughout the states of Wisconsin and Illinois and consists of four separate divisions (which encompass a total of 15 hospitals): The Eastern Wisconsin Division-(EWD), Western Wisconsin Division-(WWD), Central Illinois Division-(CID) and Southern Illinois Division-(SID). The implementation of the EMR system for this organization began back in 2012 with only EWD, and in 2015 the system approved a project that would bring the EMR to 11 of their hospitals over a four- and half-year period. Since the time of the project's approval, none of the data that has been collected, has been analyzed to determine the areas in which improvement is needed with their EMR. Moreover, no action plans have be created to address areas that appear to be bothersome to healthcare providers from a technical functionality perspective. The four divisions will, therefore, be surveyed with the hope of identifying features of the EMR that contribute to end user satisfaction from the perspective of Anesthesiologists and Certified Registered Nurse Anesthetists.

The purpose of this quantitative study is to identify the impact of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists in a multifaceted health care system. Specifically, this proposed study design will be utilized throughout the four divisions of a medium-sized health care system that extends throughout the states of Wisconsin and Illinois. The contents of this chapter will include a description of the research methodology and design, a short overview of alternative methodologies, a brief review of the population and sampling that will be utilized, and a synopsis of the materials and data collection methods. Furthermore, this section will define the operational variables of the study, the study's procedures, assumptions, limitations, delimitations and ethical assurances.

Research Methodology and Design

In order to appropriately describe the rationale behind selecting a quantitative based research methodology for this study, it is suitable to define the different methods that were considered. Before the selected quantitative research methodology is reviewed, the qualitative and mixed methodologies will be briefly defined respectively. A scholar that opts to select a qualitative research technique, accumulates open-ended, emerging data that is then utilized to generate variables (Campbell, 2014). The qualitative method permits for a study of an exploratory nature (Campbell, 2014). According to Campbell (2014), the examination and discovery of data via a qualitative research method frequently designates that there is not much written about a study's research subjects or the variable of study, which would not accurately support the topic of this proposal, as there is a plethora of work that exists on the topic of EMR end-user satisfaction. Qualitative research characteristically takes place in a natural setting and utilizes various methods that are focused on developing data rather than investigating heralded data and being essentially informative (Campbell, 2014).

Al Hunter best defined the mixed method research approach as a phrase that is usually used to designate combining qualitative and quantitative research methods in the same research project (Johnson, Onwuegbuzie & Turner, 2007).Johnson, Onwuegbuzie and Turner (2007), share a variety of different definitions of the mixed method approach, but referring to the scheme as being a multimethod research approach indicates that diverse styles of research may be united in the same research project. The different research styles do not need to be restricted to quantitative and qualitative; but could perhaps include qualitative participant observation with qualitative in-depth interviewing (Johnson, Onwuegbuzie & Turner, 2007). Alternatively, according to Johnson, Onwuegbuzie and Turner (2007), the mixed method style could comprise of quantifiable survey research with quantitative investigational research.

Quantitative research is the numerical depiction and management of observations for the purpose of relating and explaining the singularities that those observations imitate (Sukamolson, 2007; Campbell, 2014). Quantitative research permits data to be collected that places an emphasis on precise and unbiased measurements that use arithmetical and statistical analysis to support or contest a hypothesis (Campbell, 2014). The outcomes of quantitative research are habitually generalizable, foreseeable, and afford a causal explanation (Sukamolson, 2007; Campbell, 2014). The researcher person is considered separated and unbiased (Campbell, 2014). Data gathering methods comprise of random sampling of research subjects that should statistically denote a population, a measured experiment that can be replicated in which variables can be attuned to observe the outcome, or documentation of observations as with a case study (Campbell, 2014). Statistical analysis of the data may well contain calculations of a mean, standard deviation and a t-test; and the analysis of the information is used to reify the

data(Campbell, 2014). The quantitative research method is the investigation method with which most research scholars are most familiar with.

Due to the fact that qualitative research methods are used by researchers to collect open-ended developing data sets that will be used to develop a variable (Campbell, 2014); and that mixed methods utilize various methods to examine different questions within the same study, the quantitative method was chosen for this study to merely employ an experiential method and empirical statement. Therefore, in order to explore the potential impact that the previously identified constructs have on healthcare provider satisfaction, a 5 point-Likert scale survey that consists of 24 items (3 items per variable), will be used to assist in identifying features of an EMR system that contribute to end user satisfaction for providers in a medium sized healthcare system in the Midwestern part of the United States. The survey will consist of eight constructs, which were originally introduced by Chen et al. (2006): speed, accuracy, communication, efficiency, online tools, practice of medicine, perceived patient satisfaction and availability outside of the hospitals (see Figure 1).

Population and Sample

To determine the sample size that is required for this research study to be worthwhile conducting, G*Power 3.0.10 software was utilized to run a correlation: point biserial model statistical test with an a priori: compute required sample size-given α, power and effect size type of power analysis. The overarching goal of the prospective power analysis is to estimate a necessary sample size for a given power (α) and population effect size (ES), where the detected power analysis is shown to estimate the power, given the sample size and the sample ES(Abaci, Long & Peng, 2012).Since effect size can only be calculated after data is collected for a study, an estimate for the power of analysis was used. Common practice is to use a value of 0.5, which in

the case of this statistical test indicates a large effect size convention. Based on the results of the G*Power software's calculations, this study would require a total sample size of 42 healthcare providers, which would equate to roughly 10 providers from each of the four divisions: EWD, WWD, CID and SID (see Figure 2). Based on previously published literature such as Chen et al. (2006), the estimated completion rate for studies that include surveys of this design typically falls around 66 percent. Thus, approximately 64 eligible providers will be needed for this study. Research participant eligibility will be established based on reported user provisioning, which is drawn directly from medical practice credentialing within the system, i.e. only current practicing Anesthesiologist and CRNAs will be included within the population sample. The above-mentioned sample size is appropriate due to the fact that both theory and historical data unite on the deduction that parametric methods examining variances in correlation, for sample sizes greater than 5, do not necessitate the assumption of normality, and will produce effectively correct answers even for strikingly non-normal and asymmetric distributions like exponentials (Boneau, 1960; Norman, 2010). Hence, parametric statistics (which make assumptions about defining properties of a population) can be used with Likert data and small sample sizes with no fear of arriving at the incorrect conclusion (Norman, 2010). With that said, the power of analysis test returned an actual power of 0.96. Since power is 1-beta, and the power of a hypothesis test is between 0 and 1, if the power is close to 1 the hypothesis test is very good at detecting a false null hypothesis (Jackson, 2012). Therefore, this study is one that could be deemed appropriate to conduct.

Materials and Instrumentation

The importance of statistical power and precise estimation of sample size is regarded not only as a compulsory condition of attaining success in methodical exploration, but it is also

viewed as a procedural facet which is chiefly under an individual scientist's control(Abaci, Long & Peng, 2012). Therefore, to increase the reliability and validity of the proposed study, the G Power analysis tool was used as a means of performing the prospective power analysis of the study, rather than performing a descriptive or inferential statistical analysis (Abaci, Long & Peng, 2012). A survey that will be reviewed and validated by an appropriate institutional review board and is comprised of questions that relate to the eight variables of: speed, accuracy, communication, efficiency, online tools, practice of medicine, perceived patient satisfaction and availability outside of the hospitals, will be measured using a 5-Point Likert Scale, which is available in the appendix section of this proposal for reference (Appendix C).Each variable will consist of 3 scale item questions, resulting in a total of 24 questions that will be used to assess provider satisfaction for each variable. The survey validation statement and statement of permission from the approving IRB body is also available for reference in appendix D, E, and F of this proposal as well. Spearman's correlation coefficient will be used to study any uncontrolled connotations and the relationships between the various responses and provider satisfaction will be observed using analysis of covariance (ANCOVA), adjusted for covariates. P values that report out as less than 0.05 ($P < 0.05$) will be considered statistically significant and the data analysis will be completed using SPSS software. For this particular study, no field or pilot testing will take place as this survey has been previously validated.

Operational Definitions of Variables

All eight of the variables: speed, accuracy, communication, efficiency, online tools, practice of medicine, perceived patient satisfaction and availability outside of the hospitals are ordinal in nature and thus, have been divided separately (Chen et al. 2006). Each variable will be measured using a 5-Point Likert Scale. Each of the non-numeric concepts that are intended to

reveal the level of satisfaction of Anesthesiology providers will be measured on an ordinal scale where: 1= Strongly Disagree, 2=Disagree, 3=Neither Agree nor Disagree, 4=Agree, and 5=Strongly Agree. In order to produce unbiased estimates and conservative results, if there are any survey data sets in which responses are missing, those surveys will be omitted from the total scores (Chen et al., 2006; Kang, 2013).

Accuracy: This survey item is projected to determine the exactness in which documentation can be found on the correct patient, whether documentation is more legible and presentable to review and seeks to reveal that patient records are more complete (Chen et al., 2006).

Communication: This survey item is intended to determine how content providers are with being able to send and obtain messages electronically in order to communicate with their colleagues (Chen et al, 2006).

Efficiency: This survey item is projected to determine whether less effort is taken to research web-based literature or review a patient's medical history (Chen et al, 2006). This items also will attempt to identify whether providers believe that less effort is exerted to communicate with their colleagues or if it takes less effort to review and interpret lab results for patients (Chen et al, 2006).

Online Tools: This survey item is intended to determine whether there is value to allow providers to access information online through the EMR system (Chen et al, 2006)., i.e. websites that house certain medical protocols.

Outside Access to the System: This survey item is intended to determine whether providers like having the ability to access their electronic messages while away from the hospital to review patient history and/or review lab results (Chen et al, 2006). This

item also seeks to determine the impact that such access has on their life while away from the hospital.

Perceived Patient Satisfaction: This survey is intended to determine how patients observe the use of the EMR and whether the use of the EMR impacts the care that they provide (Chen et al, 2006).

Practice of Medicine: This survey item is intended to determine how well constructed the system is to allow for providers to deliver care that is within the scope of their medical practice (Chen et al, 2006).

Speed: This survey item is intended to determine the timeliness of completion of tasks that providers perform, i.e. test results are available for viewing sooner, patient summaries are more readily available for viewing and patient questions are addressed more-timely (Chen et al., 2006).

Study Procedures

This study was conducted at a health care system that comprises of 15 hospitals throughout the states of Illinois and Wisconsin, in which 12 of the 15 hospitals have implemented electronic medical record software. The bipolar scale survey was deployed to the participating Anesthesiologists and Certified Registered Nurse Anesthetists via the appropriate email addresses that were obtained from the Information Technology Service Managers at each of the facilities. Site permission was obtained from each of the 12 health care facilities that have implemented the EMR system, through email communication with the Chief Operating Officers of each facility or division, the health care organization's Vice President and Chief Physician Executive or each sites Research Program Coordinator (Appendices D& E). The IRB validated survey was deployed via the basic version of the Qualtrics online tool. Research participant

eligibility was established based on reported user provisioning, which is drawn directly from medical practice credentialing within the system, i.e. only current Anesthesiologist and CRNAs will be included within the population sample. The research subjects consented to their participation in the study by clicking on the "Start Survey" option in the initial Qualtrics email communication that will be received. The survey questions were written to address each of the following eight variables: speed, accuracy, communication, efficiency, online tools, practice of medicine, perceived patient satisfaction and availability outside of the hospitals. From a demographic perspective, the survey inquired about a provider's experience in healthcare, experience with computers and experience using the EMR while practicing in the field of Anesthesiology. All surveys were distributed via electronic communication (email) to at least 42 Anesthesiology providers, as deemed necessary by the G Power Software data analysis (see Figure 2). All Anesthesia providers were recruited using an export of provider electronic access records from the EMR and consent was obtained through a full disclosure question at the start of the electronic survey.

