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Exploring Strategies Hospital Leaders Use to Reduce Costs of Medication Administration Errors

ANTHONY ODILI
Walden University

Walden University

College of Management and Technology

This is to certify that the doctoral study by

Anthony Odili

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
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Review Committee
Dr. Lisa Cave, Committee Chairperson, Doctor of Business Administration Faculty

Dr. Stella Rostkowski, Committee Member, Doctor of Business Administration Faculty

Dr. Deborah Nattress, University Reviewer, Doctor of Business Administration Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
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Abstract

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MBA, Walden University, 2013

BS, University of Port Harcourt, 1997

Doctoral Study Submitted in Partial Fulfillment

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Abstract

Medication administration errors occur in hospitals resulting in adverse negative effects, including deaths. Hospital leaders are responsible for promoting patient safety and reducing harm and costs from medication administration errors. Grounded in complex adaptive systems theory with Six Sigma, the purpose of this qualitative multiple case study was to explore strategies hospital leaders adopted to reduce the costs of medication administration errors. The participants were five hospital leaders who successfully reduced the costs of medication administration errors. Data were collected through semistructured interviews and a review of the hospital's financial records. Through thematic analysis, four themes emerged: education, communication, use of technology, and continuous audits. A key recommendation is for hospital leaders to educate clinicians, maintain communication, use new technological devices to improve internal processes, and maintain audits. The implications for positive social change include the potential to improve the quality of care for people in the community.

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Dedication

I dedicate this doctoral research to God, for giving me the perseverance to deal with the vicissitudes of life. And for showing me a reason to live when I almost took my life. I also dedicate it to my family for their guidance, love, and support. To you daddy, mummy, Chidi, Ada, Uche, and Anupu. To my daughters Nkemjika and Nkwachi. And to you LJ for your love and support.

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This doctoral research would not have been completed without the assistance and feedback from my Chair, Dr. Lisa Cave. I struggled immensely as life threw curve balls at me and these impacted my doctoral work. Throughout these phases, Dr. Cave was there, guiding, coaching, mentoring, and encouraging me. Thank you. I also thank my second committee member, Dr. Stella Rostkowski for her feedback and support. I further thank the URR, Dr. Deborah Nattress for her feedback and support.

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Section 1: Foundation of the Study

Medication administration errors occur in healthcare organizations. Encinosa and Bernard (2005) revealed that at least 10% of adults reported that they or a family member experienced a medical error in a hospital. Healthcare professionals are obligated to prevent avoidable errors that are detrimental and potentially fatal for patients (Shingler-Nace et al., 2019).

Medication error is one of the most common events threatening patient safety (Farzi et al., 2020; Keers et al., 2018). Medication administration errors occur in hospitals across the United States. These errors not only cause injuries and negative outcomes for patients but can lead to mortality. Hospitals are responsible for providing treatment for patients suffering from medication administration errors and this significantly increases hospital costs (Márquez-Hernández et al., 2019).

Understanding the process and changing the culture of response by hospital leaders is one way to minimize the risk of reoccurrence (Shingler-Nace et al., 2019). Apart from other adverse effects and loss of human lives from medication administration error occurrences, preventable medical errors cost the U.S. healthcare system approximately $4.2 billion annually (Hong et al., 2019). The continued occurrence of medication administration errors is a cause for alarm because of its potential to engender avoidable costs for healthcare organizations. Hospital leaders should adopt effective strategies to reduce medication administration errors which in addition to improving patient outcomes could reduce costs (Yallew et al., 2017).

It is essential for hospital leaders to reduce medication administration error occurrences. In this multiple case study, I explored strategies that hospital leaders utilized to reduce medication administration errors. The results of this study could enable hospital leaders to develop strategies to improve care delivery, enhance patient safety, and reduce medication administration errors to reduce costs.

Background of the Problem

In the United States, medication administration errors occur in healthcare organizations. Medication administration errors not only inflict harm on patients but are also costly to the healthcare institution. Encinosa and Bernard (2005) estimated that between 44,000 and 98,000 Americans die each year as a result of medical errors. Goolsarran et al. (2018) further revealed that medical errors claim 400,000 lives each year and is the third leading cause of death in America. Medical errors occur in many forms as medication errors, incorrect physician orders, and hospital-acquired infections including pressure ulcers, urinary tract infections, and others (Goolsarran et al., 2018). The control of medical errors should be one of the utmost priorities of any healthcare organization considering costs incurred from medical errors may be avoidable. Broyles et al. (2009) indicated that hospital costs were significantly higher when medical errors occur. Hospital leaders have a role in the prevention of medical error occurrences, in changing hospital workers' practices when they do not conform to established protocols, and in reducing costs to sustain company finances. When hospital leaders effectively limit medical error outbreaks, improvements in patient safety may be attained which may limit the financial burden of unfavorable clinical outcomes caused by medical errors.

Problem Statement

Hospital errors claimed 251,000 lives each year in the United States from 1999 to 2013 (Makary & Daniel, 2016, p. 2). Patient harm from hospital errors decreased hospital revenue (Adler et al., 2018, p. 67). Uğurlu and Vural (2020, p. 404) reported that hospital errors caused about $20 billion in additional costs each year. The general business problem is that medication administration errors contribute to rising costs in hospitals. The specific business problem is that some hospital leaders lack strategies to reduce medication administration errors to reduce costs.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies hospital leaders used to reduce the costs of medication administration errors. The target population for this study consisted of five hospital leaders who successfully reduced costs from reduced medication administration errors within their respective organizations located in Nevada. The result of this study could contribute to positive social change by helping hospital leaders develop strategies to reduce medication administration errors, enhance the trust of patients in hospitals, improve patient care, and improve the health of people in local communities.

Nature of the Study

Daniel (2018) reported that research methodologies include quantitative, qualitative, and mixed methods. Researchers use the quantitative methodology to characterize variables and explain variables' relationships by testing hypotheses (Daniel, 2018). The purpose of this study was not to examine variables' characteristic or

relationships through testing hypotheses. Therefore, the quantitative method was not appropriate to answer the research question. Researchers use the qualitative method to ascertain how participants perceive real-life events by asking open-ended questions (Yin, 2018). Researchers also use the qualitative methodology to collect in-depth data from participants with shared experiences and provide an explanation of the phenomenon (Lanka et al., 2021). Therefore, the qualitative methodology was appropriate to answer the research question. Using the mixed method requires including both the qualitative and quantitative methodology (Leppink, 2017). Since my study did not require using the quantitative method to answer the research question, the mixed methodology was not suitable.

Qualitative research designs such as phenomenological, ethnographic, and case study are options that I considered. Alfakhri et al. (2018) indicated that researchers use a phenomenological design to explain the meanings of lived experiences of individuals. I did not explain the meanings of lived experiences of individuals in this research, so the phenomenological design was not suitable. Researchers use the ethnographic research design to immerse themselves in the culture and traditions of a group (Chew & Armstrong, 2017). I did not explore the culture and traditions of hospital leaders, so the ethnographic design was also not suitable for this study. Researchers use the case study design to investigate a real-life phenomenon within its environmental context (Riddler, 2017). I used the case study design to investigate strategies hospital leaders used to reduce cost of medication administration errors in this study. A single case design requires a careful investigation to avoid misrepresentation and vulnerability, whereas data

gathered from multiple sources in a multiple case study will elicit more compelling information (Yin, 2018). I chose the multiple case study design for this research over a single case study design to enable obtaining more compelling information that can be compared across the cases.

Research Question

The central research question in this case study is: What strategies do hospital leaders adopt to reduce medication administration errors to reduce costs?

Interview Questions

1. How did you perceive the issue of medication administration error in your hospital?
2. How did you arrive at this perspective?
3. What successful strategies did you implement to reduce medication administration errors and their derivative costs?
4. What key challenges did you face during the implementation of successful strategies?
5. How did you overcome the key challenges in implementing the strategies?
6. What assessment tool(s) did you use to measure the success of the strategies?
7. What methods did you use to sustain the strategies during the implementation process?
8. What additional information can you provide about your strategy to reduce medication administration error occurrences that resulted in reducing costs?

Conceptual Framework

In this multiple case study, I used the complex adaptive systems (CAS) theory with Six Sigma DMAIC quality improvement process as the conceptual framework. Originated at the Santa Fe Institute in 1984, Holland (1992) stated that the pivotal characteristic of a CAS is the ability of parts to change or adapt. Holland (1992) indicated that a CAS has three characteristics: (a) evolution, (b) aggregate behavior, and (c) anticipation. Evolution implies that system units adapt, aggregate behavior connotes that a unique behavior is exhibited, and anticipation implies the presumption of a changing circumstance and forming rules to counter it (Holland, 1992). Norberg and Cumming (2013) noted that a change in a person's behavior following an encounter is adaptive if the same person, facing the identical situation as before, makes a different decision based on improved understanding. Whereas an organization adapts when individual system components collectively respond to change.

Six Sigma was developed by a Motorola engineer in 1986 as a response to the necessity for improving quality and reducing defects (Montgomery & Woodall, 2008). Six sigma is based on the use of a structured tools and techniques; define, measure, analyze, improve and control (DMAIC) designed to help organizations define and measure performance gaps, analyze underlying causes and potential solutions, implement effective improvements and sustain control of processes to meet established performance metrics (Madhani, 2020). Hospital leaders can use Six Sigma DMAIC to find and eliminate causes of defects or mistakes in business processes by focusing on process outputs which are critical (Madhani, 2020).

Holland and Miller (1991) revealed that human behavior is driven by adaptation, and improvements in a CAS occurs regularly. Since hospitals are made up of units that form the hospital system and adapt collectively to change, hospital leaders, aware of new information, could develop rules to establish that change. As McDaniel et al. (2009) reported, learning by diverse agents leads to self-organization, so the CAS theory through adaptive change may enable hospital leaders to recognize the need to change employee behavior, identify ineffective policies, improve their strategies and effectuate change in their organizations.

Hospital leaders jointly using the CAS and Six Sigma DMAIC strategies will identify opportunities to eliminate waste, unwanted variation, and errors in business practices, all of which increase costs (Madhani, 2020). I used a composite framework of CAS and DMAIC to facilitate my understanding of how the participating hospital leaders identified existing internal causes of medication administration errors, developed solutions, reorganized processes, implemented effective improvements and sustained the control of these initiatives to ensure that medication administration errors and their costs were reduced.

Operational Definitions

Complex adaptive system theory: A CAS is a system of units which evolves and dynamically reorganizes its components in ways better suited to survive in its environment (Assoudi, & Lounis, 2015). When applied to organizational management, the CAS theory may provide a framework where hospital leaders will use its tenets not just to educate staff or change their behavior but also to improve work performance.

Hospital leader: The use of the term hospital leader in this multiple case study refered to a healthcare professional at a manager, director, or other administrative position with the capacity to provide oversight to a work unit, a group of or all employees. Mazzoccoli and Wolf (2016) reported that a leader provides support to subordinates and can accomplish well-defined established goals. The hospital leader should be knowledgeable and experienced in identifying medical errors.

Medical error: While there is no consensus definition of what a medical error is, in this research study, a medical error refered to an act of commission or omission that caused or contributed to the cause of an unintended injury (Elder et al., 2006) to a patient while in the care of hospital workers.

Assumptions, Limitations, and Delimitations

Assumptions

An assumption is a belief held to be true. Iessa et al. (2017) reported that because many statements are not backed up by empirical findings, they are considered assumptions. In this research study, I assumed that the participants have the requisite knowledge of medication administration errors and provided true and honest answers to the open-ended questions. I also assumed that hospital personnel delivered quality healthcare to patients when admitted.

Limitations

A limitation may influence a researcher's work. Helmich et al. (2015) reported that a limitation is a constraint beyond the researcher's control. The location of this research study was Las Vegas, Nevada, so a potential limitation is that the study may not

be reproduced or transferable to other geographical locations. The participants were from different hospitals and their feedback may be from generalizations of their various hospitals. Similarly, the participants' responses to the open-ended questions were based on their knowledge and experience of correcting medication administration error occurrences. Lastly, the results of this study may only apply to the healthcare industry.

Delimitations

Factors or variables intentionally omitted from a research study are referred to as delimitations (Leedy & Ormond, 2005). In this study, the participants had experienced curbing medication administration errors in their various healthcare organizations. I did not specifically discuss all types of medical errors but focused on medication errors which may not be generalizable to all medical errors. While this study was conducted in Las Vegas, with feedback from five different hospital leaders, the results may be delimited and not representative of all healthcare organizations.

Significance of the Study

Contribution to Business Practice

The findings from this multiple case study could provide information which hospital leaders can utilize to develop strategies to reduce medication administration error occurrences and reduce costs. Findings from this multiple case study could also reveal how hospital leaders could formulate specific hospital policies to direct the behavior and actions of employees to reduce medication administration error occurrences. In addition, the study's findings may be of significance to hospital leaders responsible for improving patient care and reducing costs. As Hessels and Larson (2016) reported, improved

reimbursement for hospitals, enhanced cost savings and decreased patient mortality result when fewer errors occur.

Implications for Social Change

Knowledge derived from my multiple case study's findings may enable hospital leaders to adopt strategies that could be used to reduce medication administration error occurrences and reduce costs. Hospital leaders may also gain awareness of effective strategies for reducing medication administration errors and improving patient care. Furthermore, hospital leaders implementing effective strategies for the reduction of medication administration errors, could reduce hospitalization days and improve patient outcomes (Hong et al., 2019). A positive patient outcome may enhance an individual's health status, which indicates the effectiveness of the quality of the care (Shingler-Nace et al., 2019) and this may lead to an improvement of care for the people in communities thus advancing positive social change.

A Review of the Professional and Academic Literature

The purpose of this literature review was to consider the business and social implications of medication administration errors and strategies to reduce them. In this multiple case study, I explored strategies that hospital leaders adopted to reduce medication administration errors to reduce costs in hospitals in the Nevada area. I also reviewed published literature regarding medication administration errors and discussed the conceptual framework in the study. The conceptual framework for this study was the CAS with Six Sigma DMAIC theory. The literature review consisted of scholarly articles from the following sources: ABI/INFORM, Business Source Complete, EBSCO,

MEDLINE with Full Text, ProQuest Health & Medical Collection, ProQuest Nursing & Allied Health Source, PsycINFO, PubMed, Emerald Insight, Sage Journals, Ovid Nursing Journals Full Text, and Google Scholar. Ninety-three percent of the articles are from peer-reviewed journals and 93% are published within the past 5 years. Keywords that I searched for included: *medication administration error, medical error, adverse drug events, patient safety, hospital leadership, healthcare quality, complex adaptive system theory,* and *six sigma*.