Data Collection and Analysis

Spearman's correlation coefficient was used to study any uncontrolled connotations and the relationships between the various responses and provider satisfaction was observed using analysis of covariance (ANCOVA), adjusted for covariates (Chen et al., 2006). Unlike the statistical model that was shown in the study conducted by Chen et al. (2006), all statistical comparisons will be performed using a two-sided test at the 5 percent significance level. P values that report out as less than 0.05 ($P < 0.05$) will be considered statistically significant and the data analysis will be completed using SPSS software. The provider functional satisfaction survey construct responses would be determined using a 5-Point Likert Scale. From a statistical analysis

standpoint, the subscales of the overall scores would be evaluated for core consistency using standardized Cronbach's alpha coefficients. The specific scores that are calculated from the survey will be derived directly from the raw data that is obtained in the survey. The survey questions were written to address each of the constructs (the independent attribute variables), to determine the potential impact that each has on the dependent variable, which is provider satisfaction. To yield unbiased estimates and conservative results, if there are any survey data sets in which responses are missing, those data points within the respective surveys will be omitted from the total scores in accordance with the listwise deletion method (Chen et al., 2006; Kang, 2013).The listwise deletion method is the most commonly used method in handling missing data, and accordingly has become the default selection for analysis in most statistical software packages, such as SPSS (Kang, 2013).

All providers would be randomly selected from each of the four hospital divisions that use the exact same electronic medical system. Each participant would be encouraged to complete the EMR functional satisfaction survey that is designed to identify any association between the eight separate constructs and overall provider satisfaction when it comes to the utilization of their EMR system. The survey will be deployed to both providers that are hospital employees and those that are contracted in via third party organizations, using their direct professional email addresses. The survey questions will also address demographic data for the research participants, experience in healthcare, experience with computers and experience using the EMR.

Below is the deconstructed bipolar survey that will use a 5 Point-Likert Scale measurement system to determine the overall internal consistency of the responses from the research participants, and thus will be evaluated against the previously identified hypothesis of this research design:

For each of the questions below, select the radio button next to the response that best exemplifies how you feel about the statement, where: 1= Strongly Disagree, 2=Disagree, 3=Neither Agree nor Disagree, 4=Agree, and 5=Strongly Agree.

Accuracy: This survey item is projected to determine the exactness in which documentation can be found on the correct patient, whether documentation is more legible and presentable to review compared to their previous legacy system and seeks to reveal that patient records are more complete (Chen et al., 2006).

1. Documents that are clinically relevant to the care of my patients are enclosed in the correct patient's chart more frequently and are readily available compared to the previous legacy system (paper documentation, a different EMR, etc.).

2. In the current instance of my organization's EMR, patient records are more extensively complete compared to the previous legacy system (paper documentation, a different EMR, etc.).

3. Documentation within the charts of my patients is more legible compared to the previous legacy system (paper documentation, a different EMR, etc.).

Communication: This survey item is intended to determine how content providers are able to send and obtain messages electronically in order to communicate with their colleagues (Chen et al, 2006).

1. The messaging system in my organizations EMR allows for me to communicate with my colleagues regarding patient care in a timely manner.

2. Receiving messages and sending messages using the EMR systems messaging feature is convenient.

3. The EMR messaging system feature is able to route messages to the correct recipient quickly.

Efficiency: This survey item is projected to determine whether less effort is taken to research web-based literature or review a patient's medical history (Chen et al, 2006). These items also attempt to identify whether providers believe that less effort is exerted to communicate with their colleagues or if it takes less effort to review and interpret lab results for patients (Chen et al, 2006).

1. The organization's EMR allows me to review a patient's medical history with less effort than the previous legacy system.

2. The EMR allows for me to effortlessly review records related to imaging, consents and lab results for my patients.

3. The EMR allows for me to exert less effort when it comes to communicating with my colleagues compared to the previous legacy system (paper documentation, a different EMR, etc.).

Online Tools: This survey item is intended to determine whether there is value to allow providers to access information online through the EMR system (Chen et al, 2006)., i.e. websites that house certain medical protocols.

1. The EMR provides access to external links to literature that is useful in the care of my patients.

2. I am able to reference medical protocols in a timely fashion using external links that are available within the EMR.

3. The EMR allows for me to report out to practice based quality management organizations, such as AQI (Anesthesia Quality Institute) if necessary.

Outside Access to the System: This survey item is intended to determine whether providers like having the ability to access their electronic messages while away from the hospital to review patient history and/or review lab results (Chen et al, 2006). This item also seeks to determine the impact that such access has on their life while away from the hospital.

1.I find it convenient to have the ability to access and review the EMR messaging system while I am away from the hospital.

2.I find it convenient to have the ability to access new patient results while I am away from the hospital.

3. Having access to the EMR system while being away from the hospital infringes on my personal life while I am away from the hospital.

Perceived Patient Satisfaction: This survey is intended to determine how patients observe the use of the EMR and whether the use of the EMR impacts the care that they provide (Chen et al, 2006).

1. My patients express dissatisfaction with my use of the EMR during pre-evaluations and post-operative follow-ups.

2. Patients express more concern about their medical information being captured in an electronic system.

3. Patients enjoy having the ability to review their medical records and results through the EMRs patients centered electronic platform.

Practice of Medicine: This survey item is intended to determine how well constructed the system is to allow for providers to deliver care that is within the scope of their medical practice (Chen et al, 2006).

1. The EMR allows for me to execute my workflow in a logical and precise manner.

2. The EMR allows for me to provide better overall care compared to the previous legacy system (paper documentation, a different EMR, etc.).

3. The EMR allows for me to access patient charts more easily compared to the previous documentation system that the organization utilized (paper or another EMR).

Speed: This survey item is intended to determine the timeliness of completion of tasks that providers perform, i.e. test results are available for viewing sooner, patient summaries are more readily available for viewing and patient questions are addressed more-timely (Chen et al., 2006).

1. I am able to develop a summary of a patient faster using the current instance of the organizations EMR compared to the previous legacy system (paper documentation, a different EMR, etc.).

2. Results related to patient imaging encounters, consents and labs are accessible in a timely manner.

3. If patients have questions regarding a past, recent or future encounter, the EMR allows for me to access the patient's chart and provide the answers that they are seeking in a timely manner.

Assumptions

The assumptions that align with variables of accuracy, communication, efficiency, online tools, outside access to an EMR system, perceived patient satisfaction, practice of medicine and speed, are based on research that has been published by recent health care research scholars. For instance, accuracy as it pertains to validating patient data electronically, has yielded favorable results in recent works, such as in the recent study published by Bagshaw et. al. (2018) where their study provided support for EMR system repositories serving as high quality sources for

quality assurance auditors. As a result of such published research work, the assumption that relates to the variable of accuracy is that it will in fact have an impact on the functional satisfaction of providers that serve in the field of Anesthesiology from an alternative hypothesis perspective. Likewise, the variables of communication and efficiency hold similar assumptions with respect to the research methodology outlined in this manuscript, as timely perioperative communication has become an increasingly important quality metric for provider and hospital performance (Blake et al. (2013).

Access to online tools and accessibility of an EMR outside a health care facility have also drawn attention in regard to having an impact on provider satisfaction. For example, Chen et. al. (2006) discovered in their research that many providers liked having outside access and the use of such functionality attributed to a 93 percent approval rating from providers that agreed that the functionality improved communication (Chen et al., 2006). Furthermore, many scholars today, such as Adikey et al. (2018), allude to the notion that many studies suggest that physicians find the loss of autonomy at work, reduced control over the work environment (including the tools that are accessible for electronic documentation in some respects), inefficient use of time due to administrative requirements, and loss of support from colleagues, to be the chief factors that are associated with their dissatisfaction of EMRs. Therefore, it is reasonable to deduce that both access to an EMR outside of a health care facility and access to additional online clinical tools, such as medical protocols, could have an impact on functional provider satisfaction.

Since health care has been and will always be about the patient, it comes as no surprise that the variable of perceived patient satisfaction with a provider use of the EMR is an area of focus and interest in the modern-day healthcare setting. Blake et al. (2013) alongside numerous other scholars have cultivated support for the notion that the use of EMRs in health care facilities

have shown an improvement when it comes to the satisfaction of patients, as it has enhanced the speed and clinical relevance of the information that is shared with patients and their loved ones. As for the variable of a providers practice of medicine, there are still studies that have conflicting points of view when it comes to the clinical relevancy of the tools that are accessible to providers. Scholars such as Doebbeling et al. (2009), Bardoel and Drago (2016) and Adikey et al. (2018), have identified that there is a sense of aversion in medical practice against EMR tools. This sullenness is a response to the failure of the studied features to mollify the workflow of their users from a clinical relevancy and documentation perspective. It is clear that there is an impact that will be made as it pertains to the variable of a providers practice of medicine and use of an EMR. However, the directionality of that impact, rather it be positive or negative, has not been distinctly represented in current research literature.

Limitations

Technology as a tool is imperfect in many ways and thus, there are limitations that this proposed study may face. A few of the limitations that could be impactful on this proposed study is that there exists the possibility of the research participants experiencing technical glitches (e.g., system downtime, interface disruptions and crowded server data file space), operational wastefulness, data errors, and system incompatibility issues (Freudenheim, 2012). To mitigate the various limitations that are listed above, the organization that was selected for use in this study, has utilized a scheduled failover process to prevent such disruptions. Furthermore, the organization has also scheduled system downtimes so that they occur in the early hours of the morning to allow for system upgrades that will have a marginal impact on end user navigation of the software, due to low volume of clinical care activity.

Perhaps the most challenging limitation that exists within this study is that of physician support in the use of the EMR. According to Chen et. al. (2019), physicians are the most important users of EMR in the hospital setting. One important caveat to add here is that many physicians are concerned about autonomy loss or changes in power structure (Sherer, 2010). Lack of support for practicing physicians has been identified as a major obstacle to the widespread acceptance and adoption of EMRs (Chen et. al., 2019). In order to increase the health care providers' intent of adopting an EMR, the primary and chief prerequisite is to change their attitude and have their incessant support because they are the principal users of these systems. As a means of extenuating this key concern, the selected health care organization has implemented, within the last few years, a workgroup forum that provides an avenue for health care personnel (including a workgroup specific to the anesthesiology specialty) to be involved in the development of the EMR system, so that it aligns more closely with the real-world application of the system in their everyday scope of medical practice. Previous research studies have suggested that information technology studies need to astutely assess the possible effect of unique circumstantial issues that exist in the medical industry on the adoption of EMRs (Chen et. al., 2019). This study has been constructed to investigate those issues from the perspective of the anesthesiology specialty.

Delimitations

The objective boundaries of this research design were built based on implications proposed by previous research scholars that have shone light on the importance of EMR functional satisfaction on health care personnel. Per Bosserman, Patt, and Stella (2018), EMRs have continued to develop in functionality and usefulness. The overarching problem that is addressed by this study is the lack of research analysis that exists on the impact of EMR features

on Anesthesiologists and Certified Registered Nurse Anesthetists in a multifaceted health care system. Manuscripts that have been published prior to this research have implied that additional studies of multispecialty health care facilities of varying sizes are necessary to gain a greater scope of how EMR system functionality is associated with EMR acceptance and adoption (Chen et. al., 2006; Alawi et. al, 2017; Beck et. al. 2018). This study will be conducted at a health care system that comprises of 15 hospitals throughout the states of Illinois and Wisconsin, in which 12 of the 15 hospitals have implemented electronic medical record software. The bipolar scale survey will be deployed to the participating Anesthesiologists and Certified Registered Nurse Anesthetists via their personal email addressed using a basic version of the online Qualtrics tool.

All research participants will be enlisted using an export of provider electronic access records from the EMR and consent will be obtained through a full disclosure question at the start of the electronic survey, that will indicate their consent to the survey and in turn, the research study. All eight of the variables: speed, accuracy, communication, efficiency, online tools, practice of medicine, perceived patient satisfaction and availability outside of the hospitals will be evaluated via the 5-Point Likert Scale survey. Constructed on the results of the G*Power software's calculations, this study would necessitate a total sample size of 42 healthcare providers, which would equate to roughly 10 Anesthesia providers from each of the four divisions: EWD, WWD, CID and SID (see Figure 2). Previously published works, such as Chen et al. (2006), has projected that the completion rate for studies of this design typically falls around 66 percent. Thus, roughly 64 eligible Anesthesia staff will be needed for this study.

As with most studies, there are multiple methodological research approaches that could have been encompassed into this particular studies construction. For instance, utilizing a data extraction methodology such as that of Blakley and Weber (2013), where data on EMR

functional use could have been compiled through a database search and reported out on to determine areas of resentment that have been identified by various other scholars. However, indulging in such a design would have introduced a highly skewed representation of a selection sample population through unassociated grouping of the participants as they would not necessarily be utilizing the same EMR system. Furthermore, research methods such as those derived from the findings of Blakley and Weber (2013) and Curtis et. al. (2018). Blakley and Weber (2013) propose that there exists a mismatch between EMR tools and the medical practice workflow of providers. The findings of Blakley and Weber (2013) are certainly worthy of investigation and could have just as well been the primary focus of this studies design, however, the technical use aspect of EMR utilization stretches out much further than just the unaligned balance of system tools and their exact replication of legacy systems, such as that of paper charting. Quality assurance in every sense of the phrase is vital to the function of health care. However, there is a need to focus first on the individual pain points of the various healthcare specialties in order to derive resolutions that yield direct outcomes for those EMR end-users.

Curtis et. al. (2018) introduce another very interesting methodological approach that holds merit. The method utilized by Curtis et. al. (2018) examined the use of an EMR as a tool to assess the quality of chronic illnesses and their care through quality metrics in a large health care system. The study design that was utilized by Curtis et. al. (2018), could have just as well been utilized to focus in on anesthesia quality measures and the potential that exists in advancing interoperability between an organization's EMR system and third-party organizations or federal regulation bodies such as the Center of Medicare and Medicaid Services (CMS). Yet, at the foundation of interoperability is the technical function of an EMR platform and its ability to

provide access to the tools that are necessary to store the medical documentation in a way that allows for it to be called upon or extracted at a moment's notice.

The proposal of this quantitative investigative study has been erected based off of a system theory that was developed and offered by Leveson (2011). The STAMP theory principally propositions that when accidents arise, it is not because of human fault or even any solitary specific weakness in the system of contributors and interactions from which that accident arose (Leveson, 2011). Leveson (2011) advocates that as an alternative, accidents occur due to consequences of the formation of numerous weaknesses in the control structure that is intended to prevent them. Therefore, in an attempt to focus in on the potential individual structural weaknesses of the EMR system, this study intends to investigate the integrated "nodes" of the EMRs technical structure, to highlight and eventually reveal any possible areas of improvement.

Ethical Assurances

This quantitative research study will receive approval from Northcentral University's and the selected research organizations' local ministry Institutional Review Boards (IRB) prior to data collection. Due to the fact that no personal identifiable information will be obtained in this study, the potential risk to the participants is minimal and possesses no relevant ethical issues. Confidentiality or anonymity will be achieved through ensuring that all respondents are assigned a generic name when their survey results are gathered (i.e. Respondent 1 etc.). Moreover, the survey will be secured via the use of personal credentials that are only known by the researcher. All raw survey data will be exported into an excel file that will be encrypted by credentials developed and established using the Microsoft visual basic programming environment.

From a quantitative research study perspective, the role of the researcher is theoretically non-existent (Simon, 2011; Campbell, 2014). In essence, the participants of this study will be

acting independently of the researcher, as the survey tool items have been constructed in a manner that does not favor any directionality when it comes to the response of the participants. Quantitative study designs should ideally be repeatable by other scholars, under the same circumstances and should produce comparable results (Simon, 2011). The topic of EMR functional satisfaction for providers of the Anesthesiology specialty is of great interest to me as a scholar, as the field of health care information technology is the field in which I currently reside within. As a Systems Analyst within the health care industry, it is of vital importance to know whether or not an Anesthesiology provider accepts the use of an electronic medical record, or if there is more that can be done to assist them in changing their attitude towards an EMR systems use and its adoption.

Summary

The purpose of this quantitative study is to identify the effect of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists in a multifaceted health care system. Explicitly, this proposed study strategy will be utilized throughout the four divisions of a medium-sized health care system that extends throughout the states of Wisconsin and Illinois. A survey that will be reviewed and corroborated by an appropriate institutional review board and is comprised of questions that relate to the eight variables of: speed, accuracy, communication, efficiency, online tools, practice of medicine, perceived patient satisfaction and availability outside of the hospitals, will be measured by means of a 5-Point Likert Scale. From a statistical analysis perspective, the subscales of the overall scores will be assessed for core consistency using standardized Cronbach's alpha coefficients. The specific scores that are calculated from the survey will be derived directly from the raw data that is attained in the survey. The survey questions were written to address each of the constructs (the independent attribute variables), to

determine the potential effect that each has on the dependent variable, which is provider satisfaction.

Spearman's correlation coefficient will be used to study any uncontrolled associations and the relationships between the various responses and provider satisfaction will be observed using analysis of covariance (ANCOVA), adjusted for covariates (Chen et al., 2006). All statistical comparisons will be performed using a two-sided test at the 5 percent significance level. P values that report out as less than 0.05 ($P < 0.05$) will be considered statistically significant and the data analysis will be completed using SPSS software. Preceding research studies have proposed that information technology studies need to astutely assess the possible effect of unique inferred issues that exist in the medical industry on the adoption of EMRs (Chen et. al., 2019). This study has been built to explore some of those issues from the perspective of the anesthesiology specialty. Chapter 4 will report the findings.

Chapter 4: Findings

The overarching purpose of this quantitative study was to identify any potential influence of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists in a multifaceted health care system. The study was conducted with the intent of investigating the lack of research analysis, as it pertains to the impact of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists that have implemented and utilized one shared instance of an electronic medical record system, to serve as the primary means of clinical documentation within 12 of the 15 hospitals in the healthcare system. The remainder of chapter 4 will focus on the research questions and hypothesis of the study and will provide evidence for the psychometric soundness of the social survey tool that was generated and utilized in the collection of data for this study. Moreover, an interruption of the results from all statistical tests will be shared. The chapter will end with a brief discussion that will specify the extent to which the findings of the study compare with existing philosophy and research.

Validity and Reliability of the Data

Internal reliability of the 24 item 5-Point Likert Scale survey was examined using Cronbach's alpha. The data met the assumption of the Cronbach's alpha statistical test, which is used when one assumes that multiple items are measuring the same underlying construct or variable (Dennick & Tavakol, 2011), except for the variables of outside access to the system and perceived patient satisfaction. Justification for moving forward with the analysis following the production of the Cronbach's alpha values for those two variables will be explained in greater detail later on in this chapter. Results for the overall Cronbach's Alpha calculation was equal to .88, which is considered adequate. It was discovered through the statistical removal of each cluster of scale items that composed each EMR functional variable, that the exclusion of

perceived patient satisfaction group of scale items increased the level of internal consistency that was obtained by 0.3. To ensure convergent validity of the functional EMR survey tool, a computation of Spearman's rho correlation coefficient was conducted between each variable and the total provider satisfaction score.

Results

The surveys were disseminated out via email throughout the 12 healthcare facilities that utilize the multifaceted healthcare systems instance of their EMR. Over a duration of three weeks, weekly electronic mail reminders were sent out by leaders of the Anesthesiology specialties at the healthcare facility locations to encourage the completion of the surveys, as physical email addresses could not be shared directly due to medical staffing policy for the system. Out of the eligible 466 Anesthesiologist and Certified Registered Nurse Anesthetist staffing population, only forty-nine (11%) of surveys were returned for analysis. Participants from all four divisions of the healthcare system were represented, with the Eastern Wisconsin Division and Central Illinois Division ascribing for the most respondents, twelve (25%) and twenty-four (49%), respectively. The Western Wisconsin and Southern Illinois Divisions contributed to the study with nine (18%) and four (8%) respondents respectively, amongst all survey participants.

Respondents that fell into the age cohort of an Adult (18-65 years of age) offered the largest amount of participation with forty-seven (96%) total respondents (Table 1). Only two (4%) of the respondents categorized themselves to fall within the cohort of an Older Adult (Over 65 years of age). Sixteen anesthesia providers reported having had 5-10 years of EMR experience. Whereas, thirteen (26.5%) respondents for the EMR years of experience range of 0-5

years were reported, and thirteen of the participants (26.5%) characterized themselves as falling within the 10-20-year range for experience with EMRs (Table 2).

Table 2

Age demographics and EMR experience.

Age Cohort	Number of Respondents	Percentage of Respondents
Adult (18-65 years of age)	47	96%
Older Adult (Over 65 years of age)	2	4%
EMR Experience (in years)	**Number of Respondents**	**Percentage of Respondents**
0-5 years	13	26.5%
5-10 years	16	33%
10-20 years	13	26.5%
> 20 years	7	14%

It is important to note that following the collection of survey data, a change in the statistical approach for this study was implemented. There was no change in regard to the use of Spearman's rho correlation coefficient as it was used to study any uncontrolled connotations. However, the relationships between the various responses and provider satisfaction was observed using a bivariate correlation, instead of using an analysis of covariance (ANCOVA), adjusted for covariates. The constructed research questions were designed with the purpose of examining the relationship between each independent scale variable separately against the dependent variable of total provider satisfaction. P values that reported out as being less than 0.05 ($P < 0.05$) were considered statistically significant and the data analysis was completed using SPSS software. For this particular study, no field or pilot testing took place.

Research Question 1: Do the functional EMR variables of speed, accuracy, efficiency, communication, the use of online tools, or the practice of medicine have a statistical impact on provider satisfaction amongst Anesthesiologist and Certified Registered Nurse Anesthetist end users?

EMR Accuracy

Anesthesiologists and Certified Registered Nurse Anesthetist providers were satisfied with the clinical relevance of the documents that were enclosed within the charts of their patients (71%) and were also satisfied with the frequency and availability of those documents. Respondents reported being fairly satisfied (65%) with how much more extensive and complete patient records were compared to their legacy system. The majority of respondents to the survey reported being very satisfied (92%) with documentation within patient charts being more legible compared to the documentation method that was utilized prior to the implementation of the EMR. A Spearman's rho correlation was calculated for the relationship between EMR Accuracy and Total Provider Satisfaction. A strong positive correlation was found (Spearman's rho = .75, $p < .001$), indicating a significant relationship between EMR Accuracy and Total Provider Satisfaction. Hence, these results suggest that EMR Accuracy significantly and positively related to provider satisfaction with the EMR.

EMR Communication

Only 39% of Anesthesiology providers felt that the EMR messaging system allowed for timely communication with their peers, while 26% of respondents reported that sending and receiving messages via the EMRs messaging system was convenient. As for the EMR messaging system feature having the ability to correctly route messages from one provider to another quickly, 43% of respondents agreed that the system allowed for said action to take place. A

moderate positive correlation was found between the total provider satisfaction variable and EMR Communication (Spearman's rho = .48, p = .001). EMR Communication is significantly and positively related to provider satisfaction with the EMR.

EMR Efficiency

Survey participants felt that the health care systems EMR provided them with an opportunity to spend less effort on being able to complete an adequate review (77%) of a patient's medical history. 69% of research participants agreed that the EMR granted them the ability to locate and effortlessly review patient records that were related to imagining, labs results, and legal consents. In regard to the EMR allowing for less effort to be exerted from a workflow perspective, 49% of all respondents agreed that the EMR provided such efficient functionality compared to their legacy system. A mere 37% of respondents fell into the neutral category when it came to rating the EMRs efficiency. A strong correlation (Spearman's rho = .86, $p < .001$) was discovered between the total provider satisfaction variable and EMR Efficiency, suggesting that higher EMR efficiency results in higher provider satisfaction.

EMR Online Tools

Accessibility of external online tools through the EMR in question was found to be slightly advantageous, as 39 % of all respondents agreed that access to such resources was useful. The majority of participants felt uncertain (41%) with the EMRs ability to report out to practice based quality management organizations. Respondents also felt ambiguous (39%) about their ability to reference medical protocols in a timely manner. Although a majority of the respondents fell into the neutral category when it came to their satisfaction towards access to online tools through the EMR, there was a moderate positive relationship between access to online tools and provider satisfaction (Spearman's rho = .69, $p < .001$).