The purpose of this literature review was to consider the business and social implications of medication administration errors and strategies to reduce them. Firstly, I discussed medical and medication administration errors and indicated how these topics related to the conceptual framework. I presented an overview of adverse medical events (AMEs), patient safety, and medical errors emphasizing medication administration errors. I discussed the causes of medical and medical administration errors, including the human and system factors, the role of hospital leaders, and related them to the conceptual framework. After reviewing supporting and contrasting models, I concluded the literature review by making a business case for hospital leaders to explore strategies to reduce medication administration errors to reduce costs. I reviewed 144 sources, and 134 (93%) of them were peer-reviewed. I used Ulrich's periodicals directory accessed through Walden University Library to verify the peer-review status of the sources. Table 1 details a summary of the literature review sources.

Table 1

Summary of the Literature Review Sources

Reference type	Total	2016-2021	<2016
Peer-reviewed journals	134 (93%)	126 (93%)	8 (8%)
Non-peer reviewed journals	9 (6%)	9 (7%)	0
Websites	1 (1%)	0	0
Total	144 (100%)	135 (100%)	8 (100%)

CAS/Six Sigma DMAIC

The CAS theory with six sigma quality improvement processes was the conceptual framework for this multiple case study. Originated at the Santa Fe Institute in 1984, Holland (1992) stated that the pivotal characteristic of a CAS is the ability of parts to change or adapt. Complex adaptive systems are systems that consist of numerous interacting agents that behave independently, engage in co-evolution, resulting in complex behaviors (McBride & Draheim, 2020). CAS theory is defined as the dynamic ability of systems to adapt and evolve to changes in an environment (Yaroson, et al., 2021). CAS theory can be used to explain the nature of the interdependencies and interactions among agents within a system, and how they can be managed (Dentoni et al., 2021). While CAS focuses on the interactions between the agents and their changing environment (Rooney & Cao, 2019; Yaroson et al., 2021), the principles of CAS can be used to define behavior (Burrows et al., 2020).

In a CAS, the interactions are unpredictable, self-organizing, adaptable, and evolving (Turner & Baker, 2020). The adaptive tenet of a CAS implies that agents can

evolve and learn, and as such it is this adaptation that ensures that agents cope with the uncertainties inherent in a complex system (Orr et al., 2018). Since these agents interact in different functions and sometimes with conflicting goals and preferences, these interactions could result in positive or negative outcomes for organizations or their subunits (Orr et al., 2018). Although the complex, dynamic nature of a CAS makes outcomes difficult to control (Newton-Lewis et al., 2021), order emerges as agents adapt to conditions and changes (Reilly et al., 2019). Since CAS has heterogeneous and interacting adaptive agents, its principles are a useful tool for transformation (Starnes-Ott et al., 2020).

Self-organization and emergence are fundamental attributes of a CAS (Werder & Maedche, 2018). While self-organization is a process where new internal structures arise, emergence connotes that new, unexpected processes result from the collective behavior of agents (Werder & Maedche, 2018). While agents work in parallel, they also interact with each other to formulate a response to multiple issues affecting an organization (Fidan & Balci, 2017; Werder & Maedche, 2018). As such, in a CAS like a hospital, self-organization and emergence could enable agents to interact and develop new processes, form new actions plans which could lead through their collective behavior to innovations within the hospital.

Complex adaptive systems have many moving parts, teeter between equilibrium and disequilibrium, and are unpredictable (Van Nuland et al., 2020). These parts are characterized by uncertainty both from within and outside (Van Nuland et al., 2020). Regardless of this uncertainty, complex adaptive systems can optimize their performance

when they function as interrelated network of mutually dependent components (Fidan & Balci, 2017). These components can have a large effect on the overall system and produce unpredictable results (Orr et al., 2018). In hospitals, these unpredictable results could lead to medication administration error occurrences which could decrease quality of care given and cause other adverse effects for patients. Interdisciplinary hospital teams can focus more on team members' interaction with each other rather than on the characteristics of individual team members to enhance hospital processes and harmonize results for patients (Pype et al., 2018). To further mitigate unpredictable results, leaders could apply CAS principles to align the interconnectivity of hospital subunits allowing for more effective information and knowledge diffusion (Statsenko et al., 2018).

Complex adaptive systems are in a constant state of flux as they undertake transformations (Kennedy, 2020). The heterogenous agents interacting in this state of flux adapt to each other's actions and this results in behavioral and transformational change (Gomersall, 2018). Each aspect of the transformation is characterized by obstacles that must be overcome by agents practicing excellence to change their actions in organizations (Kennedy, 2020). Agents must practice excellence continually for the organization to be relevant (Kennedy, 2020). Leadership must use control parameters to shepherd all stakeholders during this transformational process to attain system objectives (Freeburg, 2020). The CAS theory could be used by hospital leaders to design better interventions and enhance existing processes to ensure behavior change (Gomersall, 2018).

Leaders use a CAS framework when considering quality improvement programs within organizations (Ellis & Herbert, 2011). CAS has three main characteristics: (a) evolution, (b) aggregate behavior, and (c) anticipation (Holland, 1992).

Evolution

Evolution implies that system units adapt (Holland, 1992). Researchers have used the evolution element of CAS to explain human responses to problem-solving and evolutionary change processes within organizations (Chaffee & McNeill, 2007; Ellis & Herbert, 2011). Through evolution in a CAS, leaders can change their leadership styles and utilize new ways to solve complex problems in their organizations (Bar-Yam, 2003; Calvano & John, 2004; Schneider & Somers, 2006).

The evolution component of CAS is useful because through interaction, agents change their routine to adapt to their environment, and exchange resources resulting in outcomes (Kazakov et al., 2021). These outcomes could be positive for improvement of work processes and improvements. Lizier and Reich (2021) found that through evolutionary learning, agents adapted to emerging demands resulting in positive work outcomes. Forrest and Mitchell (2016) found that evolution was pertinent because it enabled agents to change their behavior to improve work performance.

Aggregate Behavior

Aggregate behavior connotes that a unique behavior is exhibited which results from the interaction of the component parts (Holland, 1992). In a CAS, the aggregate behavior of the agents changes over time, resulting in complex problems (Kazakov et al., 2021). Agents change their behavior to adapt to the environment, which produces effects

(Kazakov et al., 2021). In a CAS such as a hospital, multiple subsystems with interconnected agents, resource structures, and processes exist. They include doctors, patients, drugs and drug suppliers, hospital workers, and regulators' whose interrelations evolve and change together (Kazakov et al., 2021). When agents interrelate, behaviors change, and these changes could lead to noncompliance of hospital practices which could further result in medication administration errors and adverse outcomes for patients.

In a CAS, new behavior and interactions emerge from single agents and the overall system (Hodiamont et al., 2019). Since aggregate behavior emerges from the interaction of parts, it is pertinent to modify it (Holland, 1992). Hospital leaders could modify employee behaviors to conform to set standards. Leaders have used aggregate behavior outcomes of a CAS to improve work processes and achieve company goals (Herrera-Restrepo & Triantis, 2019).

Anticipation

Anticipation means the presumption of a changing circumstance and the formation of rules to counter it (Holland, 1992). As the agents in a CAS interact, some of the behaviors exhibited could be contrary to rules of the organization which may impede workflows and result in negative consequences for the company. Organizational leaders could use the anticipation tenet of the CAS theory to formulate policies and provide rules for employees to follow. Herrera-Restrepo and Triantis (2019) found that anticipation could enable leaders to develop policies that positively influence operations and facilitate the achievement of company goals. Haraguchi (2020) also found that through anticipation of the CAS, organizational leaders have improved work responses and operations.

In a CAS like a hospital, leaders could generate, implement, and adapt new ideas to innovate existing processes (Glover et al., 2020). Similarly, hospital leadership, which provides oversight, could monitor agents' interactions and collaborations, and based on innovative actions to emerging problems, set new rules which could engender newer behaviors from agents (Ellis & Herbert, 2011). When hospital personnel interact, deliver medical care and cause medication administration errors, this results in negative outcomes for patients and increased hospital costs. Hospital leaders could use the CAS to develop new action plans, effectuate change in their organizations, reduce medication administration error occurrences and reduce costs.

Managing a CAS can be very challenging, especially when attempting to manage complexity (Rosenhead, 2006). While the emergent behaviors and agents' attitudes toward change may be critical for successful innovations, these innovations may require a different approach to be successfully implemented (Glover et al., 2020). However, the CAS theory provides a valuable lens through which to understand the complex nature of hospital systems, and it also offers useful innovation tenets that could enable hospital leaders to effectuate change within their organizations (Han et al., 2021). In addition, hospital leaders in a CAS must determine the right balance of emergent versus controlled behavior to achieve and sustain change (Glover et al., 2020).

Six sigma is a quality improvement strategy developed in 1986 and aimed at reducing defects (Montgomery & Woodall, 2008). Six sigma is a useful metric for gauging the success of business initiatives and creating efficiency (Dreachslin & Lee, 2007). Six sigma became prominent as a strategy that business leaders use to improve

internal processes, effective practices, and for problem-solving (Mast & Lokkerbol, 2012). Six sigma is a comprehensive improvement method used in business to achieve and sustain success (Patil et al., 2020). Six sigma is a disciplined data driven approach which focuses on the minimizing and elimination of defects in any process (Kansal & Singhal, 2017).

Six sigma is a proven methodology to achieve breakthrough improvement in process performance that generates significant savings to bottom line of an organization (Narula & Grover, 2017). Six sigma is an organized and systematic method for strategic process improvement and for development of new products and services (Kansal & Singhal, 2017). Six sigma demonstrates the vital linkages between process improvement and process variation (Narula & Grover, 2017).

Six sigma methodology is used by organizations to identify and implement improvements that leads to an increased confidence in the quality of the product produced or services delivered at all levels (Karout & Awasthi, 2017). Other benefits of the Six sigma methodology include identifying and eliminating defects, setting performance goals, enhancing value to customers, and achieving strategic objectives (Patil et al., 2017). Six sigma brings real benefits to the companies that have implemented the methodology and is a veritable strategy for enhanced business performance (Mueller & Cross, 2020).

Six sigma business strategy is used to design processes, eliminate wastes, identify process variations and their root causes, and improve processes (Furterer, 2018). Six sigma continues to be a good business initiative and has been used for improvements on

product quality (Ulfah et al., 2021). Six sigma trims down wastes and generates improvement (Gupta et al., 2017).

Six sigma is based on the use of a structured tools and techniques (DMAIC) designed to help organizations define and measure performance gaps, analyze underlying causes and potential solutions, implement effective improvements and sustain control of processes to meet established performance metrics (Hakimi et al., 2018; Madhani, 2020). Six sigma DMAIC quality improvement strategies could provide hospital leaders with guidelines to improve the service delivery process towards reducing medication administration error occurrences, thereby reducing costs.

Ahmed, 2019; Patil et al., 2020; Ponsiglione et al., 2021; Smętkowska & Mrugalska, 2018 suggested that to accomplish objectives using the DMAIC strategy, the following steps should be taken:

1. Hospital leaders must clearly define the project, the objective, the scope for the team, what it should accomplish, and both hospital leaders and the team should agree on the problem.
2. Hospital leaders should identify the input and outcome measurements such as conducting process level data collection, establishing baseline metrics, logically placing array data in visual depictions and following statistical rigor.
3. Hospital leaders should analyze the information collected in the measurement phase to identify the sources of delays, waste and poor

quality in the service process, and teams discover new problems in this phase.

4. Hospital leaders could make improvements when the team eliminates the root causes of defects which have influenced the process, makes changes that increases waste and costs related to the customer needs, and uses common tools and strategies to select the best alternatives to meet the customers' need.
5. Hospital leaders could control the variables critical to process performance, track it, ensure that all team members are working on the same set of updated procedures to achieve sustainable solutions.

Hospital operations are composed of complex interconnected systems or subunits which deal with complex tasks (Ahmed, 2019). The complexity is the state of having many different parts connected or related to each other in a complicated manner (Johnson et al., 2018). Complex problems can overwhelm systems that cannot adapt quickly enough, address multiple issues simultaneously, or process information quickly enough to make effective decision-making possible (Johnson et al., 2018). Hospital personnel should work through different internal systems, policies, and protocols to administer medical care to patients. Hospital personnel through their actions in this CAS, may cause medication administration errors, which could engender adverse outcomes for patients.

Since it is impossible to eliminate human error, hospital leaders must reduce medication administration error occurrences and reduce corresponding costs. Other clinicians should support the implementation and success of patient-centered initiatives as

part of a quality-improvement program and organizational learning (Sanchez et al., 2017). Hospital leaders should create a culture of safety in hospitals in which clinicians can work interactively. Safety culture is fundamental for avoiding patient harm and emphasizes the improvement of systems rather than blaming individual people (Mueller et al., 2019). A culture of safety should address human fallibility by concentrating on the conditions under which people work and building defenses to avert errors or mitigate their effects and not focus on the errors of individual people (Mueller et al., 2019).

In current general use, researchers have utilized the CAS/Six sigma frameworks to improve work processes, the delivery and quality of care and to reduce organizational costs (Barach & Kleinman, 2018; Mahajan et al., 2019). In organizations, agents react unpredictably to attempts at control, resulting in the need by leaders to apply both CAS and six sigma principles to modify their behavior (Mahajan et al., 2019). As these agents experiment and gain experience, they learn and system behavior changes over time (Hodges & Larranaga, 2021; Kok et al., 2021; Mahajan et al., 2019). Also, organizational leadership achieves influence over agent behavior by shifting the balance in behavior towards collaboration, cooperation, and coordination, away from conflict (Liu et al., 2021; Mahajan et al., 2019). As a result, organizational executives who seek to improve work processes, reduce costs, and improve performance use both CAS/Six sigma approaches for their objectives to be fully effective (Kuwaiti, & Subbarayalu, 2017; Mahajan et al., 2019).