EMR Practice of Medicine

Satisfaction with the EMR was associated with a fair amount of agreement (84%) that the EMR allowed providers to execute their workflow in a logical and precise way. Although the majority of respondents were split with their opinion, 35% fell into the neutral category and another 35% agreed that the EMR allowed for better overall care of a patient. A respectful 74% of respondents agreed that the EMR allowed for easier access of patient charts compared to their previous legacy system. Providers were fairly satisfied with the EMRs alignment with their practice of medicine within the specialty of Anesthesiology (Mean = 10.98, SD = 2.43). A strong positive correlation was found (Spearman's rho = .84, $p < .001$), which suggests a significant relationship between the variables of EMR Practice of Medicine and Total Provider Satisfaction. In essence, a greater alignment with the Anesthesiology providers practice of medicine may result in better overall Total Provider Satisfaction scores.

EMR Speed

Survey participants were satisfied with the overall speed of the EMR system in question (Mean = 11.41, SD = 2.24). A favorable 69% of respondents expressed agreement when asked how they felt about their ability to develop a summary of a patient sooner using the EMR compared to their legacy system. Respondents shared a satisfactory opinion (71%) when asked about how they felt about being able to access a patient's lab and imagining results and consent forms in a timely manner. Providers were also satisfied (73%) when asked about how they viewed the speed of the EMR when it was utilized to access a patient chart upon request, to retrieve information relating to past, recent, or future medical encounters. A strong correlation that was significant (Spearman's rho = .76, $p < .001$) was found between the variables of provider satisfaction and speed.

Research Question 2: Do the functional EMR variables of outside access to the system or perceived patient satisfaction have a statistical impact on provider satisfaction amongst Anesthesiologist and Certified Registered Nurse Anesthetist end users?

EMR Outside Access

Respondents expressed an indeterminate response to their satisfaction with their ability to access the organizations EMR outside of their respective hospitals, with 45% of respondents falling into the neutral category when asked about how they felt about being able to access the EMRs messaging system externally (Table 4). Only 48% of providers found it convenient to have the ability to access new patient results while away from the hospital, whereas 35% of respondents disagreed that having the ability to access the organizations EMR remotely infringed on their personal life while they were away from their respective hospital locations. The Spearman's rho correlation between the variables of satisfaction and outside access to the EMR revealed a moderate correlation between the two variables (Spearman's rho = .62, $p < .001$). The relationship between provider satisfaction and access to the EMR remotely, appears to indicate a reasonable positive relationship between the two variables.

EMR Perceived Patient Satisfaction

When respondents were asked to share their level of agreement with the survey questions that pertained to their perception of patient satisfaction with their use of the EMR in their medical treatment, a majority of the participants fell into the neutral category (Table 4). When asked if they felt their patients expressed dissatisfaction with their physical use of the EMR during the pre-evaluation and post-operative phases of care, 37% of providers were unbiased. In addition, 37% of providers professed that they disagreed that their patients expressed any dissatisfaction with their use of the EMR during those phases of care. From the vantage point of

the Anesthesiology providers, 45% of the survey respondents fell into the neutral category when asked about their perception of patients expressing concern with their medical information being captured in an electronic medical record.

Contrariwise, 37% of survey participants disagreed that patients expressed any concern about their personal health information being captured via an EMR system. While 41% of respondents shared that their patients enjoyed having the ability to review their medical records and results through the EMR, 59% of providers provided a neutral response to the aforementioned functionality. A Spearman's rho correlation coefficient was calculated for the relationship between Total Provider Satisfaction and the variable of Perceived Patient Satisfaction with the EMR. A non-significant weak negative correlation (Spearman's rho = -.23,p = .119) was found.

Evaluation of the Findings

The chief goal and purpose of the present study was to identify the impact of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists in a medium-sized health care system that extends throughout the states of Wisconsin and Illinois. The lack of research analysis that exists on the impact of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists in a multifaceted health care system is the problem that prompted the execution of this study. Based off of results extracted from the statistical analysis that was conducted, the functional EMR features of speed, accuracy, efficiency, communication, the use of online tools, and the practice of medicine do in fact have a statistical impact on provider satisfaction (Table 3). Furthermore, it can be inferred from the results of this study, that the functional EMR variable of outside access to the system also has a statistical impact on the overall provider satisfaction of the EMR that is utilized by the selected populace of

Anesthesiology providers. The findings that pertain to the variable of perceived patient satisfaction yielded results that do support the alternative hypothesis that states that the variable has an impact of the dependent variable of total provider satisfaction. However, the correlation between the two variables was found to be weak and non-significant.

Table 3

EMR variables related to hypothesis 1.

Questions (n=24)	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Accuracy: Cronbach's Alpha = 0.77					
Availability of relevant and correct Documents	18% (9)	53% (26)	12% (6)	16% (8)	0% (0)
Pt. records are more complete	18% (9)	47% (23)	22% (11)	10% (5)	2% (1)
Records are more legible	57% (28)	35% (17)	6% (3)	2% (1)	0% (0)
Communication: Cronbach's Alpha = 0.88					
More timely communication	10% (5)	29% (14)	49% (24)	10% (5)	2% (1)
More convenient receiving and sending of messages	6% (3)	20% (10)	61% (30)	12% (6)	0% (0)
Able to route messages to the correct recipient more quickly	8% (4)	35% (17)	50% (24)	4% (2)	2% (1)
Efficiency: Cronbach's Alpha = 0.78					
Less effort to review chats	24% (12)	53% (26)	8% (4)	14% (7)	0% (0)
Less effort to review records related to imaging, consents, etc.	18% (9)	51% (25)	10% (5)	16% (8)	4% (2)
Less effort when communicating with others	12 % (6)	37% (18)	37% (18)	10% (5)	4% (2)
Online Tools: Cronbach's Alpha = 0.73					
Useful external links	10% (5)	29% (14)	31% (15)	22% (11)	8% (4)
Access to medical protocols	4% (2)	29% (14)	39% (19)	20% (10)	8% (4)
3rd party reporting	6% (3)	31% (15)	41% (20)	12% (6)	10% (5)
Practice of Medicine: Cronbach's Alpha = 0.79					
Logical and precise workflow	13% (6)	71% (34)	8% (4)	4% (2)	4% (2)
Provides overall better care	10% (5)	35% (17)	35% (17)	16% (8)	4% (2)
Access pt. charts more easily	29% (14)	45% (22)	14% (7)	10% (5)	2% (1)
Speed: Cronbach's Alpha = 0.83					
Developing pt. summaries	22% (11)	47% (23)	22% (11)	6% (3)	2% (1)
More accessible results	12% (6)	59% (29)	18% (9)	10% (5)	0% (0)
Recent, past, and future encounter information is more accessible	20% (10)	53% (26)	18% (9)	8% (4)	0% (0)

Overall Cronbach for all eight variables = 0.88

Table 4

EMR variables related to hypothesis 2.

Questions (n=24)	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Outside Access:					
Cronbach's Alpha = 0.23					
Convenience of remote access to the EMR messaging system	16% (8)	22% (11)	45% (22)	10% (5)	6% (3)
Convenience of being able to access pt. results remotely	24% (12)	24% (12)	37% (18)	8% (4)	6% (3)
EMR infringes on personal life away from the hospital	4% (2)	8% (4)	37% (18)	35% (17)	16% (8)
Perceived Patient Satisfaction:					
Cronbach's Alpha = 0.32					
Pts. Express dissatisfaction with the EMR	0% (0)	8% (40	37% (18)	37% (18)	18% (9)
Pts. express more concerns about EMR privacy	0% (0)	4% (2)	45% (22)	37% (18)	14% (7)
Pts. enjoy having the ability to review their medical records and results through EMRs	6% (3)	35% (17)	59% (29)	0% (0)	0% (0)

The data that was collected for this study via the deployment of the survey instrument, suggests that intrinsic features of an electronic record system may be worth further exploration and analysis. From the perspective of the Anesthesiology provider population sample that participated in this study, the most satisfaction was found with respect to the EMR features of accuracy, efficiency, practice of medicine and speed. Providers were unbiased in their attitude towards how patients fared from a satisfaction perspective with their use of the EMR doing phases of care. There have been numerous studies that have been published that pertain to provider satisfaction with EMRs. However, this is the first study to date that provides a narrow focus on provider satisfaction from the perspective of Anesthesiologists and Certified Registered

Nurse Anesthetists who serve within a multifaceted health care system that spans across two separate states.

Results of this study coincide very well with previous research findings that sought to investigate the impact of EMR use on health care provider satisfaction. In this particular study, respondents favored the functional EMR features of Accuracy, Efficiency, Practice of Medicine and Speed the most. High satisfaction with computer-based documentation within the EMR, as it pertains to accuracy and practice of medicine are two of the most notable features that have been continuously noted through previously published works that address the notion of provider EMR satisfaction. Although responses that were related to communication, outside access to the system and access to online tools all revealed a positive correlation to the total provider satisfaction variable, responses to all questions pertaining to the aforementioned functions yielded neutral acknowledgement.

An important point to add to this discussion is that of the result that was calculated for the Cronbach's Alpha coefficient for the variable of perceived patient satisfaction (Cronbach's alpha = 0.32) and outside access to the system (Cronbach's alpha = 0.23). There are various notions that have been shared by scholars in the social sciences that vie to provide an explanation for situations in which low Cronbach Alpha calculations are returned. Most commonly, scholars have shared that a low Cronbach's Alpha indicates there may not be enough questions on a test (survey in this instance) that are directed to measure the same latent variable (Dennick & Tavakol, 2011). A recent study conducted by Beaman, Vaske and Sponarski (2017) presents an intriguing explanation for the low Cronbach Alpha values found between the variables of perceived patient satisfaction and outside access to the system.

According to Beaman, Sponarki and Vaske (2017), items that have been designed to measure one latent variable in a Likert scale are presumed to be positively correlated with each other because they are gauging the same theoretical concept. A negative estimate of Cronbach's Alpha can transpire when the scale items are not positively correlated among themselves (Ritter, 2010; Beaman, Sponarski & Vaske, 2017). In the previously identified scenario, one or more variables may need to be recoded, so all items are coded in the same conceptual direction. In the current study, a recoding of the variable scale for both variables that returned low Cronbach's Alpha calculations, did not change the numerical value of either variable. Although Beaman, Sponarski and Vaske (2017) were alluding to a negative correlation, which occurs when respondents' answer inconsistently (Thompson, 2003), the low Cronbach Alpha values for the variables of outside access to the system and perceived patient satisfaction may perhaps be impacted by similar logic.

Taber (2018) recently shared work related to common notions of Cronbach Alpha and its use in social science research. The common conceptual notion of there being a threshold of acceptability for Cronbach Alpha values is seen as a theoretical rule of thumb (Plummer & Tanis, 2015). Namely, Cronbach's Alpha was not always seen as implying that lower values of alpha should be taken as indicating an unsatisfactory instrument. For instance, work conducted by Brok et al. (2014) reported a cross-national study looking at student interests in science where numerous values calculated for Cronbach's alpha were below the acceptable values. Brok et al. (2014) attributed and justified the low Cronbach alpha values to the low number of items included in the survey tool that was used and supported the notion that adding more items to the survey would lead to acceptable values for Cronbach's Alpha (Taber, 2018). Results of this current study have yielded similar results to the previously mentioned published works.

Therefore, it can be respectfully justified that adding additional items that are built to measure the latent variables of outside access to the EMR system and perceived patient satisfaction would yield the same results as previously noted by Brok et al. (2014) and Taber (2018).

Although this study is the first to date, to focus specifically on provider satisfaction of an EMR on the specialty of Anesthesiology, the work was completed using only one medium sized healthcare system, comprised of 15 hospitals, 12 of which were live on the EMR software, within one region of the United States. It would be of great benefit for future research to span out into other specialties and healthcare systems of varying sizes across different regions and perhaps internationally to provide a greater perspective of the topic of EMR functional satisfaction as a whole in the healthcare industry. Based off of recent publications that relate to the topic of EMR provider satisfaction and the most common methods of analysis for measuring such affective constructs, further development of data collection tools (increasing the physical number of items in a survey for instance) that look to use multiple items to measure a single overarching variable could perhaps provide more statistically justified results.