In current use in hospitals, leaders utilize CAS/Six Sigma DMAIC to find strategies to ensure that hospital personnel abide by policies and protocols and deliver

medical care to patients with minimal risks (Appelbaum et al., 2016). Hospital leaders utilize CAS/DMAIC strategies to initiate patient safety projects, such as creating medication tracking systems and utilizing innovative technology solutions to minimize error risk (Hamm et al., 2018). Hospital leaders can incorporate CAS/DMAIC to implement and use standardized care protocols for specific conditions, such as checklists or clinical practice guidelines, and monitor adherence (Donovan & Mullen, 2019). Hospital leaders use CAS/DMAIC to create stringent patient safety interventions such as rigorous patient identification processes, multiple clinician confirmations before administering high-risk medications (Koyama et al., 2020), and monitor the use of timeouts before surgical or other invasive procedures (Jones, 2019).

Furthermore, hospital leaders can encourage clinicians to abide by hospital best practices and form interprofessional teams to review best practices or changes necessary periodically. Hospital leaders could find strategies to change the ineffective organizational culture that leads to medication administration errors and replace that with an error management culture. Error management culture could integrate error prevention and enable hospital leaders to create an environment for error management development, thus permitting them to learn from errors and reduce their adverse consequences (Farnese et al., 2019).

By integrating CAS and Six Sigma DMAIC, hospital leaders could reduce waste and work imbalance in the service process, enhance healthcare performance by reducing medical costs, and reduce medication administration errors and other internal defects (Ahmed, 2019). Similarly, jointly using CAS and DMAIC could enable hospital leaders

to identify existing internal causes of medication administration errors, develop solutions, reorganize processes, implement effective improvements and sustain the control of these initiatives to reduce medication administration errors and the resulting costs. The reduction of error-related costs should be a vital benefit of any intervention addressing medication administration error.

Healthcare practices and organizations are complex adaptive systems, which are characterized by relationships, interactions, structures, work processes and cultures (Barach & Kleinman, 2018; Naylor et al., 2020). Medical errors occur in hospitals resulting from the interaction of clinicians, patients, and system failures, thus using CAS/Six Sigma DMAIC to implement and evaluate changes in process is imperative (Barach & Kleinman, 2018; Phillips & Ritala, 2019). Hospital leaders could utilize CAS/Six Sigma DMAIC to effectively assess clinical flow, address variations in hospital processes to reduce errors, and improve the quality and efficiency of the delivery of care to patients (Barach & Kleinman, 2018).

Supporting Framework

CAS/Six Sigma DMAIC theory could enable hospital leaders to explore strategies to reduce medication administration error occurrences to reduce costs. An alternative conceptual framework is transformational leadership theory. Hospital leaders could also use transformational leadership theory to explore strategies to reduce medication administration errors to reduce costs. Researchers use transformational leadership theory to explain variance in leadership effectiveness and enhance organizational performance (Bednall et al., 2018; Siangchokyoo et al., 2020). According to the transformational

leadership theory, the extent to which leaders are considered transformational is a function of four leader dimensions which include; (a) idealized influence (role modeling attributes and behaviors), (b) inspirational motivation (articulations of compelling and inspiring visions of the future), (c) intellectual stimulation (challenging existing assumptions and stimulating new ways of thinking), and (d) individualized consideration (attending to followers' needs and concerns) (Seitz & Owens, 2021; Siangchokyoo et al., 2020).

Hospital leaders could use inspirational motivation to depict a positive vision of the organization, use intellectual stimulation to engage employees in dialogue about their concerns with the innovation being implemented, and use individualized consideration to foster a sense of trust and confidence in employees' ability to implement change (Fahranak et al, 2019). Researchers have highlighted that the transformational leadership framework has benefits that include identifying the necessity for change, motivating followers, influencing employees' attitudes, promoting innovative work behavior, and engendering positive organizational outcomes (Bednall et al., 2018; Fahranak et al., 2020; Li et al., 2019; Zuraik & Kelly, 2019). Similarly, hospital leaders who demonstrate transformational leadership create environments that promote high-quality patient care (Boamah et al., 2018). Hospital leaders may need to change their leadership styles to improve the outcomes in the work environment and provide transformational leadership development to leaders. Organizational leaders should recruit and train other leaders in transformational leadership to ensure innovation results (Zuraik & Kelly, 2019).

Hospital leaders could use transformational leadership to seek employees' input in innovative programs within the organization. Transformational leadership has a significant impact on employees' creative process engagement, enhances practices, and improves performance (Mahmood et al., 2019; Para-González et al., 2018). Attitudes toward change and transformational leadership are essential determinants of implementation success (Fahranak et al., 2019). Transformational leaders influence employees' attitudes in various ways, and transformational leadership transforms individual employees to make them more receptive to and build capacity for bringing about organizational change (Fahranak et al., 2019).

Hospital leaders could use transformational leadership to improve employee attitudes toward organizational change (Bednall et al., 2018; Fahranak et al., 2019). Employees' attitudes toward implementing a new vision by hospital leaders to reduce medication administration error occurrence are vital. A successful innovation implementation to reduce medication administration error occurrences could require that nurses and other personnel attend training sessions, adopt new technology, and utilize new practice to reduce error occurrences. Should hospital personnel perceive that implementing a new initiative to reduce medication administration error occurrence could be beneficial, they may be more likely to implement the innovation and ensure its success. Hospital leaders who use transformational leadership could ensure that personnel who are required to implement new programs have positive attitudes toward the innovation, foster work engagement, provide support and adequate resources, and implement new plans to create high-quality patient care and reduce errors (Amor et al.,

2020; Boamah et al., 2018; Fahranak et al., 2019). When hospital leaders utilize transformational leadership to engage staff, align them to the new hospital's vision to reduce medication administration error occurrence, they could enhance trust from personnel which could translate to the successful implementation of new programs. Transformational leadership is the most effective and active form of leadership behavior (Curtis, 2018).

A limitation of transformational leadership is that it could lead to increased dependence of subordinates on the leader, difficulties in planning activities, and a deterioration of interpersonal relationships among employees (Barbinta et al., 2017). Also, transformational leadership is not the most effective method of enhancing organizational learning because it requires staff engagement and empowerment (Farag et al., 2017). Transformational leaders must get followers to buy in and achieve deep-level change for transformational change to be successful (Seitz et al., 2021). In this regard, if followers do not buy in, do not enhance their organizational learning, or are not aligned to the new vision, the organizational change initiated by the transformational leader could be thwarted. Thus, if nurses and other healthcare personnel are not transformed into the new vision of change to reduce medication administration error occurrences, hospital leaders who use the transformational leadership framework could be unsuccessful in changing it.

Contrasting Framework

The transactional leadership theory may not be beneficial to engender change from nurses and other personnel to reduce medication administration errors in hospitals.

Transactional leaders lead by maintaining the status quo using defined processes (Nielson et al., 2019). Transactional leaders suppress innovation and pay attention to followers' work to find faults and deviations (Jelaca et al., 2020). Transactional leaders use rewards and punishments to gain compliance from their followers, and these strategies may not be effective in changing employee behavior (Nielson et al., 2019). Transactional leaders supervise staff members by management by exception-active (MBEA), routine monitoring of follower behavior to actively search for and correct deviations from the norm as they occur, and management by experience-passive (MBEP), which corrects such mistakes only after they have occurred (Young et al., 2021). The development of high-quality exchanges is unlikely when leaders display MBEA or MBEP, as the quality of these exchanges between transactional leaders and their followers is thought to be poor (Young et al., 2021). These behaviors may not engender change in nurses or other healthcare personnel, and as such, medication administration error occurrences may continue to be prevalent. Since MBEA involves vigorously monitoring the behavior of followers to ensure that they meet performance standards (Young et al., 2021), the pressure to comply as well as the threat of receiving punishment may reduce the sense of autonomy perceived by followers (Deci et al., 2017) and signal to them that their mistakes are expected and probable, leading to diminished sense of follower competency (Young et al., 2021). As a result, the transactional leadership framework may not be the most effective approach for hospital leaders to reduce the cost of medication administration error occurrences and reduce costs.

Changing nurses' and other healthcare personnel behavior may be pertinent to reducing medication administration error occurrences, and costs but transactional leadership framework may not be successful at that. Hospital leaders should align clinicians' perceptions to new visions, goals, and seek their buy-in. When hospital leaders incorporate these, initiatives aimed at reducing medication administration errors could become successful resulting in reduced costs.

Medical and Medication Administration Errors

The Institute of Medicine (IOM) released a report in 2010 entitled *To Err is Human: Building a Safer Health System,* which estimated that 98,000 people die annually from preventable medical errors (Sheldon, 2016). As a result, national attention to the occurrence, clinical consequences, cost of adverse drug events (ADEs), and medication errors in hospitals was highlighted. Medical error is a patient safety issue that can impact patients and healthcare organizations. Medical errors occur at an alarming rate with consequential effects on patients. Over 20% of Americans reported a personal experience with a medical error (Dimond, 2018). Medication errors impact all patient populations, including neonatal, pediatrics, and adult patients. Medication errors play a significant role in the morbidity and mortality of patients admitted to hospitals resulting in injuries, disabilities, and deaths yearly (Bates & Singh, 2018).

A medication error does not have one specific definition. According to the National Coordination Council for Medication Error Reporting and Prevention (2016), a medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care

professional, patient, or consumer. A medication error is a wrong medication that includes an inappropriate selection of the medicine, previous history of allergy, contraindicated medication, or inappropriate medication for the patient due to his age or clinical condition (Manzanares & Rodriguez, 2019). Medication errors are a type of medical error that may result in the misuse of drugs or patient injury (Eslami et al., 2019). Medication administration error is a medication error that occurs while administering a medication to a patient (Baraki et al., 2018). Children are at increased risk for medication administration errors because of their varied physical characteristics, stages of development, communication barriers, and treatment by non-pediatric healthcare providers (Baraki et al., 2018; Manzanares & Rodriguez, 2019).

Medication administration in hospitals is a complex multistage process dependent on the successful interaction of health professionals functioning within different disciplines (Farag et al., 2017). Any healthcare team member, including but not limited to physicians, physician assistants, nurse practitioners, nurses, respiratory therapists, and pharmacists, can cause medication administration errors. Medication administration errors frequently occur in hospitals and are the most common medical errors noted in healthcare organizations (Harkanen et al., 2017). A large proportion of medical errors occur during the medication administration process (Strudwick et al., 2018), and medication administration errors occur in 20% to 25% of dose administrations (Koyama et al., 2020). Medication administration errors cause increased patient morbidity, prolonged hospital stays, and adverse drug events (Berdot et al., 2016; Blignaut et al., 2017; Hammoudi et al., 2017).

The medication continuum comprises distinct phases, namely prescription, delivery, and administration (Dubovi et al., 2017; Vrbnjak et al., 2016). The prescription stage encompasses physicians or other authorized hospital personnel such as the physician assistant or nurse practitioner who write medication orders manually in paper charts or enter them through a computerized physician order entry system. The delivery stage consists of pharmacists who interpret the prescribed order, prepare the medication, and make them available to other staff members, including nurses and respiratory therapists, for administration. The administration stage involves the actual dispensing of the medicines to patients by healthcare personnel. All stages of the medication continuum are susceptible to human error (Dubovi et al., 2017; Vrbnjak et al., 2016). Healthcare personnel play a significant role in ensuring that patients do not continue to suffer from medication administration errors. Many factors make patients more susceptible to medication administration errors and their consequences (Baraki et al., 2018; Harkanen et al., 2017).

Causes of Medication Administration Errors

Medication administration in hospitals is a core component of healthcare personnel duties, especially for the nursing staff. Standards govern the medication administration process, legal mandate, and the “5 rights”; right patient, right drug, right dose, right time, and right route (Martyn et al., 2019). Despite being an essential part of nurses' and other healthcare personnel training, medication administration errors still occur.

The incidence of medication administration error is still an unresolved issue in clinical practice settings which has prompted hospital leaders to explore strategies to reduce them. Categories of medication administration errors include unauthorized drug, extra dose, wrong dose, omission, wrong route, wrong form, wrong technique, and wrong time (Strudwick et al., 2018). An unauthorized drug is the administration of a medication not prescribed. An extra dose is any dose dispensed over the physician's total number of times prescribed. A wrong dose is any dose of preformed dosage unit which contained the wrong prescription strength or number. An omission is a failure to dispense a prescribed dose. Wrong route is medication administered to a patient using a different route from that prescribed. Wrong form is administering a dose in a different form than that prescribed. Wrong technique is the exclusion or incorrect performance of a procedure prescribed immediately before administering a dose. Wrong time is the administration of a dose more than 60 minutes before or after the prescribed administration time.

When medication administration errors occur in hospitals, the impact could be devastating for patients, but it may also be negative for the healthcare practitioner and the organization. When a patient seeks medical care in a hospital, they receive a bar-coded wristband, which identifies the patient and transmits demographic information to the hospitals' computer system (Strudwick et al., 2018). Nurses, respiratory therapists, and other healthcare personnel scan the wristband, transmitting information regarding the prescribed medication (Owens et al., 2020; Thompson et al., 2018). Despite this precaution, medication administration errors still occur (Strudwick et al., 2018). Some

contributory factors to a high incidence of medication administration error occurrences include failure to confirm a patient's identification, scanning a medication package after administration, and attaching the patient's barcode to a location convenient for the nurse (Strudwick et al., 2018).

Other factors attributed to medication administration error occurrences include understaffing, long shifts, fatigue of healthcare personnel, interruptions, and distractions (Hayes et al., 2017; Widyanti & Reyhannisa, 2020). In a high-stress environment like a hospital, interruptions and distractions are prevalent. Interruptions and distractions contribute to medication administration errors since they interfere with the knowledge and skill of the healthcare personnel by causing a diversion of attention, which impedes performance (Suclupe et al., 2020). Distractions or interruptions compete for the caregiver's attention and can result in an error. Interruptions delay work routines, disorganizes planning, results in ineffective working procedures, affects nurses' focus, and cause medication administration error (Hopkinson & Wiegand, 2017; Laustsen & Brahe, 2018). Interruptions may occur because of other nurses, patients, or operational failures of the devices being used (Hung et al., 2016). The impact of interruptions are far□reaching, significantly associated with medication administration errors, and a significant patient safety issue (Gao et al., 2018; Hayes et al., 2017).

Other common errors that occur during the medication administration stage arise from issues such as administering the wrong dosage (40.9%), overdose (36.4%), administering the wrong drug (19%), and using the wrong route for drug administration (9.5%; Cloete, 2015). While the medication administration stage is the most vulnerable

stage where a high proportion of medication errors occur (Strudwick et al., 2018), intravenous (IV) infusion devices have the most significant potential for patient harm (Schnock et al., 2018). Medication administration errors involving IV infusion devices have a higher chance of causing harm to the patient if the nurse does not identify the error before the pump is programmed (Schnock et al., 2018).

Nurses administer some high-risk medications, such as insulin and morphine, intravenously due to the risks involved with infusion devices that do not integrate into the standalone systems of medical facilities (Abusaksaka et al., 2020; Farzi et al., 2020; Ni et al., 2020). “Smart” infusion pumps with drug error reduction software have been implemented across many health care organizations to reduce IV infusion pump errors (Koeck et al., 2021). However, despite this technology, medication administration errors still occur (Jani et al., 2020; Strudwick et al., 2018). Adverse medical events accounted for 14.5% of hospitalizations, medication administration errors occurred in 9.0%, and these errors occurred more in patients admitted during the weekend (Vermeulen et al., 2018). The causes of medication administration errors in clinical practice are human and system errors (Truter et al., 2017).

Human Errors

Although errors are component aspects of human lives, every error in the daily administration of medication to patients in a hospital has a cause. The Agency for Healthcare Research and Quality identified 246 medication errors reported in the United States related to human factors (Widyanti & Reyhannisa, 2020). These factors pertain to how humans’ interaction with others, tasks, and the environment, influence their

performance (Widyanti & Reyhannisa, 2020). Medication administration errors create an increased risk of morbidity and mortality for patients. There has not been a significant change in hospital error occurrences from the past few years since the IOM published its findings on preventable medical harm (Bates & Singh, 2018).

Human factors that cause medication administration errors include; (a) checklist not followed correctly, (b) procedure not followed correctly, (c) rushed or delayed necessary action, (d) noise interference, (e) life stressors, (f) task over□saturation, and (g) unclear physician orders (Asefa et al., 2021; Newroz et al., 2018; Widyanti & Reyhannisa, 2020). There may be an increased likelihood of patient harm or adverse events from medication administration error occurrences in hospital units with higher acuity. The higher acuity of patients or high nurse-to-patient ratios can affect the time and quality that each nurse spends with each patient. In medical-surgical units of hospitals, the nurse-to-patient ratio is typically 5-6 patients to 1 nurse (Griffiths et al., 2016). The nurse may have several patients calling for various reasons, such as administering pain medications, assistance to the bathroom, and inquiries of the patient's plan of care. The complex nature of nurses' workload may cause longer amounts of time with each patient, delays in dispensing medications, or error occurrences due to disruptions or lack of concentration which may lead to patient harm (Campbell et al., 2021; Jin et al., 2018; Zarea et al., 2018). There is a significant relationship between low nurse staffing levels and increased mortality rates (Griffiths et al., 2016). Safe staffing ratios are necessary to help improve patient outcomes.

Mental fatigue also plays a role in medication administration errors (Nejati et al., 2016; Widyanti & Reyhannisa, 2020). Healthcare personnel work for extremely long hours during their shifts. Some of the shifts worked are 12 hours a day while others, due to staff shortages, work additional hours. Lunch break times for healthcare personnel are usually 30 minutes long, which is insufficient when coupled with a long shift. Extended hours may disrupt sleep, resulting in poor concentration, and harmful job performance (Rheaume, 2017). It is challenging to sustain mental sharpness during these long periods of work without adequate rest and large workloads. The lack of rest time during shifts, combined with a lack of sleep, triggers fatigue among healthcare workers (Gorgich et al., 2016; Widyanti & Reyhannisa, 2020). Thus, it is necessary for healthcare personnel to get adequate rest with fair workloads to reduce the incidence of medication administration errors.

Other human factors contributing to medication administration errors are emotional stress, lack of motivation, high workload, poor communication, and missed patient information on the information system (Al-Ahmadi et al., 2020). In addition, interruptions caused by other healthcare personnel play a significant role. Interruptions are breaks in the performance of a human activity initiated by a source internal or external to the recipient (Huckels-Baumgart et al., 2021). In the hospital setting, interruptions are situations in which a nurse or other healthcare personnel ceases the medication preparation or administration to attend to an external stimulus (Huskels-Baumgart et al., 2021). An interruption can be self-initiated or instigated by another individual. Any member of the healthcare team can cause medication administration

errors. However, nurses are known to report the highest number of these incidents because they usually administer more medications than other healthcare personnel. One of the essential functions of a registered nurse (RN) is medication administration (Booth et al., 2017; Harkanen et al., 2020).

Physicians are another source of human medication administration errors. The operating room is one of the only areas of the hospital where physicians prescribe, prepare, and administer each medication, often without the assistance of a second provider, without electronic clinical decision support, and sometimes under stressful or chaotic conditions (Litman, 2018). During medication preparation from a drug vial or ampule in the operating room, it is possible for the physician to accidentally choose the wrong vial or the unintended concentration of the correct medication and dispense it to patients (Litman, 2018). Physicians could cause more errors when drug containers look similar or are placed close to each other in the anesthesia drug tray (Litman, 2018). These factors result in various mechanisms for medication administration errors and the potential for more dangerous outcomes (Lobaugh et al., 2017; Wahl et al., 2017).

System Errors

Despite human factors, system factors contribute to medication administration error occurrences. Understanding the systemic conditions under which medication administration errors occur is essential to keeping patients safe, continuous quality improvement, and sound risk management (Sanchez et al., 2017). Ironically, one such system factor is the computerized prescriber order entry (CPOE) (Amato et al., 2017). While the CPOE is a system designed to identify and prevent medication errors, it is not

always accurate, and as such may result in errors. When system factors exist, medication administration errors still occur. Of 2,522 system medication error reported, 1,308 (51.9%) were related to CPOE (Amato et al., 2017).

Another system factor of medication administration error occurrence is burnout. Health systems recognize the negative impact of burnout on healthcare quality, patient safety, and financial performance (Stehman et al., 2019). Burnout is a psychological syndrome featuring emotional exhaustion, depersonalization with widespread consequences, including poor quality of care, increased medication administration errors, patient and provider dissatisfaction, attrition from medical practice and patient harm (Shanafelt et al., 2019; Stehman et al., 2019). The COVID-19 pandemic generated additional stress on healthcare personnel who frequently had to work very long hours with increased workload to ensure that patient care was delivered resulting in burn out and increasing the risk of medication administration error occurrences (Muabbar & Alsharqi, 2021). Other system impediments to medication administration error occurrences include failure to provide adequate staffing resources, failure to provide proper training, and lack of effective communication (Widyanti & Reyhannisa, 2020).

Disclosure of Medication Administration Error Occurrences and Barriers to Reporting

Human beings are fallible, including healthcare personnel who administer medications to patients. Since physicians, nurses, respiratory therapists, pharmacists, and others are humans, unintentional errors occur during medication administration. Unintentional medication administration errors will always be a part of the medical system (Robertson & Long, 2018). While unintentional medication administration errors

impact patients and their families, it may also contribute to adverse mental and emotional effects on the involved providers. However, when unintentional medication administration errors occur, it is pertinent for them to be reported.

In the United States, 26 states and the District of Columbia have reporting systems that collect information from hospitals and other facilities about hospital errors and adverse medical events resulting in patient death or serious harm (Sanchez et al., 2017). Healthcare workers have a responsibility to report hospital errors. The benefits of reporting include increased access to additional expertise, to improve patient safety and an increase of transparency in the organization (Asefa et al., 2021; Sanchez et al., 2017). Also, reporting conveys to the public that hospital personnel are proactively trying to prevent similar patient safety events in the future (Sanchez et al., 2017).

Reporting, reviewing, and analyzing medication administration errors provides hospital leaders with opportunities for understanding root causes and suggesting measures for preventing subsequent errors (Farag et al., 2017). Hospital leaders have an essential role in ensuring open and honest communication between employees (Mueller et al., 2019). Hospital leaders should encourage other hospital personnel to report medication administration error occurrences (Ayorinde & Alabi, 2019). Hospital policies for reporting medication administration error occurrences conveyed to all healthcare personnel should be clear and detail the reporting process (Mueller et al., 2019). Hospital leaders are responsible for ensuring that when medication administration errors occur, they do not automatically choose a disciplinary pathway to punish staff involved (Ayorinde & Alabi, 2019). One impediment to the reporting of medication administration

errors is the fear of retribution from a punitive work environment (Hewitt et al., 2017). Nurses fear punishment from hospital leaders and obtaining a poor reputation from peers (Hewitt et al., 2017). Psychological fears of reporting include blame, liability, and poor reputation or ostracism from peers (Castel et al., 2015). Barriers to medication administration error reporting make it less likely that nurses or other personnel will report medication errors, especially errors where patient harm is not apparent or where an error might be hidden (Rutledge et al., 2018). Such underreporting impedes the collection of accurate medication administration error data, prevents hospitals from changing harmful practices, masks the extent of the actual problem, and delays implementing corrective actions (Farag et al., 2017; Rutledge et al., 2018). It is essential for hospital personnel to report medication administration errors whenever they occur.

The Role of Hospital Leaders

The role of hospital leaders is to ensure that appropriate reporting systems, policies, and procedures are in place (Applebaum et al., 2016). Hospital leaders should train hospital personnel to be compliant with the process. Hospital leaders can create system improvements that provide electronic notification when an incorrect medication is scanned or when a patient's armband does not match the specified barcode indicator (Truitt et al., 2016). While many hospitals have increased the use of information technology to facilitate the medication administration process, including double checking, which requires two nurses to sign off on medications through the computer system, its effectiveness is still unclear (Koyama et al., 2020).

Hospital leaders should find strategies to ensure that healthcare personnel abide by policies, protocols and deliver medical care to patients with minimal risks (Appelbaum et al., 2016). Hospital leaders can initiate patient safety projects, such as creating medication tracking systems and utilizing innovative technology solutions to minimize error risk (Hamm et al., 2018). Hospital leaders can implement and use standardized care protocols for specific conditions, such as checklists or clinical practice guidelines, and monitor adherence (Donovan & Mullen, 2019). Hospital leaders can create stringent patient safety interventions such as rigorous patient identification processes, use multiple clinician confirmations before administering high-risk medications (Koyama et al., 2020), and monitor the use of timeouts before surgical or other invasive procedures (Jones, 2019).

Furthermore, hospital leaders can encourage clinicians to abide by hospital best practices and form interprofessional teams to review best practices or changes necessary periodically. Hospital leaders could find strategies to change the ineffective organizational culture that leads to medication administration errors and replace that with an error management culture. Error management culture could integrate error prevention and enable hospital leaders to create an environment for error management development, thus permitting them to learn from errors and reduce their adverse consequences (Farnese et al., 2019).

Hospital leaders could play a significant role in reducing medication administration errors. Hospital leaders could develop other initiatives which could enhance clinician best practices and reduce medication administration errors. Also,

hospital leaders could provide training which hospital personnel could use to institute error management culture.

Medication Administration Errors Impact on Organizational Costs

I have highlighted via the literature review how medication administration error occurrences increase hospital costs, cause patient harm, could lead to litigation, and cause decreased revenue. One business reason for hospital leaders to reduce medication administration errors to reduce costs is to build well-being programs that avert burnout among caregivers, resulting in increased costs for the organization. System factors cause burnout among health care professionals, are expensive and have an organizational cost of approximately $6,600/physician each year (Shanafelt et al., 2019). In hospitals where physicians are direct employees, the extra cost incurred by burnout adds additional cost to the hospital expenditure, decreases hospital revenue, and increases costs. A workforce with minimal burnout and maximal professional fulfillment is highly desirable and supports the business case for promoting clinician well-being to deliver high-quality care (Shanafelt et al., 2019).

Hospital leaders could garner insights from their investigations into medication administration error occurrences to improve the system medication administration process, ensure that errors are reduced, and improve patient outcomes. Also, hospital leaders should not be primarily motivated to punish employees who cause medication administration errors and evaluate all contributing factors to eradicate errors. When punishment becomes the only remedy, it could result in unsavory decisions by hospital leaders because the motivation to learn from failure is hindered (Dahlin et al., 2017).

Medication administration errors and adverse events are associated with prolonged length of hospital stay, high mortality, unplanned readmissions, and deteriorating health status and quality of life of patients, all of which are associated with increased expenditures (Wang et al., 2020). Tethering financial penalty with patient outcomes forces the hospital personnel to deliver high-quality care (Mosley, 2020). It is imperative for hospital leaders not just to reduce error occurrences to reduce costs but also to receive reimbursements for medical care delivered. The Centers for Medicare and Medicaid Services (CMS), the federal agency which uses a pay-for-performance program to reimburse hospitals and charged with administering the Affordable Care Act's two cost reduction initiatives, the Readmissions Reduction Program (RRP) and the Value-Based Purchasing (VBP) programs, aggressively pursue cost savings through reducing the number of hospital readmissions that are preventable (Bates & Singh, 2018; Kocakulah et al., 2021; Liu et al., 2021). Also, under the Hospital-Acquired Condition Reduction Program (HACRP) of the Affordable Care Act, hospitals face reimbursement reductions for having high rates of readmission and hospital-acquired conditions (Hollenbeak et al., 2020).

When medication administration errors cause patient readmissions, hospitals incur the additional costs of treatment which causes a considerable direct financial cost to the health system. Fifteen percent of hospitals' expenditure goes towards additional tests and interventions to treat the effects of hospital harm (Kuriakose et al., 2020). Similarly, the CMS does not reimburse the hospital for the care delivered which caused patient harm and readmissions, but it imposes penalties on hospitals for causing those readmissions.