Summary

Overall, the statistical findings of this study yielded results that have been commonly found in past and present research on the topic of healthcare provider satisfaction. The EMR functional variables of accuracy, communication, efficiency, access to online tools, remote or outside access to the EMR system, provider practice of medicine and speed all yielded a positive correlation to, and hence are related to the total satisfaction of the populace of Anesthesiology providers used for this study. As for the variable of perceived patient satisfaction, a weak and non-significant correlation was determined to exist when an attempted association was made with the total provider satisfaction scores. Previous research has suggested that low values

related to Cronbach alpha calculations, that are meant to measure internal consistency amongst items, can be attributed to a low number of items that are built with the intention of measuring one overarching latent variable. Further statistical research is needed to determine if the variable of perceived patient satisfaction is in fact a measure that has been rightfully represented using survey items of this nature, or if perhaps there is an association that is being made that truly does not exist when measuring affective constructs such as satisfaction from an external, indirect viewpoint. Chapter 5 includes resulting implications, recommendations and conclusions for this study.

Chapter 5: Implications, Recommendations, and Conclusions

The problem that was addressed in this study's investigation was the lack of research analysis that existed that pertains to the impact of EMR features on Anesthesiologists and Certified Registered Nurse Anesthetists in a multifaceted health care system. Functional satisfaction with an EMR system, maintains a crucial role in its application and successive use (Chen et al., 2006). Preceding research studies on the influence of EMR functionality on health care personnel, has been isolated to one individual health care center location, clinic, department, specialty and/or has focused on national surveys. The present study's research methodology was been built to dive deeper into how EMR system features associated with provider satisfaction fair within a more complex healthcare system. In the remaining text of this chapter, a brief review of the study's methodology and design is discussed, the study's limitations are discoursed, and implications based on the research questions are presented. Chapter 5 is concluded with a review of the study's recommendations for practice and future research.

Precisely, this proposed study design was utilized throughout the four divisions of a medium-sized health care system that extends throughout the states of Wisconsin and Illinois. Based on the fact that qualitative research methods are used by researchers to amass open-ended developing data sets that will be used to develop a variable (Campbell, 2014); and that mixed methods apply various means to examine different questions within the same study, the quantitative method was selected for this study to simply employ an experiential method and empirical statement. Consequently, in order to explore the possible impact that the formerly identified constructs have on healthcare provider satisfaction, a 5 point-Likert scale survey that consists of 24 items (3 items per variable), was used to assist in detecting features of an EMR system that contribute to end user satisfaction for providers in a medium sized healthcare system

in the Midwestern part of the United States. The survey consisted of eight constructs, which were originally introduced by Chen et al. (2006): speed, accuracy, communication, efficiency, online tools, practice of medicine, perceived patient satisfaction and availability outside of the hospitals (see Figure 1).

This study was carried out at a health care system that comprises of 15 hospitals throughout the states of Illinois and Wisconsin, in which 12 of the 15 hospitals have implemented electronic medical record software. The bipolar scale survey was deployed to the 466 eligible Anesthesiologists and Certified Registered Nurse Anesthetists via the appropriate email addresses that were obtained from the Information Technology Service Managers at each of the facilities. Site permissions were obtained from each of the 12 health care facilities that have implemented the EMR system, through email communication with the Chief Operating Officers of each facility or division, the health care organization's Vice President and Chief Physician Executive or each sites Research Program Coordinator (Appendices D& E). The IRB validated survey was deployed via the basic version of the Qualtrics online tool. Research participant eligibility was established based on reported user provisioning, which is drawn directly from medical practice credentialing within the system, i.e. only current Anesthesiologist and CRNAs were included within the population sample. The study subjects consented to their participation in the study by clicking on the "Start Survey" option in the initial Qualtrics email communication that they received. All surveys were distributed via electronic communication (email) to 466 Anesthesiology providers. All Anesthesia providers were recruited using an export of provider electronic access records from the EMR and consent was obtained through a full disclosure question at the start of the electronic survey.

Implications for Research Question 1

EMR Accuracy

Results of the research study revealed that Anesthesiologists and Certified Registered Nurse Anesthetist clinicians, were pleased with the accurateness of the clinical documents that were stored within the charts of their patients (71%). Additionally, the anesthesia providers were also satisfied with the frequency and accessibility of the clinically relevant documents. The anesthesia providers also expressed a fair amount of satisfaction (65%) with how complete patient records were compared to their previous clinical documentation system. Respondents of the survey expressed a tremendous amount of satisfaction (92%) with documentation being more decipherable compared to the documentation method that was used before the implementation of the EMR system. In line with what was hypothesized in the first research question, a strong positive correlation was found between EMR accuracy and total anesthesia provider satisfaction. The correlation that was revealed between to the two aforementioned variables (Spearman's rho = .75, $p < .001$), suggests that there exists a significant relationship between the two variables. The findings of this study are consistent with the finds of previous published research.

EMR Communications

Although a moderate positive correlation was found between the total provider satisfaction variable and the EMR Communication variable (Spearman's rho = .48, $p = .001$), only 39% of Anesthesiology providers shared that they felt the EMR messaging system permitted for more timely communication with their peers. Moreover, 26% of respondents conveyed that sending and receiving messages via the EMRs messaging system was expedient. Results from previous research studies such as Chen et. al. (2006), yielded higher percentages of satisfaction with EMR communication. However, it is possible that the population of anesthesia

providers that elected to participate in this study could be those amongst the 466 eligible anesthesia providers that the survey was distributed too, that do not utilize the feature often.

EMR Efficiency

A strong correlation (Spearman's rho = .86, $p < .001$) was exposed between the total provider satisfaction variable and EMR Efficiency, signifying that higher EMR efficiency results in higher provider satisfaction. Respondents satisfaction with EMR efficiency mirrored the results of previously published works very closely, as a majority of providers were satisfied with the EMRS efficiency. Collectively, 77% of the survey respondents expressed agreement when asked about the reduced amount of effort that is exerted when attempting to complete a suitable review of a patient's medical history. While 69% of the research participants reported that the EMR allowed for them to effortlessly identify the location of clinical records such lab results and legal documents that were saved to a patient's chart, 49% of respondents felt that it took less effort from a workflow perspective to achieve such efficiency.

EMR Online Tools

Although most of the respondents fell into the neutral category (41%) when asked about their agreement when it came to their satisfaction towards access to online tools through the EMR. There was a moderate positive relationship between access to online tools and provider satisfaction (Spearman's rho = .69, $p = .001$). Previous research has reported higher levels of support for access to online tools and the value that they provide. The neutrality of the results of this study as it relates to the variable of online tools, introduces the notion that perhaps further research is needed to determine the true dimensionality or usefulness of having electronic based tools available in the context of the anesthesiology specialty. The results of this study provide evidence that there exists a positive correlation between anesthesia provider satisfaction and the

variable of EMR online tool access. However, greater details related to the content of the online tools and the frequency in which the content is accessed, could potentially provide better insight in why the anesthesia providers of this study reported unambiguous opinions in relation to this variable.

EMR Practice of Medicine

Respondents were equitably satisfied with the EMRs configuration and alignment with their practice of medicine within the specialty of Anesthesiology (Mean = 10.98, SD = 2.43). in line with hypothesis 1, and with what has been shared via previous research works, a strong positive correlation was found (Spearman's rho = .84, $p < .001$), which indicates a significant relationship between the variables of EMR Practice of Medicine and Total Provider Satisfaction. Though the majority of participants were divided with their opinion, 35% fell into the neutral category and another 35% agreed that the EMR granted them the opportunity to provide better overall care to a patient. A respectful 74% of all survey respondents agreed with the notion that the EMR allowed for quicker access to patient charts compared to their previous legacy system. In addition, satisfaction with the EMR was connected to a fair amount of agreement (84%) that the EMR permitted providers the ability execute their workflow in a logical and precise way. These results provide sound evidence for the importance of ensuring that an EMR is configured with content that is clinically relevant and comprehensive. The strong positive correlation that was found between EMR practice of medicine and provider satisfaction may provide greater support and a basis for investigating further, the involvement of health care professionals in the configuration of an EMR system from a specialty perspective.

EMR Speed

Respondents were satisfied with the overall speed of the EMR system. A strong correlation that was significant (Spearman's rho = .76, $p < .001$) was found between the variables of provider satisfaction and speed, which is consistent with previous research. Respondents were content when asked about how they observed the speed of the EMR when it was used to access a patient chart upon request (73%), to recover information connecting to past, recent, or forthcoming medical encounters. A satisfactory 69% of respondents stated agreement when asked how they felt about their capability of developing a synopsis of a patient sooner using the EMR compared to their legacy system. Survey respondents collectively shared a satisfactory opinion (71%) when asked about how they felt about their ability to access a patient's laboratory and imagining outcomes and consent forms in a timely manner. Although a majority of providers were satisfied with the speed of the EMR, the variable of EMR speed may present the greatest opportunity for growth when it comes to provider satisfaction. Due to the immense development of technology, placing a greater focus on the infrastructure of a technological system could add to the satisfaction of EMR end users. Specifically, a stronger connection between EMR software and the digital hardware that is used to support it, could further enhance the research that has been done to this point on the topic of EMR usage and provider satisfaction.

Implications for Research Question 2: EMR Outside Access and Perceived Patient Satisfaction

The functional EMR variables of outside access to the system and perceived patient satisfaction also yielded notable results in this study. The variable that was constructed to measure satisfaction with the Anesthesiology providers ability to access the EMR outside of their

respective healthcare facilities yielded a moderately positive correlation (Spearman's rho = .62, p < .001). The above-mentioned finding indicates that the ability to access the EMR outside of a hospital location does have a statistical impact on provider satisfaction amongst Anesthesiologist and Certified Registered Nurse Anesthetist end users. Furthermore, a Spearman's rho correlation coefficient was calculated for the relationship between Total Provider Satisfaction and the variable of Perceived Patient Satisfaction with the EMR. A weak negative correlation (Spearman's rho = -.23) that was not significant (p = .119) was found. From a statistical perspective, the preceding results suggest that there exists a weak negative correlation between the variable of perceived patient satisfaction and total provider satisfaction. The results above only partially support $H2_a$, which states that the functional EMR variables of outside access to the system and perceived patient satisfaction will have a statistical impact on provider satisfaction amongst Anesthesiologist and Certified Registered Nurse Anesthetist end users. Strong evidence against the second null hypothesis is provided as it pertains to the variable of outside access to the system (p = .001). However, weak evidence against $H2_0$was provided in regard to the relationship between perceived patient satisfaction and total provider satisfaction (p = .119). Hence, the statistical results associated with the variable of perceived patient satisfaction, indicates a failure to reject $H2_0$.

Study Limitations

Although the results of this study yielded similar results compared to previously published research, a greater return rate for the survey instrument would have been more ideal as it would have provided a larger sampling size to work with. An additional limitation with this study hinges on the fact that it was conducted several years after the implementation of the EMR system throughout the healthcare system. Thus, it would have been advantageous to have had

pre-implementation data to work with as well, as it may have provided greater insight into results that were generated in the study. Consequently, this study was performed after the phasing out of the legacy systems that the healthcare facilities had previously utilized, forcing respondents to compare the current EMR to the memory of their legacy systems. The remainder of this chapter will focus on the implications of this study, recommendations for how the study's findings can be applied in the present-day arena, and it will provide some guidance how future research could build off of the study's findings. The chapter will conclude with a brief summary of the contribution that this study adds to the already abundant amount of work that was has been completed and published on the topic of medical provider total satisfaction with the use of electronic medical records.

Recommendations for Practice

Removing Inconsequential Variables from Provider Satisfaction

As Liu et al (2015) suggests, facilitators and barriers to satisfaction after the implementation of an EMR are important to comprehend, as it is related to patient satisfaction and the improvement of healthcare and meaningful use of EMRs. Findings of this study suggest that perceived patient satisfaction yields no significant correlation between perceived patient satisfaction and provider satisfaction. Patient satisfaction is an outcome that is hard to adequately measure, as there is no exact manner in which to measure the variable (Fitzpatrick, 1991; Liu et al., 2015). Due to the fact that there exists such a variation within the numerous tools that can be used to measure patient satisfaction, we arrive at the theoretical underpinning of Levenson's STAMP theory. As Leveson (2011) suggests, weaknesses within a system combine to undo the work that has been done to prevent failure or in the case of this study, a lack of satisfaction with some of the features of the EMR. Instead of including variables that seek to measure the

judgement of someone other than the provider within a provider satisfaction survey, perhaps scholars should set their focus on the technical implementations of the EMR functions that they are supplied. Therefore, healthcare entities must place a greater focus on their technical systems. Placing a focus on technical functions such as dependable power, connectivity and networking capabilities where EMRs are deployed (Hayward et al., 2016), can add incredible value not only to provider satisfaction, but also in areas that are related to patient satisfaction and overall productivity of healthcare staff and their respective facilities.