For the fiscal year 2015, CMS penalized about 2,610 hospitals, with estimated fines of about $428 million for readmissions caused by hospital errors, including medication administration errors (Kocakulah et al., 2021). In addition, among 2,135 private acute care hospitals, 477 (22.3%) received a HACRP penalty leading to revenue losses (Hollenbeak et al., 2020).

Another business reason for the reduction of medication administration errors is the litigation that ensues from hospital errors. Healthcare professionals have an ethical duty to communicate harmful medical errors to patients, despite the risks of losing patient trust, decreasing satisfaction, and increasing the possibility of a malpractice suit (Giraldo et al., 2020). Four hundred and thirty-four medical malpractice claims caused by medical errors contributed to revenue loss in hospitals between 2012 and 2013 (Giraldo et al., 2020). This extra cost from malpractice claims not only decreases revenue for hospitals, but the negative publicity from malpractice claims could adversely impact the hospital, which could lead to a lack of patronage from community people, resulting in further loss of revenue. Hospital leaders should invest in all resources to reduce medication administration error occurrences since patient harm negatively impacts hospital revenue and increases costs. Such an investment could reduce both Medicare expenditures, hospital costs, and enhance the delivery of safer care (Wang et al., 2020).

The primary objective of the literature review was to consider the business and social implications of medication administration errors and find strategies to reduce them. The literature review contains subtopics including the conceptual framework, adverse medical events, medical and medication administration errors, causes of medication

administration errors such as human and system factors, and the role of hospital leaders in reducing medication administration errors. Also, I evaluated the business case for reducing medication administration errors. When hospital leaders are successful in reducing medication administration errors, patient outcomes from such error occurrences could be positive, resulting in reduced costs for hospitals.

Transition and Summary

Section 1 included the foundation of the study, the background to the problem, the problem statement and the purpose statement. Section 1 also contains the nature of the problem and the research design and method. I discussed how assumptions, limitations, and delimitations could influence the outcome of the study. I presented the literature review which detailed the problem being studied and highlighted its significance to business practice. In Section 2, I discuss the significance of the research process and presented the purpose statement, the role of the researcher, the participants, the research design and method. Other sections I discuss in Section 2 include, population and sampling, ethical research, data collection, data collection instruments and technique, data organization technique, data analysis, and reliability and validity.

Section 2: The Project

In Section 2, I describe the research process for this study. This section is composed of a review of the role of the researcher and the participants, and a discussion of the research method and design. I also discuss population and sampling, ethical research, data collection instruments, data collection technique, data organization technique, data analysis, and reliability and validity.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies hospital leaders used to reduce medication administration errors to reduce costs. The target population for this study consisted of five hospital leaders who have successfully reduced costs from reduced medication administration errors within their respective organizations located in the city of Las Vegas, Nevada. The result of this study could contribute to positive social change by helping hospital leaders develop strategies to reduce medication administration errors, enhance the trust of patients in hospitals, improve patient care, provide continuous education, enable a culture of safety, institute hospital best practices, and improve the health of people in local communities.

Role of the Researcher

The researcher collects data during the research process. Marshall and Rossman (2016) stated that the researcher gathers data in qualitative research. Kornhaber et al. (2015) suggested that a qualitative researcher collects, analyzes, understands, and interprets data as it relates to a phenomenon. As the researcher in this study, my role

included selecting participants, conducting interviews, reviewing and analyzing data, and reaching conclusions.

As a healthcare provider, I have heard about medication administration errors occurring with various negative outcomes including deaths, so I have some knowledge of this phenomenon. I also became familiar with this issue as an existing business problem, by examining literature on medication administration errors, I became familiar with this issue as an existing business problem. I did not know the study participants, have no personal or business relationships with them, and only spent limited time with them during the interview process. I am aware of unsuccessful hospital initiatives to decrease medication administration errors, but I do not have knowledge of veritable and successful strategies to ensure that medication administration errors are curbed to reduce hospital costs. In this regard, I expected the study participants to provide information or illustrate strategies which enabled hospital leaders to decrease the incidence of medical administration errors and reduce costs.

I followed standard ethical research guidelines for this research study and collected data after approval by the Institutional Board Review (IRB). I adhered to the three ethical tenets of the *Belmont Report*. Ethical guidelines outlined in the *Belmont Report* include (a) respect for individuals, (b) beneficence, and (c) justice (Department of Health, Education, and Welfare, 1979). A fundamental aspect is participant's right to informed consent prior to their participation (Department of Health, Education, and Welfare, 1979). I obtained informed consent, signed by the participants prior to starting the interviews. While beneficence aims to maximize the benefits of research without

harming participants, justice refers to balancing the needs of society with the cost to participants (Bromley et al., 2015). I adhered to the guidelines of the *Belmont Report* in this research study.

Bias may influence the outcome of a research study. Yin (2018) reported that in qualitative research, data is viewed through a personal lens. Marshall and Rossman (2016) pointed out that a researcher's identity or experience may create bias. To mitigate bias, I did not view or interpret data collected though a personal lens and used member checking. Member checking is a process of reviewing and validating study findings (Yin, 2018). Fusch and Ness (2015) indicated that researchers use member checking to avoid bias and ensure that data presented reflects the views of participants.

Researchers use an interview protocol to organize the structure of an interview. Benia et al. (2015) stated that interviewers who follow a protocol adhere to appropriate interview practices and lower the risk of biased participant responses. I used an interview protocol to mitigate bias (see Appendix A).

Participants

I selected five hospital leaders located in Las Vegas, Nevada. After obtaining IRB approval #10-01-21-0303390 and with the ongoing COVID-19 pandemic, participants in this study met with me in a face-to-face interview where their responses to questions were collected. Participants were asked to review and consent prior to participating in this research study. To elicit honest responses and successful interaction from participants to interview questions, it is pertinent for a researcher to develop a trusting relationship with

participants (Marshall & Rossman, 2016). I maintained professionalism during the interview process to establish a trusting relationship with the participants.

He et al. (2015) reported that each research study may have a pertinent set of eligibility criteria. The eligibility criteria for participants in this study were: (a) a hospital leader who has experience with strategies to reduce medication administration errors to reduce costs, (b) employed at a Las Vegas hospital, and (c) has a minimum of 10 years hospital leadership experience. Hoyland et al. (2015) indicated that many researchers face challenges getting access to participants during the data collection process. To gain access to the participants, I requested permission to approach hospital leaders from the Chief Executive Officer (CEO) of each hospital (Appendix B). I presented a letter of cooperation from the CEO to each participant, explained the research, and requested their consent to participate in the study. To identify a strategy for a working relationship with participants, I showed each participant evidence of approval to conduct the study from the CEO and asked them to select a suitable location and time for the interviews. This strategy engendered trust, enabled them to participate effectively in the study, and provided information which showed strategies to reduce medication administration errors and reduce costs.

Research Method and Design

I used a qualitative multiple case study to explore how hospital leaders adopted strategies to reduce medication administration errors and reduce costs. Olubiyi et al. (2019) opined that a qualitative researcher explores the experiences of respondents and obtains deeper, meaningful insights into real life situations. I selected the case study

design for this study. The purpose of a case study is to conduct an analysis and develop an in-depth understanding of a phenomenon (Yin, 2018). I used the case study design to elicit an in-depth exploration of the perspectives of how hospital leaders have successfully used strategies to overcome the incidence of medication administration errors and reduced costs.

Research Method

Researchers use a qualitative method to ascertain how participants perceive real-life events by asking open-ended questions (Yin, 2018). A qualitative case study method also provides an in-depth opportunity to gather data via events that occur within a bounded system (Erbas, 2019). Researchers use a qualitative method to provide subjective explanation of a phenomenon (Saunders et al., 2015). The qualitative methodology is appropriate for this study because researchers collect subjective data which provide information on strategies that are useful to reduce medication administration errors. Researchers use the quantitative method to test a hypothesis (McCuster & Gunaydin, 2015). A quantitative approach involves the application of statistical techniques to interpret data and present results (Nooraie et al., 2019). A mixed method integrates both a quantitative and qualitative method to a study (Guetterman & Fetters, 2018). I did not collect numerical data, perform statistical analysis, or test hypothesis, therefore, the quantitative method and the quantitative portion of the mixed method were not appropriate for this study.

Research Design

Research designs such as phenomenological, ethnographic, and case study are options for qualitative studies. Researchers use a phenomenological design to explore the lived experiences of individuals (Chance et al., 2020). In this study, I did not focus on the lived experiences of hospital leaders, so the phenomenological design was not appropriate for this study. Researchers use the ethnographic design to immerse themselves in the culture and traditions of a group (Chew & Armstrong, 2017). Since I did not explore the culture and traditions of hospital leaders, the ethnographic design was not suitable for this study.

Guetterman and Fetters (2018) reported that in a case study, researchers collect data to gain a more complete understanding of the case as it relates to a real-life situation. Yin (2018) reported that researchers use a case study to provide relative explanations. Researchers also use a case study to answer questions about real-world problems (Yin, 2018). Stolldorf et al. (2020) indicated that in a multiple case study, data collected provides more detailed information. As the researcher in this study, by using the multiple case study design instead of a single case study design, I obtained more compelling information oriented towards exploration (see Ciano et al., 2021) from participants, and analyzed data relevant to a real-life setting to ascertain strategies hospital leaders used to reduce medication administration errors and reduced costs. The case study design was appropriate for this study over the other designs because I explored the real-life problem of medication administration errors and its impact on hospital costs.

Fofana et al. (2020) suggested that data saturation occurs when data collection ends and it is reached when no new relevant information emerges with additional interviews. Similarly, Marshall and Russman (2016) stated that when data collection results in the same findings, data saturation has been attained. To ensure data saturation, I checked that no new information emerged after the initial interviews.

Population and Sampling

The population for this research study consisted of five hospital leaders in different healthcare organizations in Las Vegas, Nevada, who have successfully reduced medication administration errors in their hospitals and reduced costs. Hughes et al. (2020) indicated that interview data represents peoples' thoughts and feelings. I collected data from hospital leaders and asked in-depth, open-ended questions during the interviews in order to answer the research question. Researchers use several sampling methods to collect data. Tran et al. (2017) suggested that an adequate sample size during interviews depends on attaining data saturation. Ames et al. (2019) stated that purposive sampling is one way of achieving a manageable amount of data. Researchers use purposeful sampling to identify and select individuals experienced in a phenomenon (Palinkas et al., 2015). The more useable data are collected from each person, the fewer participants are needed (Morse, 2000). Malterud et al. (2015) suggested that the more information power a sample provides, the smaller the required sample size. I used purposeful sampling to identify, select, and collect data from five participants experienced in reducing medication administration errors in hospitals to reduce costs.

Data saturation is an essential aspect of qualitative research and it is defined as a research point where observing more data will not result in more information related to the research question (Lowe et al., 2018). In qualitative research, data saturation is the solution to determine adequate sample size (Fofana et al., 2020). Fusch and Ness (2015) reported that data saturation occurs more rapidly in smaller studies than in more extensive studies. I checked for data saturation after interviewing five participants, by determining if no new information had emerged. I achieved data saturation after collecting data from the initial sample, so I did not continue to interview additional participants.

The selection criteria for participants were (a) a hospital leader who has experience with strategies to reduce medication administration errors and reduce costs, (b) employed at a Las Vegas, Nevada, hospital, and (c) had a minimum of 10 years of hospital leadership experience. Saunders and Townsend (2016) stated that the participants of a research study should reflect the populations' characteristics. In this study, the participants were chosen for their leadership status in the hospitals, their level of experience and expertise, and demonstrated achievement in reducing medication administration errors to reduce costs. Based on these criteria, the participants possessed the authority and expertise to fully answer the interview questions. Despite the ongoing COVID-19 pandemic, each participant agreed to meet face-to-face with safeguards. I scheduled a date and time for interviews with each participant in their office.

Ethical Research

I conducted this research following ethical guidelines. Adherence to ethical issues is the foundation that ensures ethical integrity during research (Sun, 2018). Researchers use an ethical principle of integrity when conducting studies (Hammersley, 2015). I began data collection after obtaining Walden University IRB approval number 10-01-21-0303390. Participants reviewed and gave informed consent before starting the interviews. Researchers use the informed consent process to alert participants to the purpose of the case study (Yin, 2018). I provided each participant with a synopsis of the research process, interview process, and consent, and ensured ethical participation in the study.

I did not use any incentive to induce participants in this study. Participants provided information voluntarily and were free to discontinue the interview process any time they chose to, for whatever reason, without any consequence. None of the participants withdrew from the study. To ensure the ethical protection of participants, I recorded the interviews, took notes, and summarized information to ensure the accuracy of data collected. To safeguard their privacy, I denoted participants with numbers during data analysis. Lancaster (2017) reported that maintaining participants' confidentiality is an essential and integral aspect of the research process. I maintained participant confidentiality and removed participant-specific identifier. To protect the names of the individuals and organizations, I annotated letters to each hospital and participant involved in this study, thus; Hospital A, Hospital B, and so forth, and Participant A, Participant B, Participant C, and so on, for the five participants in this research study.

I will maintain participants' recorded responses from the interviews in my data repositories, including my password-protected computer and my back-up flash drive device, which will be stored in my digitized password-protected safe at home for 5 years. Antonio et al. (2020) suggested that researchers use data repositories to secure and store data from respondents. I will secure obtained data in these data repositories. I have shredded all notes taken during interviews, including correspondence from each hospital, after uploading them into a password-protected file on my computer. I will destroy data 5 years after the CAO approves the study.

Data Collection Instruments

The researcher is the primary data collection instrument (Clark & Veal, 2018; Yin, 2018). As the researcher in this study, I was the primary data collection instrument. I investigated how research participants had experiences with reducing medication administration errors and reducing costs. An impediment to good research is inadequate data collection (Thomas et al., 2018). I chose participants because of their experience and knowledge in hospital leadership. I utilized semistructured interviews and asked open-ended questions to participants to obtain responses from their personal experiences in reducing medication administration errors and reducing hospital costs. An interview protocol provides an interviewer with a step-by-step approach through all interview phases (Benia et al., 2015). I used the interview protocol to guide me during the interview process.

Research participants use open-ended questions to increase their range of answers, which provides detailed information (Thomas et al., 2018). Karimi et al. (2017)

reported that semistructured interviews offer researchers details of participants' experiences. I asked participants questions that not only enhanced data collection but provided information on how medication administration errors were reduced to reduce costs.

To ensure the reliability and validity of the data collection instrument in this study, I utilized member checking. Member checking is a process researchers use to review and validate study findings (Yin, 2018). Harvey (2015) reported that researchers use member checking to assess the reliability and validity of the information provided. To member check, I sent participants' a synopsis of their responses to ensure that I interpreted their responses accurately and ascertained no new information. Thomas et al. (2018) suggested that validity is the degree of congruence between what an instrument intends to measure and what it measures. As the primary data collection instrument in this study, I collected data to ascertain how hospital leaders have utilized strategies to reduce medication administration errors and reduced costs.

Data Collection Technique

As the primary data collection instrument, I gathered data by asking open-ended questions to participants during semistructured interviews. Pickard and Roster (2020) stated that researchers use interviews to collect qualitative data based on people's responses to open-ended questions. Peesker et al. (2019) suggested that respondents share their experiences through semistructured interviews. Guest et al. (2017) revealed that qualitative researchers use open-ended questions during individual interviews to elicit experiences, beliefs, and opinions from study participants. By asking hospital leaders

questions during interviews, I obtained information about strategies suitable to reduce medication administration errors to reduce costs. I followed the interview protocol (see Appendix A) to guide the interview process.

Guo (2020) posited that data analysis requires accurate and reliable data. The interview process with each participant began when as the researcher, I asked ice-breaker questions to ensure a comfort level and discussed the research topic and purpose of the study. Sipes et al. (2020) postulated that obtaining consent for data collection is challenging. I ensured that each participant consented to participate, and I notified them of their rights to terminate the interview at any time without consequences. Kamazi et al. (2019) advised researchers to uphold the privacy of respondents. Mehmood et al. (2016) opined that researchers see confidentiality as a hallmark of good research. I reemphasized the need to maintain the confidentiality of data collected and not divulge any personally identifiable information. I disclosed the recording of the notetaking devices to each participant. I asked interview questions and follow-up questions to ensure clarification and thanked each participant for participating in the interview.

Kazawa et al. (2020) reported that the face-to-face method of interview is advantageous. One is that a researcher can observe facial clues or expressions from the participant, and the technique is simple. Onwuegbueze and Byers (2014) reported that nonverbal expressions account for 93% of human communication. I followed nonverbal cues from participants during interviews. Fusch and Ness (2015) suggested not to overutilize nonverbal expressions when summarizing data collected. Since the participants chose their venues for the interviews, they felt comfortable providing

information in that location. Pickard and Roster (2020) indicated that face-to-face interviews are regarded as sensitive or threatening by interviewees. A disadvantage of a face-to-face interview is that the participant in their professional environment may feel inhibited and not offer a free exchange of information.

I used member checking to validate participants' responses. Researchers use member checking to improve the reliability of data interpretation (Yin, 2018). Member checking is a process where participants reaffirm a researcher's data for correctness (Iivari, 2018). Member checking in qualitative research assesses validity (Madill & Sullivan, 2018). During member checking, I sent participants a synopsis of their responses to ensure that I interpreted their responses accurately and invited their feedback to improve the data collected. Participants responded that I interpreted their responses accurately and no new information emerged.

Data Organization Technique

I used a journal to take notes during the interviews with participants. I also used a recording device to record the audio responses from participants during the interview process. Researchers organize and secure data collected (Oksana et al., 2020). For accuracy, I annotated the interview dates and times and the participants' roles within the organizations.

Yin (2018) indicated that researchers use computer software to manage data effectively. I utilized Microsoft Word software to file collected data. Woods et al. (2016) suggested that databases enhance a researcher's ability to store, manage and protect data. Dalkin et al. (2021) stated that a computer-assisted qualitative data analysis software

(CAQDAS such as NVivo) aids the researcher in obtaining an accurate picture of the data and offers better data analysis. I utilized NVivo to enhance data analysis. I will store and secure collected data from the interviews in a password-protected file in my computer and back-up flash drive stored in my digitized password-protected safe and delete it after 5 years.

Data Analysis

Qualitative data analysis is the consistent processing of data that comprises human-based data analysis and automatic tools (Marzouki et al., 2019). Yin (2018) reported that qualitative data analysis encompasses collection, interpretation, and analysis. This research study is a multiple case study that explored strategies hospital leaders used to reduce medication administration errors and reduce costs. I utilized Microsoft Word for transcription of data and NVivo software for data analysis. Rooshenas et al. (2019) reported that researchers use data from different sources (methodological triangulation) to support findings. Data analysis through methodological triangulation from participants and other hospital information sources such as performance improvement plans, policies, quality assurance programs, and strategies implemented were used to explore strategies that hospital leaders utilized to reduce medication administration errors to reduce costs.

I took notes of my observations of participants' responses and used member checking to ensure responses are accurately captured. Christie et al. (2015) stated that researchers sort interview data and field notes into a word processor before feeding the information into software for classifying themes. Marzouki et al. (2019) reported that

researchers should be careful of non-raw (biased data) obtained from notes and observations since they do not represent participants' written information. Post-interview, I used member checking to ascertain the accuracy of responses from participants.

I utilized thematic content analysis to review data. Researchers use thematic content analysis to examine data through a specific matrix and present data summaries by exploring the similarities and differences (Ormanci, 2020). Thematic analysis involves presenting the findings and interpretations of qualitative research data as a theme (Dinçer, 2018). Researchers use thematic analysis to create a clear view of the data collected. Ormanci (2020) reported to create categories for each theme to enhance data analysis. I categorized data collected from participants into themes while analyzing data, and this showed the results during data analysis.

Marzouki et al. (2019) indicated that researchers use automatic data analysis tools when the data volume is large. I used NVivo software to analyze data. Yin (2018) reported that data analysis is a constant process that is essential to data saturation. Marshall and Rossman (2016) suggested that researchers ensure that the interpretation of data collected is accurate to challenge emerging assumptions and biases. The data analysis process, according to Marzouki et al. (2019), includes; a) choosing a data analysis technique, b) deleting keywords from data to ensure integrity and transparency, c) separately analyzing raw and non-raw data, d) establishing a statistical analysis of results, e) producing a detailed report of data analysis, presenting and discussing the results and challenges, and f) sharing final results with stakeholders.

During data analysis, I utilized data management tools and triangulation to analyze data. Ranney et al. (2015) postulated that triangulation and member checking are techniques that ensure the trustworthiness of data analysis and the elimination of researcher bias. I used methodological triangulation and member checking to ascertain that data collected and analyzed indicated what strategies hospital leaders used to reduce medication administration errors and reduce costs. Marzouki et al. (2019) stated that participants would use keywords frequently in their responses, so researchers should delete them. I deleted keywords to avoid bias during data analysis. Marzouki et al. (2019) reiterated that while raw data consists of verbatim documents and comments generated by stakeholders in their original form, non-raw (or biased) data consists of notes of observation taken by researchers. Marzouki et al. continued that these notes are biased because they are subjective interpretations by researchers, and researchers separate them during data analysis. I separated raw and non-raw data and did not use non-raw data during data analysis to avoid bias.

Nieminen (2020) suggested that statistical reporting plays a vital role in data presentation. Marzouki et al. (2019) opined that topics emerge through the statistical representation of results, making it easier to prioritize decision-making. I presented data analysis which showed clear and simple visualization of results. A researcher should present a detailed report and discuss the results and challenges (Marzouki et al., 2019). Ranney et al. (2015) reported that the presented data highlights consensus among study participants and important outlier opinions or concepts. Mishra et al. (2018) noted that researchers could convince readers through effective data presentation numerically or

graphically. After data analysis, I presented a comprehensive report of data, highlighted challenges and anomalies, and showed how hospital leaders utilized strategies to reduce medication administration and reduce costs.

Reliability and Validity

A measure of ascertaining the quality of qualitative research is rigor (Leung, 2015). The rigor of qualitative research equates to reliability and validity, and these are necessary components of quality (Cypress, 2017). Rigor is the state of being very exact, careful, with strict precision, or the quality of being thorough and accurate (Cypress, 2017). Reliability in qualitative research indicates data adequacy, while validity relates to data appropriateness (Spiers et al., 2018).

Reliability

Hays et al. (2016) suggested that reliability is the finding of consistent results from data collected. Houghton et al., (2013) posited that reliability relates to dependability. Leung (2015) asserted that reliability lies with consistency. Reliability in qualitative research is rooted in data adequacy, which shows consistent support for analysis (Spiers et al., 2018). I used the interview protocol and asked similar questions to participants during interviews to ensure consistency. Harvey (2015) reported that researchers use member checking to assess the reliability of the data collected. To member check, I sent a synopsis of responses to participants to ensure that I interpreted their responses accurately and ascertained no new information. I utilized these tools to verify the dependability of the data analyzed and ensured the reliability of the results.

Validity

Thomas et al. (2018) opined that validity is the level of congruence between what an instrument intends to measure and what it measures. Validity in qualitative research means appropriateness of the tools, processes, and data (Leung, 2015). Researchers use triangulation to analyze different data sources and draw a conclusion (Marshall & Rossman, 2016). I utilized methodological triangulation from multiple sources, including responses from participants during interviews and records obtained to enhance the validity of the results. Trustworthiness refers to quality, authenticity, and truthfulness of findings of qualitative research (Cypress, 2017). I presented trustworthy data and interpreted accurate result findings.

Credibility

Credibility encompasses an accurate description of the phenomenon being studied, the presentation of believable research and is an essential indicator of a strong qualitative inquiry (Liao & Hitchcock, 2018). Thomas (2017) stated that the credibility of research findings is enhanced when a researcher reviews interview transcripts, emerging findings, and a draft copy of the research outcomes. Roulston and Shelton (2015) posited that a threat to credibility is eliminated when a researcher does not inject biased perspectives into qualitative research. I ensured that the data collected, analyzed and interpreted were credible by using member checking to verify that information provided was accurate.

Transferability

Maxwell (2020) stated that transferability is a process where a study's results can be transferred to other contexts and situations beyond those directly studied. Morse (2015) described transferability as extending the research results to other individuals or settings. Amankwaa (2016) suggested that transferability is the application of a research outcome to different groups. Cypress (2017) reported that transferability is attained when a researcher provides a thick and accurate description with robust information from data collected to analysis. I presented data obtained without researcher bias and described components of the study such as the details of the interview responses and data analyzed to support the transferability of my study outcome.

Confirmability

A researcher uses confirmability to review participants' responses and eliminate bias from data collected (Hays et al., 2016). Confirmability indicates that the findings from a research study are trustworthy. Yin (2018) described trustworthiness as a criterion to judge the quality of research. Connelly (2016) opined that researchers maintain detailed notes for review by others to ensure confirmability. A researcher can attain confirmability by maintaining a reflexive journal during the research process to keep notes and document introspections daily that would benefit the study (Cypress, 2017). I kept detailed notes, transcripts, and a reflexive journal that depicted the research study. I gathered enough data to ensure that the research question was answered and explored strategies that hospital leaders utilized to reduce medication administration errors and reduce costs.

Data Saturation

Fofana et al. (2020) indicated that data saturation is attained when researchers do not obtain new relevant information with additional interviews. Researchers use multiple data analysis methods to confirm data saturation which provides transparency and trustworthiness (Hancock et al., 2016). Data saturation is the point during data analysis at which incoming data produces no new useful information relevant to the study objectives. In this research, I used the same interview protocol and asked the same open-ended questions to the participants. I interviewed five participants. I attained data saturation after my initial sample and did not need to interview additional participants.

Transition and Summary

Section 2 included the purpose statement, role of the researcher, participants, the research design, and method. Other sections in Section 2 include population and sampling, ethical research, data collection, data collection instruments and technique, data organization technique, data analysis and reliability and validity. In Section 3, I discuss the application to professional practice and implications for change. I also discuss emerging themes.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The primary objective of this research was to explore strategies hospital leaders use to reduce medication administration errors and reduce costs. In this section, I highlight the research findings as they relate to professional practice, describe the implications for change, recommend actions for hospital leaders and provide suggestions for future study. In this section, I also recommend strategies which hospital leaders utilized to reduce the costs of medication administration errors. I conclude this section with a self-reflection of my research experience.

The purpose of this multiple case study was to explore strategies hospital leaders use to reduce medication administration errors and reduce costs. I used a qualitative case study to address the research question by collecting data through semistructured interviews in a multisite hospital setting. The data collection process involved five leaders from hospitals in Las Vegas, Nevada and I attained data saturation. After I reviewed the interview transcripts and imported them into NVivo software, I identified four themes. These themes include education, communication, use of technology, and continuous audit. I used data from company documents to triangulate the findings from the interviews of hospital leaders.

Presentation of the Findings

I conducted face-to-face interviews with five hospital leaders using purposive sampling. Data saturation is the point in data collection when more information gathered adds nothing new to the databank (Alam, 2020; LaDonna et al., 2021). After interviewing

the fifth participant, I had attained data saturation. Researchers use purposive sampling to select participants with expert knowledge (Marshal & Rossman, 2016). Each participant consented to the study and permitted audiotaping of the interview. Each participant answered open-ended and follow-up questions that pertained to their experience in reducing medication administration errors to reduce costs. I maintained confidentiality by ascribing each hospital and participant as Hospital 1 through 4 and Participant 1 through 5 respectively.

The business problem in this research was that medication administration errors increased hospital costs. All participants (100%) indicated that medication administration error occurrences posed a veritable problem for their hospitals, but that they have utilized different strategies to reduce these errors. Participant 3 stated that medication administration error was still underreported. The research question in this study was: What strategies do hospital leaders adopt to reduce medication administration errors to reduce costs? I collected data from multiple sources including interviews and hospital sources. Methodological triangulation of these multiple data sources provided a comprehensive interpretation and enhanced the result findings (see Feng et al., 2021).

The conceptual framework for this research study was the CAS/Six sigma DMAIC. An analysis of the participants' responses supported that CAS/Six sigma DMAIC theory enabled hospital leaders adopt strategies to reduce medication administration error occurrences and reduce costs. The themes identified after coding in NVivo are detailed in Table 2 below.