Filtering the Focus to IT Infrastructure and its Challenges

Today, there exists an enormous number of organizations that have come to the point where they not only need, but have to upgrade their technology infrastructure in order to manage the pure volume of data that have now expanded and reached the scale of Petabytes (1,000 terabytes or 1,000,000 gigabytes)and to stay competitive (Ahsaan & Mourya, 2019).Of course, with the massive amount of data that is being created every minute of every day, challenges are also generated. Information technology companies have and must continue to face the challenges that arise head on. Many information technology companies recommend that their clients utilize the power of a combination of different database technologies, such as NoSQL, Hadoop, HBase and Paxata (Ahsaan & Mourya, 2019).However, technical architectures such as those that are previously mentioned, also present their share of complications. In order for organizations to adopt complex technical frameworks, they must be able to find skilled personnel to build, implement and support those platforms. Moreover, open-source database platforms such as Hadoop, while they are praised for being able to provide an organization with the ability to store large amounts of data, they also have their limitations.

Based on the pure volume of data and data queries that are made every minute of every day, especially in the healthcare sector, organizations require advanced tools and techniques that will grant them the ability to store and extract data from their systems. Most of the traditional data software systems today no longer have the aptitude to process substantial amounts of data (Godkar, Ketavarapu & Rallapalli, 2016). Although there currently exist publications that praise the use of data file systems such as Hadoop, there are many scholars that advocate for more complex methods for data processing and storage. For instance, Lang et al. (2015), suggests that data file systems such as Hadoop, are not suitable for running sophisticated workloads with task durations of sub-seconds (Lang et al., 2015), and thus must leverage additional task execution frameworks to manage application workloads. Although there are frameworks that can be leveraged to enhance data file systems such as Hadoop, there exists a sense of uncertainty when it comes to the complexities of integrating such "fixes", when there are platforms that exist that make data processing and storage more efficient and more cost effective without additional third party integration (Cai et al., 2018).

The results of this study contribute to existing research on the topic of EMR provider satisfaction by capturing the viewpoint of healthcare providers that work within the Anesthesiology specialty, which to my knowledge has not yet been examined until this time. Results of this study provide support for the notion that providers that work within the Anesthesiology specialty within the medium sized healthcare system are fairly satisfied with their instance of the EMR. This study provides added support for the notion that EMRs can be beneficial to healthcare personnel. Furthermore, results of this study also add justification for perhaps the removal of variables from measurement that are based on patient perception of provider satisfaction.

Recommendations for Future Research

The results produced by this study adds support for the need for future researchers to dive deeper into the topic of satisfaction from a more technical perspective (information system infrastructure, architecture etc.). This study also provides evidence for the notion that perhaps the removal of survey items within provider satisfaction surveys that seek to measure the perception of others (for example patients), may be appropriate or a greater standard must be developed to adequately measure the satisfaction of others with the satisfaction of providers that utilize the EMR. Future researchers can improve upon this study by obtaining pre-implementation data and performing a statistical comparison between the data obtained prior to EMR implementation and post EMR implementation. Furthermore, future researchers interested in this topic areas may benefit from conducting a cross-functional study that looks at both the functional features of an EMR and the technical functions of the actual information system infrastructure.

With the continued wide-spread adoption of electronic medical record and electronic health record systems, more and more opportunities will be presented to allow for research scholars to dive deeper into the data processing and information technology infrastructure side of the EMR satisfaction topic. In the not so distant past, manual documentation and the physical writing from a clinical perspective did not require complex processing technologies. However, in today's society most structured data necessities different forms of processing and storing technologies (Cai et al., 2018). With the massive amount of data integration that is possible, scholars must place a larger focus on the data systems that allow for such integration and data capture to occur. Future scholars will be in a position to transform the manner in which data can be collected and distributed and will have more data mining capabilities as more technologies emerge.

Future researchers will have a greater technological platform to work from directly as technology continues to evolve. Scholars that are intrigued by the topic of EMR utilization will be provided an opportunity to draw pre-implementation data from current EMR systems to use a an even greater gauge for how technology impacts healthcare personnel within all medical disciplines. Furthermore, additional research from other specialty areas could introduce new concepts and notions that could aid in the development of more efficient technologies and may also present additional opportunities for providers and other healthcare personnel, to perform technical and administrative tasks in a more effortless and timely manner.

Conclusions

As technology continues to evolve and EMRs continue to forge the pathway to greater overall quality of care for patients in the healthcare sector, a greater focus should be placed on applying what we have learned from studies that have sought to determine how satisfied healthcare personnel are with electronic medical records. The most satisfaction was found with respect to the EMR features of accuracy, efficiency, practice of medicine and speed. These results parallel and confirm finds that have been unveiled in previous studies. However, this is the first study to date that places a focus on provider satisfaction with EMR features from the perspective of Anesthesiologist and Certified Registered Nurse Anesthetists. This study provides support for a refocusing of provider satisfaction surveys in the healthcare field, away from systematic attempts to gather data from the perception of others for inclusion in their overall satisfaction scores. The study also provides a possible call for a greater standard to be created in order to measure variable such as perceived patient satisfaction from the perspective of a healthcare provider, if an actual significant relationship can be determined between the two variables.

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Appendices

Appendix A: Figure 1

Table 1: EMR Functional Satisfaction

Questions (n = 46)	Agree	Neutral/ Disagree
Speed: Cronbach's Alpha=0.79		
I can develop a synopsis of a patient faster.	66% (27)	34% (14)
New results for patients are available to me sooner.	86% (36)	14% (6)
When a patient calls on the telephone I can answer his/her questions faster.	93% (37)	7% (3)
Accuracy: Cronbach's Alpha=0.84		
Documents are contained in the correct patient's chart more often.	73% (30)	27% (11)
Documents are more legible	88% (35)	12% (5)
Individual patient records are more complete	68% (28)	32% (13)
Efficiency: Cronbach's Alpha=0.75		
It takes less effort to research web-based literature.	59% (23)	41% (16)
It takes less effort to review a patient's medical history.	86% (36)	14% (6)
It takes less effort to communicate with my staff.	88% (37)	12% (5)
It takes less effort to review records when interpreting lab results	83% (35)	17% (7)
Outside Access to System: Cronbach's Alpha=0.84		
I like the ability to access my message basket while I am away from clinic.	84% (38)	16% (7)
I like the ability to access new results while I am away from clinic.	82% (37)	18% (8)
The new system intrudes into my life while I am away from clinic in an unwelcome way. *	20% (9)	80% (36)
I value the ability to access the system from home.	80% (36)	20% (9)
The new system makes it easy for me to look up a patient's past medical history when I am at home.	83% (38)	17% (8)
Communication: Cronbach's Alpha=0.76		
The messaging in Starpanel allows me to respond more quickly to communication with my staff concerning patients	93% (39)	7% (3)
Sending and receiving messages **in my clinic** is now more convenient	90% (37)	10% (4)
When I send a message now, it is available to the intended recipient faster	88% (37)	12% (5)
There is more effective communication between attendings and residents. **	50% (22)	50% (22)

Overall Cronbach's alpha = 0.89. *excluded from outside access to system. **excluded from communication.

Figure 1.EMR Functional Impact retrieved from Chen et al (2006).

Appendix B: Figure 2

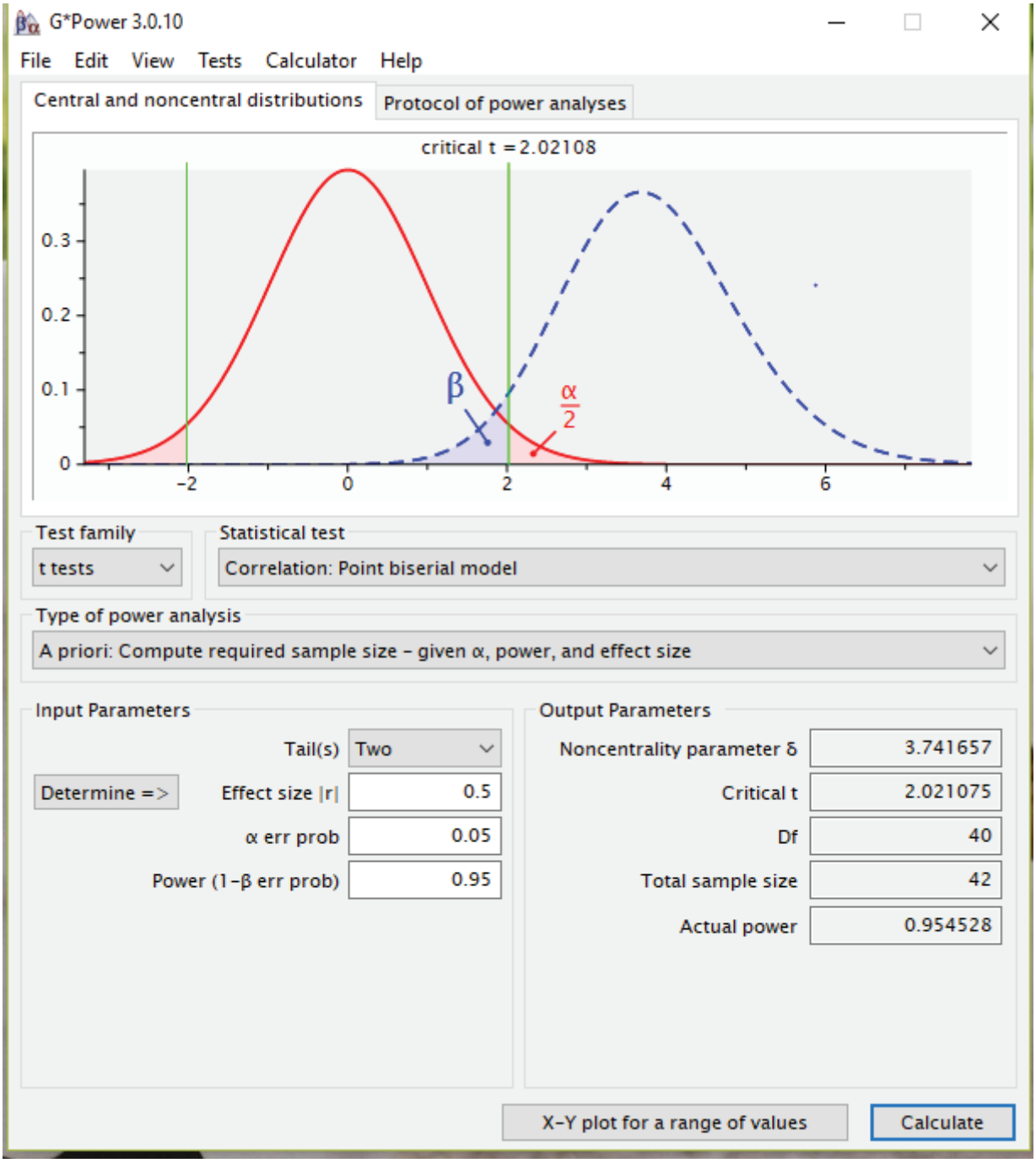


*Figure 2.*The power of analysis test used to determine the sample size for the study.

Appendix C: EMR Satisfaction Survey

For each of the questions below, select the radio button next to the response that best exemplifies how you feel about the statement, where: 1= Strongly Disagree, 2=Disagree, 3=Neither Agree nor Disagree, 4=Agree, and 5=Strongly Agree.

Accuracy: This survey item is projected to determine the exactness in which documentation can be found on the correct patient, whether documentation is more legible and presentable to review compared to their previous legacy system and seeks to reveal that patient records are more complete (Chen et al., 2006).

1. Documents that are clinically relevant to the care of my patients are enclosed in the correct patient's chart more frequently and are readily available compared to the previous legacy system (paper documentation, a different EMR, etc.) .

2. In the current instance of my organization's EMR, patient records are more extensively complete compared to the previous legacy system (paper documentation, a different EMR, etc.).

3. Documentation within the charts of my patients is more legible compared to the previous legacy system (paper documentation, a different EMR, etc.).

Communication: This survey item is intended to determine how content providers are able to send and obtain messages electronically in order to communicate with their colleagues (Chen et al, 2006).

1. The messaging system in my organizations EMR allows for me to communicate with my colleagues regarding patient care in a timely manner.

2. Receiving messages and sending messages using the EMR systems messaging feature is convenient.

3. The EMR messaging system feature is able to route messages to the correct recipient quickly.

Efficiency: This survey item is projected to determine whether less effort is taken to research web-based literature or review a patient's medical history (Chen et al, 2006). These items also attempt to identify whether providers believe that less effort is exerted to communicate with their colleagues or if it takes less effort to review and interpret lab results for patients (Chen et al, 2006).

1. The organization's EMR allows me to review a patient's medical history with less effort than the previous legacy system.

2. The EMR allows for me to effortlessly review records related to imaging, consents and lab results for my patients.

3. The EMR allows for me to exert less effort when it comes to communicating with my colleagues compared to the previous legacy system (paper documentation, a different EMR, etc.).

Online Tools: This survey item is intended to determine whether there is value to allow providers to access information online through the EMR system (Chen et al, 2006)., i.e. websites that house certain medical protocols.

1. The EMR provides access to external links to literature that is useful in the care of my patients.

2. I am able to reference medical protocols in a timely fashion using external links that are available within the EMR.

3. The EMR allows for me to report out to practice based quality management organizations, such as AQI (Anesthesia Quality Institute) if necessary.

Outside Access to the System: This survey item is intended to determine whether providers like having the ability to access their electronic messages while away from the hospital to review patient history and/or review lab results (Chen et al, 2006). This item also seeks to determine the impact that such access has on their life while away from the hospital.

1.I find it convenient to have the ability to access and review the EMR messaging system while I am away from the hospital.

2.I find it convenient to have the ability to access new patient results while I am away from the hospital.

3. Having access to the EMR system while being away from the hospital infringes on my personal life while I am away from the hospital.

Perceived Patient Satisfaction: This survey is intended to determine how patients observe the use of the EMR and whether the use of the EMR impacts the care that they provide (Chen et al, 2006).

1. My patients express dissatisfaction with my use of the EMR during pre-evaluations and post-operative follow-ups.

2. Patients express more concern about their medical information being captured in an electronic system.

3. Patients enjoy having the ability to review their medical records and results through the EMRs patients centered electronic platform.

Practice of Medicine: This survey item is intended to determine how well constructed the system is to allow for providers to deliver care that is within the scope of their medical practice (Chen et al, 2006).

1. The EMR allows for me to execute my workflow in a logical and precise manner.

2. The EMR allows for me to provide better overall care compared to the previous legacy system (paper documentation, a different EMR, etc.).

3. The EMR allows for me to access patient charts more easily compared to the previous documentation system that the organization utilized (paper or another EMR).

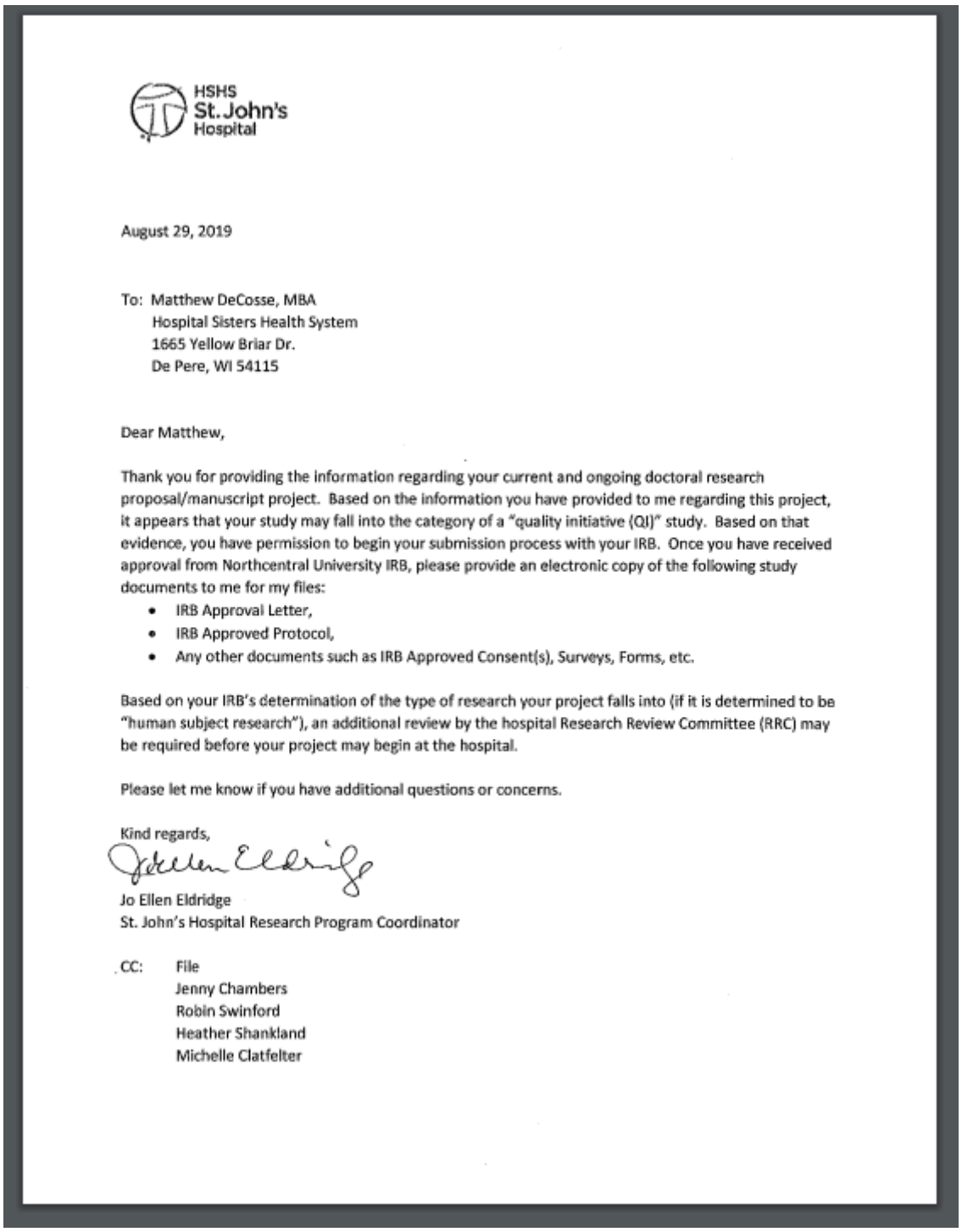
Speed: This survey item is intended to determine the timeliness of completion of tasks that providers perform, i.e. test results are available for viewing sooner, patient summaries are more readily available for viewing and patient questions are addressed more-timely (Chen et al., 2006).

1. I am able to develop a summary of a patient faster using the current instance of the organizations EMR compared to the previous legacy system (paper documentation, a different EMR, etc.).

2. Results related to patient imaging encounters, consents and labs are accessible in a timely manner.

3. If patients have questions regarding a past, recent or future encounter, the EMR allows for me to access the patients chart and provide the answers that they are seeking in a timely manner.

Appendix D: Site Permission from St. John's Hospital, Springfield, Illinois.



HSHS
St. John's
Hospital

August 29, 2019

To: Matthew DeCosse, MBA
Hospital Sisters Health System
1665 Yellow Briar Dr.
De Pere, WI 54115

Dear Matthew,

Thank you for providing the information regarding your current and ongoing doctoral research proposal/manuscript project. Based on the information you have provided to me regarding this project, it appears that your study may fall into the category of a "quality initiative (QI)" study. Based on that evidence, you have permission to begin your submission process with your IRB. Once you have received approval from Northcentral University IRB, please provide an electronic copy of the following study documents to me for my files:

- IRB Approval Letter,
- IRB Approved Protocol,
- Any other documents such as IRB Approved Consent(s), Surveys, Forms, etc.

Based on your IRB's determination of the type of research your project falls into (if it is determined to be "human subject research"), an additional review by the hospital Research Review Committee (RRC) may be required before your project may begin at the hospital.

Please let me know if you have additional questions or concerns.

Kind regards,

Jo Ellen Eldridge
St. John's Hospital Research Program Coordinator

CC: File
Jenny Chambers
Robin Swinford
Heather Shankland
Michelle Clatfelter

Appendix E: Site Permission from St. Mary's Hospital, Decatur, Illinois.

HSHS St. Mary's Hospital

August 29, 2019

To: Matthew DeCosse, MBA
Hospital Sisters Health System
1665 Yellow Briar Dr.
De Pere, WI 54115

Dear Matthew,

Thank you for providing the information regarding your current and ongoing doctoral research proposal/manuscript project. Based on the information you have provided to me regarding this project, it appears that your study may fall into the category of a "quality initiative (QI)" study. Based on that evidence, you have permission to begin your submission process with your IRB. Once you have received approval from Northcentral University IRB, please provide an electronic copy of the following study documents to me for my files:

- IRB Approval Letter,
- IRB Approved Protocol,
- Any other documents such as IRB Approved Consent(s), Surveys, Forms, etc.

Based on your IRB's determination of the type of research your project falls into (if it is determined to be "human subject research"), an additional review by the hospital Research Review Committee (RRC) may be required before your project may begin at the hospital.

Please let me know if you have additional questions or concerns.

Kind regards,

Jo Ellen Eldridge
St. Mary's Hospital Research Program Coordinator

CC: File
Jenny Chambers
Robin Swinford
Heather Shankland
Michelle Clatfelter

Appendix F: Site Permission from St. Francis Hospital, Litchfield, Illinois.

HSHS St. Francis Hospital

September 24, 2019

To: Matthew DeCosse, MBA
Hospital Sisters Health System
1665 Yellow Briar Dr.
De Pere, WI 54115

Dear Matthew,

Thank you for providing the information regarding your current and ongoing doctoral research proposal/manuscript project. Based on the information you have provided to me regarding this project, it appears that your study may fall into the category of a "quality initiative (QI)" study. Based on that evidence, you have permission to begin your submission process with your IRB. Once you have received approval from Northcentral University IRB, please provide an electronic copy of the following study documents to Heather Shankland to be included in the IRB file:

- IRB Approval Letter,
- IRB Approved Protocol,
- Any other documents such as IRB Approved Consent(s), Surveys, Forms, etc.

Based on your IRB's determination of the type of research your project falls into (if it is determined to be "human subject research"), an additional review by the hospital Research Review Committee (RRC) may be required before your project may begin at the hospital.

Please let me know if you have additional questions or concerns.

Kind regards,

James Timpe
HSHS St. Francis Hospital
President & CEO

CC: File
Heather Shankland
Michelle Clatfelter

Appendix G: Site Permission from St. Elizabeth's Hospital, O'Fallon, Illinois.

HSHS St. Elizabeth's Hospital

November 5, 2019

To: Matthew DeCosse, MBA
Hospital Sisters Health System
1665 Yellow Briar Dr.
De Pere, WI 54115

Dear Matthew,

Thank you for providing the information regarding your current and ongoing doctoral research proposal/manuscript project. Based on the information you have provided to me regarding this project, it appears that your study may fall into the category of a "quality initiative (QI)" study. Based on that evidence, you have permission to begin your submission process with your IRB. Once you have received approval from Northcentral University IRB, please provide an electronic copy of the following study documents to Alyssa Eller to be included in the IRB file:

- IRB Approval Letter,
- IRB Approved Protocol,
- Any other documents such as IRB Approved Consent(s), Surveys, Forms, etc.

Based on your IRB's determination of the type of research your project falls into (if it is determined to be "human subject research"), an additional review by the hospital Research Review Committee (RRC) may be required before your project may begin at the hospital.

Please let me know if you have additional questions or concerns.