Table 2

Frequency of Themes Identified

Themes	Frequency of occurrence	Percentage of participants contributing to theme
Education	25	100%
Communication	56	100%
Use of technology	59	100%
Continuous audits	42	80%

Theme 1: Education

The education of hospital personnel on medication administration error reduction initiatives is necessary for sustaining innovation practices in hospitals. Education enables companies to innovate and sustain performance (Rocha & Pinheiro, 2021). Aligned to the CAS/Six Sigma DMAIC conceptual framework process improvement, providing education to hospital employees including nurses will equip them with competencies and knowledge pertinent for the successful performance of their jobs and safe delivery of medications. Participants 4 and 5 reported that nurses were educated to use intravenous delivery devices to safely administer medications to patients. All participants (100%) responded that employee education was imperative to enhance improvements in their hospitals. Participant 5 stated that by providing education to registered nurses on how to utilize medication administration error reduction devices, the incidence of medication administration errors reduced thereby reducing costs. Participant 4 opined that when pharmacists not only educated nurses on medication administration error reduction initiatives, but also intervened in preventing errors, hospital costs were reduced.

Vyrostek et al. (2020) postulated that clinicians adopt several educational methods to ensure good outcomes for patient. Participant 3 emphasized that by providing education to nurses and other team members through participating in daily multidisciplinary rounding, weekly huddles, and monthly departmental meetings, medication administration error occurrences were reduced. Participant 3 stated that, "The one strategy that I was very successful in implementing was daily multidisciplinary rounds in the CVCU. It has helped to reduce medication administration errors and costs because we have a pharmacist with us every day during rounds."

Participant 2 stated that as long as nurses adhered to education provided to them through in-services, seminars, on the job training, hospital policies and procedures, and did not take short cuts, medication administration error occurrences were reduced. Participant 1 reiterated that since educational resources like the NeoFax, which details medication dosages and administration routes, was provided to nurses to use, medication administration errors had drastically reduced in the neonatal intensive care units resulting in reduced costs.

Relationship to Conceptual Framework

A fundamental tenet of the CAS conceptual framework is evolution which implies human adaptation in a system (Holland, 1992). When hospital leaders provide education to nurses and other healthcare personnel, the new information derived from such education could enable them to adapt to new work practices, create evolutionary changes in the hospital systems, and reduce the incidence of medication administration errors thus, reducing costs. Another feature of a CAS system is aggregate behavior which

results from the interaction of parts (Holland, 1992). Since new behaviors emerge such an interaction, hospital leaders could use education to modify employee behavior to conform to new standards. Through education, hospital leaders could utilize Six sigma DMAIC to analyze causes, improve the medication administration delivery process and ensure nurses reduce medication administration error occurrences to reduce costs. As Participant 4 described, when he hired and used two pharmacists to provide education to nurses in his pharmacist-intervention strategy to reduce medication administration errors, and improve the medication process, the incidence of errors reduced leading to reduced costs. Participant 4 also opined that the pharmacist-intervention initiative that he put in place to educate nurses generated a cost-savings between $70,000-$150,000/month. Participant 4 equally stated that for October through November 2019, his education strategy reduced hospital cost by approximately $100,000.

Theme 2: Communication

All participants (100%) responded that communication plays a vital role in reducing medication administration errors thereby reducing costs. Murphy and Campbell (2017) reported that internal company communication is critical to business success. Participant 1 indicated that communicating with other team members including nursing leaders, nurses, nurse practitioners, pharmacists, and physicians about the need to deliver accurate medications to patients, has contributed to the reduction in medication administration errors in the neonatal intensive care unit. Participant 2 noted that communicating to the right people, and other stakeholders was a challenge but also a good strategy to reduce medication administration errors and reduce costs. Participant 3

indicated that a very successful strategy which she used was communicating to clinicians during the daily multidisciplinary rounds in the cardiovascular intensive care unit. This participant also stated that communication was critical because during rounding, the availability of pharmacists, nurses, doctors, and other health personnel made it easier to discuss medication dosages and administration methods safely which resulted in reduced medication administration errors on patients and hospital costs.

Health professionals of all levels of experience encounter communication difficulties (Grant et al., 2021). Participant 4 reported that the accuracy of the medication reconciliation and administration process between nurses and physicians was greatly impeded by a lack of communication. Stephens et al. (2021) reported that excellent communication is essential for safe, effective patient care. Murphy and Campbell (2017) continued that a well-crafted message is successful regardless of the delivery. Participant 4 further responded that when pharmacists communicated with nurses and physicians to reconcile medications, this resulted in reduced medication administration errors for patients. Participant 5 ended his interview by stating that continued communication with nurses who deliver medications and other healthcare clinicians is a pivotal tool to reduce the incidence to medication administration error.

Relationship to Conceptual Framework

Communication between patients and physicians is imperative to manage better expectations (Lehmann et al., 2021). Since DMAIC is used to improve internal processes, hospital leaders could use it to find out where communication chains are ineffective and improve the communication process between clinicians. Hospital leaders can improve

communication to clinicians through daily huddles, emails, through multidisciplinary rounding with various health care teams to ensure safe and consistent delivery of medications to patients. The anticipation feature of a CAS implies that circumstances change, and rules are formed to counter them (Holland, 1997). Hospital leaders can use communication to change ineffective practices and policies that exist between clinicians that impede the safe administration of medications. Hospital leaders can use effective communication means to eliminate bottlenecks, clarify gaps in practice, develop new protocols and ensure that clinicians comply with new practices to reduce medication administration errors and reduce costs. When hospital leaders consistently communicate all strategies to reduce medication administration errors to hospital employees, the occurrence of errors will be reduced.

Theme 3: Use of Technology

The use of technology in the delivery of hospital services has risen. New healthcare technologies that offer benefits to public health emerge daily (Daskalopoulou & Palmer, 2021). For more than 10 years, digital technologies have been used for specific areas of healthcare such as telemedicine (Secundo et al., 2021). Technology is important in managing healthcare systems, processing healthcare data, and transmitting reports (Alrahbi et al., 2021). Many healthcare personnel are involved in the use of technology for care delivery. Clinical informatics specialists use technology to ensure that clinicians perform accurate documentation of services on patients' charts. Physicians use technology to input accurate medication orders and perform other services or procedures. Pharmacists use technological devices to verify that physician orders are accurate before

preparing medications. Nurses use various technological products including smart IV pumps to deliver medications to patients. Respiratory therapists use technological devices like life-support machines to ventilate patients and save lives. Clinicians use various computer softwares to scan and verify patients prior to the administration of medications.

Despite these advancements in technology, medication administration errors still occur. Dorrance and Clement (2021) stated that although monumental advances have been made in diagnostics and therapeutics, the technology that supports health care transaction is woefully behind. However, Koltsida and Jonasson (2021) reported that the everyday duty of a registered nurse involves the use of utilizing information technology to assess health, conducting check-ups, and administering medications.

All participants (100%) indicated that the strategic use of technology has enabled them to reduce medication administration errors. Participant 1 responded that the use of Cerner, a computerized software, which identifies the wrong medication or dose, prevents nurses in the neonatal intensive care unit from committing an error. Participant 2 responded that nurses went through Cerner training for the IV pumps to ensure they administer appropriate medication to patients. Participant 4 opined that they used technologies like MIDAS, an incident reporting software, and Electronic Health Record (EHR), to track the incidence of errors, develop the pharmacy intervention strategy, and reduce the occurrence of medication administration errors. Participant 5 responded that after instituting the bar-code scanning requirement for nurses prior to administering medications to patients, and training nurses to use the smart infusion BD Alaris IV pump, medication administration errors were reduced which resulted in reduced costs. This

participant also stated that the BD Alaris pump has an error reduction software which has a drug library built within it with default parameters to detect underdosing, overdosing, and prevent medication errors from occurring. This participant further stated that because of the new technology in the BD Alaris pump which uses an algorithm to identify errors during programming, an alert is displayed which requires the nurse to confirm the accurate medication and dosage before it infuses the medication. Participant 5 stated that:

> From a medication perspective, there are a number of strategies that we use to prevent medication administration errors. Some of those strategies include barcode medication administration within our electronic health records and medication delivery process. At the time of medication administration, nurses scan patient's armband then the medication to ensure that the appropriate medication is being delivered to a patient. Other risk-reduction strategies that we use include smart infusion pumps that have drug error reduction software built into them. We use the BD Alaris infusion technology which uses an algorithm to identify errors. The drug library that resides on the Alaris infusion pumps is developed and maintained at our corporate office in Pennsylvania. It is called the Guardrails. That being said, once that drug library is built and deployed for use in the organization, then a user of the pump, most often a nurse, has an opportunity to find a particular medication that he or she is getting ready to infuse in that drug library. And that drug library has default parameters built within it to help prevent both underdosing, overdosing and other untoward medication events that could occur. What we will look at specifically regarding reducing medication

administration errors is infusion pumps and the use of drug reduction software to help mitigate drug administration errors.

In addition, Participant 5 revealed that the BD Alaris pump generated a cost-savings of $621,250 from 71 preventive medication occurrences between October 19, 2019, and November 19, 2019, $743,750 from 85 preventive medication occurrences between November 19, 2019, and December 19, 2019, and $708,750 from 81 preventive medication occurrences between August 21, 2021, and September 21, 2021 (see Table 3 below).

Table 3

Harm Averted

*Severe harm averted and potential cost from the BD Alaris pump*Date/Month/Year	Severe Harms Averted	Total Potential Cost from severe harms averted
21-Sept 2021	64	$560,000
21-Aug 2021	81	$708,750
21-July 2021	49	$428,750
21-June 2021	44	$385,000
21-May 2021	63	$551,250
21-April 2021	38	$332,550
21-March 2021	56	$490,000
21-Feb 2021	52	$455,000
21-Jan 2021	115	$1,006,250
20-Dec 2020	70	$612,500
20-Nov 2020	89	$778,750
20-Oct 2020	53	$463,750
20-Sept 2020	54	$472,500
20-Aug 2020	80	$700,000
20-July 2020	82	$717,500
20-June 2020	63	$551,250
20-May 2020	58	$507,500
20-April 2020	60	$525,000
20-March 2020	91	$796,250
20-Feb 2020	66	$577,500
20-Jan 2020	105	$918,715
19-Dec 2019	58	$507,500
19-Nov 2019	85	$743,750
19-Oct 2019	71	$621,250

Relationship To Conceptual Framework

CAS/Six sigma DMAIC is a conceptual framework used to improve processes. DMAIC is a healthcare assessment tool (Ricciardi et al., 2020). Hospital leaders can utilize DMAIC to continuously enhance nurses' ability to deliver medications safely, reduce errors and reduce costs. Hospital leaders can also use DMAIC with technology to

eliminate internal impediments to the medication administration process and improve clinician performance. Participant 4 stated that during the pharmacist intervention strategy he implemented, he utilized DMAIC with various technological software including the EHR and MIDAS to identify the ineffective medication reconciliation process and reduce medication administration errors. Participant 5 responded that the strategy of bar-code scanning of patients prior to medication administration by nurses eliminated the problem of wrong patient identities and reduced errors. When hospital leaders adopt newer technologies, and incorporate them into the medication administration process, errors could be reduced resulting in reduced costs.

Theme 4: Continuous Audits

Audits are strategies which hospital leaders can utilize to reduce medication administration errors to reduce costs. Audits and feedbacks involve the use of an employee's clinical performance over a period of time to provide feedback to that individual for the purpose of behavioral change (Pedersen et al., 2019). An audit also involves comparing clinical practice with current guidelines or standards of care delivery, identifying areas for improvement, and implementing policy changes to meet the new standard. Since it is the duty of clinicians to deliver quality care to the patients, each clinician should implement a self-audit to ensure that their delivery standards are optimal. Nurses can self-audit their medication delivery practices and ensure compliance with hospital policies. The audit and feedback cycle is frequently used in healthcare organizations and has a positive effect in employee compliance (Pedersen et al., 2019).

Hospital leaders could utilize audits and feedback to change non-compliant nursing behaviors and improve the quality of medication administration (Glenngård & Anell, 2021). Changing and improving healthcare practices requires changing behaviors and clinical audit is an important tool that can facilitate that change (Paton, 2015).

Four participants (80%) indicated that medication auditing was a successful strategy used to reduce medication administration errors and reduce costs. Participant 1 indicated that checking and double-checking of medication orders by physicians, nurse practitioners, nurses and pharmacists was a strategic auditing method used to prevent or reduce the incidence of medication administration errors in the neonatal intensive care unit. Participant 2 stated that for as long as nurses adhere to policies and procedures pertaining to medication administration, the incidence of medication administration error is reduced. Participant 3 responded that during daily multidisciplinary rounds in the cardiovascular intensive care unit, medication orders audits were done by pharmacists and nurses prior to administration to patients resulting in reduced medication administration errors. This participant also stated that using this strategy reduced errors and hospital costs. Participant 4 emphasized that his pharmacy intervention strategy in the Emergency Department where pharmacists carried out daily audits of medications, and reconciled patient's home medication and physician-ordered medication, was a veritable strategy which reduced medication administration errors and reduced hospital cost. Participant 4 equally indicated that when he initiated medication auditing using one pharmacist, medication accuracy increased to 80% in May 2018, from 52% previously when nurses reviewed medication accuracy. This participant further stated that after he

added a second pharmacist to perform medication audits in October 2018, medication accuracy increased to 98% in February 2019. This participant concluded that a medication accuracy of 100% is hard to attain. He stated as follows:

> When we first started, we did a baseline audit for the nurses and physicians medication reconciliation process and found that there was 52% accuracy. When we started our pharmacist intervention program with one pharmacist, reconciliation accuracy went up to approximately 80% in May 2018. When we added a second pharmacist by October, the accuracy increased to 92% in December in 2018. By February 2019, accuracy had increased to 98% and this reduced medication administration errors. It is hard to obtain 100% accuracy because patients don't always report well what their medications are.

Lastly, this participant concluded that for 2021, the pharmacist intervention through medication auditing has ensured a total cost-savings of $1,408, 202.30 for his hospital (see Table 4 below).