Kind regards,

Patti Fischer
HSHS St. Elizabeth Hospital
President & CEO

CC: File
Alyssa Eller, Director- Record Compliance
April Simmons, Division Corporate Counsel

One St. Elizabeth's Boulevard
O'Fallon, IL 62269
618-234-2120
www.stelia.org

An Affiliate of Hospital Sisters Health System

Appendix H: Site Permission from St. Joseph's Hospital, Breese, Illinois.

HSHS St. Joseph's Hospital Breese

9515 Holy Cross Ln
PO Box 99
Breese, IL 62230
(618) 526-4511
www.stjoebreese.com

November 6, 2019

Matthew DeCosse, MBA
Hospital Sisters Health System
1665 Yellow Briar Dr.
De Pere, WI 54115

Dear Matthew,

Thank you for providing the information regarding your current and ongoing doctoral research proposal/manuscript project. Based on the information you have provided to me regarding this project, it appears that your study may fall into the category of a "quality initiative (QI)" study. Based on that evidence, you have permission to begin your submission process with your IRB. Once you have received approval from Northcentral University IRB, please provide an electronic copy of the following study documents to Alyssa Eller to be included in the IRB file:

- IRB Approval Letter,
- IRB Approved Protocol,
- Any other documents such as IRB Approved Consent(s), Surveys, Forms, etc.

Based on your IRB's determination of the type of research your project falls into (if it is determined to be "human subject research"), an additional review by the hospital Research Review Committee (RRC) may be required before your project may begin at the hospital.

Please let me know if you have additional questions or concerns.

Kind regards,

Chris Klay
HSHS St. Joseph's Hospital, Breese
President & CEO

CC: File
Alyssa Eller, Director- Record Compliance
April Simmons, Division Corporate Counsel

Appendix I: Site Permission from St. Joseph's Hospital, Highland, Illinois.

HSHS St. Joseph's Hospital Highland

November 6, 2019

Matthew DeCosse, MBA
Hospital Sisters Health System
1665 Yellow Briar Dr.
De Pere, WI 54115

Dear Matthew,

Thank you for providing the information regarding your current and ongoing doctoral research proposal/manuscript project. Based on the information you have provided to me regarding this project, it appears that your study may fall into the category of a "quality initiative (QI)" study. Based on that evidence, you have permission to begin your submission process with your IRB. Once you have received approval from Northcentral University IRB, please provide an electronic copy of the following study documents to Alyssa Eller to be included in the IRB file:

- IRB Approval Letter,
- IRB Approved Protocol,
- Any other documents such as IRB Approved Consent(s), Surveys, Forms, etc.

Based on your IRB's determination of the type of research your project falls into (if it is determined to be "human subject research"), an additional review by the hospital Research Review Committee (RRC) may be required before your project may begin at the hospital.

Please let me know if you have additional questions or concerns.

Kind regards,

John Ludwig
HSHS St. Joseph's Hospital, Highland
President & CEO

CC: File
Alyssa Eller, Director-Record Compliance
April Simmons, Division Corporate Counsel

12866 Troxler Avenue, Highland, IL 62249
(618) 651-2600

www.stjosephshighland.org

An Affiliate of Hospital Sisters Health System

Appendix J: Site Permission from St. Anthony's Hospital, Effingham, Illinois.

HSHS
St. Anthony's
Memorial Hospital

November 7, 2019

To: Matthew DeCosse, MBA
Hospital Sisters Health System
1665 Yellow Briar Dr.
De Pere, WI 54115

Dear Matthew,

Thank you for providing the information regarding your current and ongoing doctoral research proposal/manuscript project. Based on the information you have provided to me regarding this project, it appears that your study may fall into the category of a "quality initiative (QI)" study. Based on that evidence, you have permission to begin your submission process with your IRB. Once you have received approval from Northcentral University IRB, please provide an electronic copy of the following study documents to Alyssa Eller to be included in the IRB file:

- IRB Approval Letter,
- IRB Approved Protocol,
- Any other documents such as IRB Approved Consent(s), Surveys, Forms, etc.

Based on your IRB's determination of the type of research your project falls into (if it is determined to be "human subject research"), an additional review by the hospital Research Review Committee (RRC) may be required before your project may begin at the hospital.

Please let me know if you have additional questions or concerns.

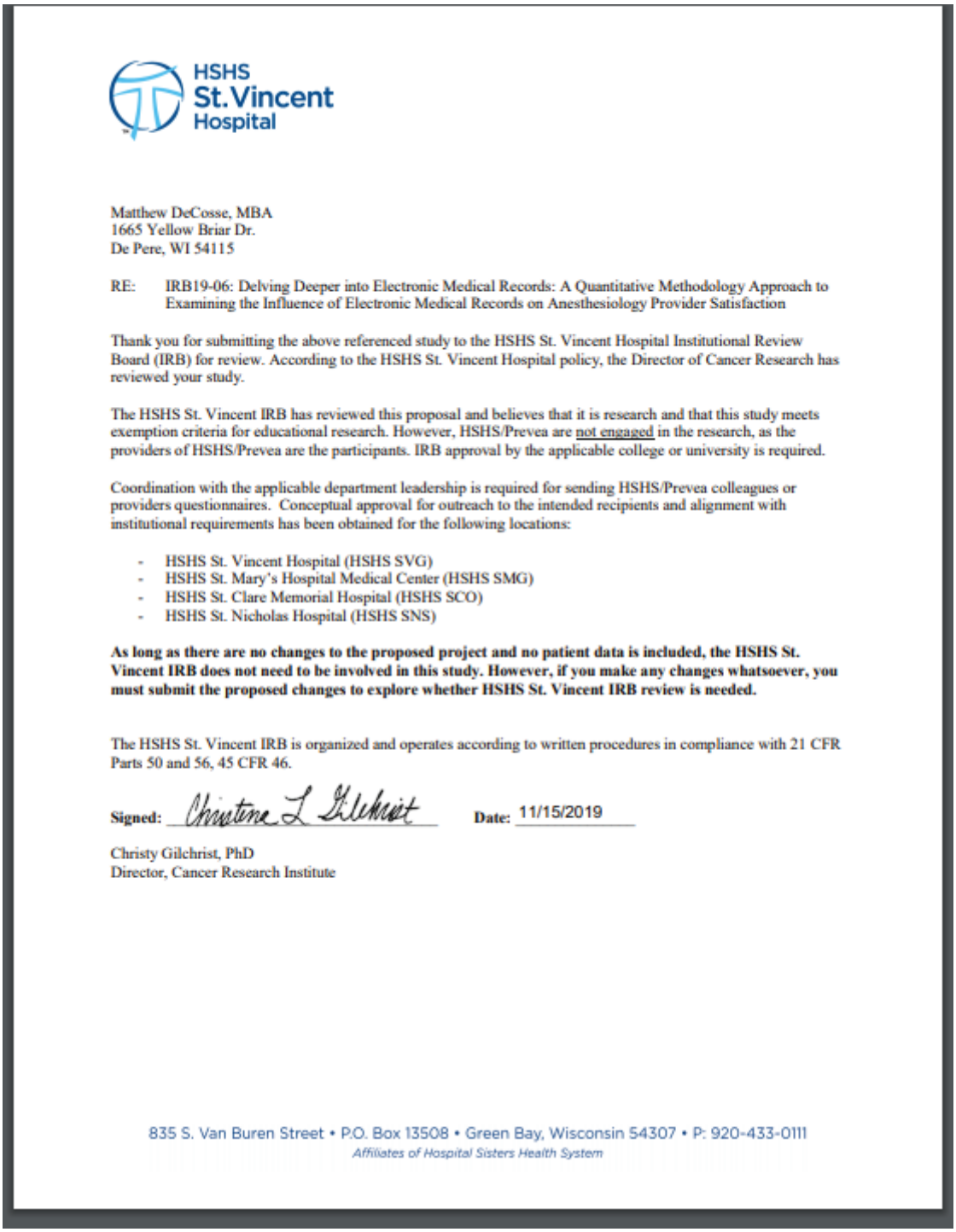
Kind regards,

Theresa Rutherford
HSHS St. Anthony's Memorial Hospital
President & CEO

CC: File
Alyssa Eller, Director-Record Compliance
April Simmons, Division Corporate Counsel

503 N MAPLE • EFFINGHAM, IL 62401
www.stanthonyshospital.org • 217.342.2121

Appendix K: Site Permission approvals from St. Vincent Hospital (HSHS SVG), St. Mary's Hospital Medical Center (HSHS SMG), St. Clare Memorial Hospital (HSHS SCO) and St. Nicholas Hospital (HSHS SNS) in Wisconsin.



HSHS St. Vincent Hospital

Matthew DeCosse, MBA
1665 Yellow Briar Dr.
De Pere, WI 54115

RE: IRB19-06: Delving Deeper into Electronic Medical Records: A Quantitative Methodology Approach to Examining the Influence of Electronic Medical Records on Anesthesiology Provider Satisfaction

Thank you for submitting the above referenced study to the HSHS St. Vincent Hospital Institutional Review Board (IRB) for review. According to the HSHS St. Vincent Hospital policy, the Director of Cancer Research has reviewed your study.

The HSHS St. Vincent IRB has reviewed this proposal and believes that it is research and that this study meets exemption criteria for educational research. However, HSHS/Prevea are not engaged in the research, as the providers of HSHS/Prevea are the participants. IRB approval by the applicable college or university is required.

Coordination with the applicable department leadership is required for sending HSHS/Prevea colleagues or providers questionnaires. Conceptual approval for outreach to the intended recipients and alignment with institutional requirements has been obtained for the following locations:

- HSHS St. Vincent Hospital (HSHS SVG)
- HSHS St. Mary's Hospital Medical Center (HSHS SMG)
- HSHS St. Clare Memorial Hospital (HSHS SCO)
- HSHS St. Nicholas Hospital (HSHS SNS)

As long as there are no changes to the proposed project and no patient data is included, the HSHS St. Vincent IRB does not need to be involved in this study. However, if you make any changes whatsoever, you must submit the proposed changes to explore whether HSHS St. Vincent IRB review is needed.

The HSHS St. Vincent IRB is organized and operates according to written procedures in compliance with 21 CFR Parts 50 and 56, 45 CFR 46.

Signed: Christine L Gilchrist **Date:** 11/15/2019

Christy Gilchrist, PhD
Director, Cancer Research Institute

835 S. Van Buren Street • P.O. Box 13508 • Green Bay, Wisconsin 54307 • P: 920-433-0111
Affiliates of Hospital Sisters Health System

Appendix L: Northcentral University's Institutional Review Board's Approval Letter

NCU Approved Date Stamp
December 17, 2019

Northcentral University

2488 Historic Decatur Road, Suite 100, San Diego, CA 92106 | www.ncu.edu

Date: December 17, 2019
PI Name: Matthew DeCosse
Chair Name (if applicable): Carissa Smock
Application Type: Initial Submission
Review Level: Exempt - Category 2
Study Title: Delving Deeper into Electronic Medical Records: A Quantitative Methodology Approach to Examining the Influence of Electronic Medical Records on Anesthesiology Provider Satisfaction

Approval Date: December 17, 2019
Expiration Date: December 16, 2020

Dear Matthew:

Congratulations! The purpose of this letter is to inform you that your IRB application has been approved. Your responsibilities include the following:

1. Follow the protocol as approved. If you need to make changes, please submit a modification form requesting approval of any proposed changes before you make them.
2. If there is a consent process in your research, you must use the consent form approved with your final application. Please make sure all participants receive a copy of the consent form.
3. Continuing review is required as long as you are in data collection or if data have not been de-identified. Failure to receive approval of the continuing review before the expiration date means the research must stop immediately.
4. If there are any injuries, problems, or complaints from participants, you must notify the IRB at IRB@ncu.edu within 24 hours.
5. IRB audit of procedures may occur. The IRB will notify you if your study will be audited.
6. When data are collected and de-identified, please submit a study closure form to the IRB.
7. You must maintain current CITI certification until you have submitted a study closure form.
8. If you are a student, please be aware that you must be enrolled in an active dissertation course with NCU in order to collect data.

Congratulations from the NCU IRB. Best wishes as you conduct your research!

Respectfully,

Northcentral University Institutional Review Board
Email: irb@ncu.edu

2488 Historic Decatur Rd., Suite 100, San Diego, CA 92106 USA
www.ncu.edu · p: 928-541-8014 · f: 928-515-5519