Table 4

Pharmacist-Intervention Savings

Clinical Specialists	Goal	Total
Clinical Specialist Interventions-ID	$40,000	$42,965.31
Clinical Specialist Interventions-TOC	$40,000	$23,799.83
Clinical Specialist Interventions-ED	$40,000	$76,035.88
Staff Pharmacists		
Staff Pharmacists Interventions	$1,000,000	$870,461.69
Clinical Initiatives		
Pharmacists IV to PO Interventions	$10,000	$7,799.83
Purchasing Alternatives (Buyer)	$150,000	$277,037.30
Metered Dose Inhaler Conversion	$15,000	$12,105.96
Vasopressin Concentration Change	$30,000	$97,996.50
Total	$1,325,000	$1,408,202.30

Relationship to Conceptual Framework

CAS/Six sigma DMAIC ensures that work processes are continuously improved to sustain efficiency. Using DMAIC, hospital leaders can audit the work performance of non-compliant clinicians who consistently cause medication administration errors and provide feedback to them to change their behaviors. With DMAIC, hospital leaders can coordinate and structure new knowledge, facilitate bottom-up processes, and with innovations, lead change (Glenngård & Anell, 2021). Hospital leaders can utilize the adaptation tenet of the CAS theory to engender change in nurses' adherence to hospital policy and reduce medication administration errors. Participant 2 indicated that when nurses did not follow policies, used short-cuts, did not scan patients' arm bands, or scanned them after administering medications, errors occurred. As a result, that clinician was held accountable for violating the medication administration policy. Participant 5

revealed that when nurses did not follow the procedure to correctly administer medication from the BD Alaris IV pump, their managers were notified and the nurse was held accountable.

Applications to Professional Practice

The Centers for Medicare and Medicaid has penalized 25% of U.S. hospitals with the highest rates of hospital-acquired conditions including medication administration errors under the Hospital-Acquired Condition Reduction Program (Vsevolozhskaya et al., 2021). As a result, hospital leaders have the business problem of ensuring that the incidence of medication administration errors are reduced to avoid penalties. Hospital leaders have the responsibility to initiate guidelines, policies, and protocols to reduce medication administration errors. Hospital leaders have to identify the best practice with which to equip clinicians to deliver safe care to patients and reduce medication administration errors.

Hall (2019) reported that evidence-based, clinical practice guidelines must be adopted to prevent errors. Hall further opined that compliance with clinical practice guidelines is the simplest and most straight forward method to prevent medical errors and lower the risk of liability. Hospital leaders should ensure that clinicians comply with clinical practice guidelines and hold personnel violating these guidelines or policies accountable. Like Participant 5 stated, when clinicians failed to comply with the BD Alaris pump procedure and caused a medication administration error which the pump identified, they were reported to their managers for accountability.

The study findings indicated that hospital leaders utilized several strategies to reduce medication administration errors to reduce costs. Additionally, the findings of the study suggested that hospital leaders have used a compendium of strategies including leadership and technology to reduce medication administration error to reduce costs. While all participants acquiesced that medication administration errors still occurred, could not be totally eliminated due to multiple factors, they indicated that the strategies adopted to reduce them, were pertinent. Participant 4 utilized pharmacists to provide education and audits to reduce errors, while Participant 5 primarily advocated for the use of technology to reduce medication administration errors. This findings of this study also suggested that communication to clinicians was a significant strategy used in the reduction of medication administration errors. Lastly, the results of this study could provide a framework to assist hospital leaders in other healthcare systems on how to reduce medication administration errors in their hospitals and reduce costs.

Implications for Social Change

The aim of the World Health Organization (WHO) challenge released in 2017 was to attain a global commitment to lessen the severity of and reduce medication-related errors by 50% within five years (Afaya et al., 2021). Different nations work within their frameworks to achieve this goal and reduce medication administration errors. In the U.S., 1.5 million people are affected by medication administration errors annually (Cetin & Cebeci, 2021). Similarly, approximately 7.6 of 1000 outpatients and 1.2 of 1000 inpatients die annually from medication administration errors (Salami et al., 2019), so medication administration errors have direct impacts on patients. The implication for

social change is that a reduction in medication administration error occurrences could reduce adverse effects, including preventable deaths experienced by patients and enable them to live a better quality of life. Also, this study's findings could enable other hospital leaders to adopt these strategies that could be useful in reducing medication administration error occurrences in their healthcare facilities.

All participants responded that they have utilized different strategies to reduce medication administration errors. When medication administration error occurrences are reduced, regardless of the strategies used, it leads to positive patient outcomes. Also, patients will not suffer unnecessarily from medication administration errors caused by clinicians which could increase their length of stay in the hospital and further increase their risk of contracting other hospital acquired infections.

In addition, other hospital leaders could gain awareness of effective strategies for reducing medication administration errors and improving patient care. Another implication is that the study results could be a building block for further research on medication administration error occurrences. When hospital leaders implement the four-prong strategies of education-communication-technology and audit, identified as the primarily strategies used by all participants in this study, medication administration errors could be reduced and patients' health could be improved. A positive patient outcome may enhance a patient's health status, resulting in an improvement of care for the people in communities and advancing positive social change.

Recommendations for Action

Medication administration errors are deleterious to patients' wellbeing, a source of financial burden for the hospital and negatively impacts reputation and funding of hospitals (Ragau et al., 2018). Hospital leaders could adopt this study's findings, ensure that clinicians deliver adequate and safe care to patients and reduce the occurrence of medication administration errors. Also, when hospital leaders adopt the findings of the study, and successfully reduce medication administration errors, hospital costs from penalties imposed by the Centers for Medicare and Medicaid could be decreased. All participants in this study highlighted various strategies that they utilized to reduce medication administration errors and reduced hospital costs. One recommendation for action is for hospital leaders to adopt all the strategies enumerated in this study to reduce medication administration errors. By utilizing education, communication, technology and audits, hospital leaders could enhance patient safety, reduce the incidence of medication administration errors and reduce costs.

Another recommendation for action is for hospital leaders to institute a patient safety program. A patient safety program could be aimed at decreasing human error and engender buy-in from all stakeholders including but not limited to patients, nurses, physicians, pharmacists, respiratory therapists and aligning the hospitals' vision of patient safety initiatives to them. Hsieh et al. (2021) stated that reducing human error and increasing patient safety are vital measures for delivering patient care. Also, hospital leaders could sustain this patient safety program by carrying out periodic surveys of all stakeholders to ascertain best clinical guidelines with new evidence-based practices. As

Hsieh et al. (2021) further opined, enhancing medication and patient safety is the responsibility of all stakeholders including patients, and not just medical staff and hospital alone.

A last recommendation for action is for hospital leaders to adopt, institute, and sustain the pharmacist-led intervention strategy to reduce medication administration errors throughout the patients' continuum of care. Continuous quality improvement is a systematic evaluation of workflow to reduce errors and improve performance (Frenzel et al., 2020). Massah et al. (2021) indicated that medication care management should be done in an interprofessional collaboration culture to prevent errors. George et al. (2019) suggested that medication reconciliation is a highly complex and time-consuming process which requires demands significant skills. Participant 4 indicated that after he implemented the pharmacy intervention program to improve workflow, medication reconciliation accuracy improved resulting in reduced medication administration errors.

By implementing these recommendations, hospital leaders could reduce the incidence of medication administration errors to enhance patient safety and reduce hospital costs. Positive patient outcomes could indicate delivery of quality patient care. I plan to publish these research findings in business journals and present them at hospital educational events, training, seminars or conferences. I will also send a synopsis of the findings of this study to participants, and the officers who authorized my interviews at the different hospitals. This research study could contribute immensely to business research, improve healthcare practices, and shows how hospital leaders can adopt various strategies to reduce medication administration errors and reduce costs.

Recommendations for Further Research

My research study has provided information which hospital leaders could adopt to reduce medication administration errors and reduce cost. Managers can improve medication care and patient safety through continuous education of clinicians (Massah et al., 2021). The strategies recommended in this research were received from participants who are hospital leaders and not from clinicians who deliver care to patients daily.

I utilized a qualitative approach to explore strategies hospital leaders could adopt to reduce medication administration errors. Using a multiple case study, I obtained data from five hospital leaders in four hospitals in the Nevada area. I triangulated data from these multiple sources to arrive at my research findings. An area for future research is one which surveys clinicians' perspective on medication administration error reduction strategies and this may provide a different perspective on how to reduce medication administration error, improve patient safety and the quality of care.

Reflections

My desire to obtain a doctorate degree propelled my decision to advance my studies after I obtained my Masters degree in 2013. The journey for my DBA has been filled with vicissitudes. Having attended Walden University for my MBA, I was accustomed to a virtual classroom, but I still experience difficulty using advanced computer programs and have challenging typing and formatting skills. Nevertheless, I persevered and attended my online classes, submitted my assignments in a timely manner, utilized feedback from instructors and professors to enhance my academic work,

went through a difficult phase of selecting topic for my research study, and today, I find myself at the cusp of graduating with a doctoral degree.

The data obtained from responses to my interview questions provided insights into how hospital leaders have utilized various strategies to reduce medication administration errors to reduce hospital costs. I followed the interview protocol with each participant to ensure consistency. During my transcription of the voice-recorded audio interviews, utilization of the NVivo software which proved to be very challenging for me, and subsequent data analysis, I ensured that my personal bias and preconceived notions were not infused into participants responses or the data interpretation process.

The healthcare field has always fascinated me. Clinicians, including physicians, nurses, respiratory therapists, pharmacists, and a whole plethora of others use evidence-based research and practices, with new technological devices to perform modern day miracles, and save human lives. However, in the performance of their work, they cause errors, including medication administration errors which cause negative effects on patients, and sometimes lead to their death. When these errors occur, not only do the patients face harm, but the hospital faces penalties which increases their costs. During this research study, I met with hospital leaders who have utilized various strategies to reduce these medication administration errors to reduce costs. Their recommendations to reducing medication administration errors have been catalogued in this research, and when adopted by other hospital leaders, could lead to better patient outcomes and an improved quality of care.

Conclusion

The objective of this research study was to explore strategies hospital leaders adopt to reduce medication administration errors and reduce costs. The conceptual framework was the CAS/Six Sigma DMAIC theory which enabled hospital leaders to eliminate defects and improve work processes and manage clinicians in dynamic work environments where complex behaviors from agents result in medication administration error and cause adverse effects for patients. The data obtained from interview responses and other sources indicated that hospital leaders utilized specific strategies to reduce medication administration errors to reduce costs, while also enhancing patient safety.

The findings of this research suggested that education, communication, technology, and audits are vital strategies which could be harnessed to sustain an improved quality of care delivered to patients. In an era where governmental agencies like the CMS imposes penalties on hospitals for causing hospital-acquired errors including medication administration errors, it is imperative for hospital leaders to reduce medication administration errors and ensure that preventable costs are not incurred. When hospital leaders sustain these initiatives, using strategies highlighted by the participants in this study, medication administration error occurrences will be greatly reduced resulting in reduced costs for hospital.

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Appendix A: Interview Protocol

Participant Information

Date: _____

Participant code: _____

Introduction

1. I will introduce myself to the participant, review the purpose of my study, and seek consent for their participation.
2. I will start the interview with the following comment: Thank you for participating in this interview to explore strategies hospital leaders may adopt to reduce medical errors and improve hospital profits. I will record your answers with an audio-recording device and transcribe your responses to my questions. I may ask follow-up questions after each initial question. I will keep your answers and identity confidential, and you are free to end this interview at any time. Do you have any questions before starting?
3. I will activate the audio-recording device.
4. I will observe for nonverbal cues and ask follow-up questions as appropriate.

Interview Questions

1. How did you perceive the issue of medical error in your hospital?
2. How did you arrive at this perspective?
3. What successful strategies did you implement to reduce medical errors and improve profit?
4. What challenges did you face during the implementation of successful strategies?

5. How did you overcome the key challenges in implementing the strategies?
6. What tool did you use to measure the success of the strategies?
7. What method did you use to sustain the strategies during the implementation process?
8. What additional information can you provide about your strategy to prevent medical error occurrences?

Conclusion

1. I will conclude the interview with the following comment: I have no further questions for you, but I will send you an email with your printed responses. I will also contact you by telephone and conduct member-checking to validate my interpretation of your answers. I will also obtain any additional information you may wish to add. Thank you for your participation.

Member Checking

1. I will send the participant a synopsis of your responses via email and call them to validate if my summary is an accurate representation of their responses. I will ask if there is any information missing or if there is more information to add.
2. I will repeat this member checking process until the participant has no additional information to add.

Appendix B: Introductory Email

Dear Dr./Mr./Mrs.,

My name is Anthony Odili and I am a doctoral student at Walden University. I am pursuing a Doctor of Business Administration degree with specialization in leadership. I am conducting a study titled: *Exploring Strategies Hospital Leaders Use to Reduce Costs of Medication Administration Errors*. I plan to interview hospital leaders who have successfully used strategies to reduce medication administration errors and reduce costs. The implication for social change is that hospital leaders may gain awareness of effective strategies to utilize to prevent or reduce medication administration errors and improve patient care. Also, a positive patient outcome may enhance an individual's health status, indicate the effectiveness of the quality of the care and may lead to an improvement of care for the people in the community.

I obtained your name from the Chief Executive Officer. I invite you to participate in this study because you are a hospital leader and have experience using strategies to reduce medical errors and improve profits. If you choose to participate, I will ask you to enable me conduct a one-on-one interview with you which will include eight open-ended questions. I have included sample questions on the attached sample form. I will also perform follow-up calls to validate my interpretations to your responses. Your participation in this study is voluntary and any information you provide will be kept confidential. I will not identify you or your organization in my final publication. Should you desire, I will send you a summary of my study findings upon final approval.

I request that you sign the attached consent form if you choose to participate in this

study and send it back to me in an email. After I receive your signed consent, I will work with your office to schedule my visit and interview in a place that will ensure your comfort and confidentiality. Three weeks after the initial interview, I will schedule a follow-up call to ensure that I have interpreted your responses accurately. Please feel free to call or email me to discuss my invitation in detail. Thank you for your cooperation.

Anthony Odili