Title

Improving Operating Room Supply Chain Efficiency and Cost-Reduction Using Data Analytics

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Improving Operating Room Supply Chain Efficiency and Cost-Reduction Using Data Analytics

A dissertation submitted in partial satisfaction of the

requirements for the degree

Doctor of Nursing Practice

by

Santino Luigi Estrera

2024

ABSTRACT OF THE DISSERTATION

Improving Operating Room Supply Chain Efficiency and Cost-Reduction Using Data Analytics

by

Santino Luigi Estrera

Doctor of Nursing Practice

University of California, Los Angeles, 2024

Professor Kenneth David Bailey, Co-Chair

Professor Paul Michael Macey, Co-Chair

The shifting landscape of healthcare and economic constraints necessitate hospitals and operating rooms (ORs) to improve the management of supply expenses while upholding patient care standards. The quality improvement (QI) project seeks to streamline operational processes and curtail unnecessary expenditures by leveraging advanced data analytics and implementing a two-bin supply delivery system. Key objectives encompass enhancing the supply chain's efficiency, mitigating stockout instances, and optimizing procurement practices. Using Lean Six Sigma (LSS) methodologies to streamline OR supply chain processes, implementing a two-bin supply delivery system, and using data analytics, the QI project demonstrates tangible

improvements in OR supply replenishment efficiency. The successful implementation of these strategies also leads to substantial cost savings and fosters a marked enhancement in operational efficacy within the perioperative environment.

The dissertation of Santino Luigi Estrera is approved.

Ali Tayyeb

Dante Anthony Tolentino

Kenneth David Bailey, Co-Chair

Paul Michael Macey, Co-Chair

University of California, Los Angeles

2024

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BIOGRAPHICAL SKETCH

Luigi Estrera, MBA, MHA, BSN, RN, NEA-BC, CNOR, is currently the Director of Perioperative Services at Children's Hospital Los Angeles (CHLA) in Los Angeles, California. CHLA is a renowned pediatric medical center that provides compassionate and comprehensive care to children from Southern California and beyond. With a history of over a century, CHLA is committed to advancing pediatric medicine through innovative research, cutting-edge technology, and a multidisciplinary approach to healthcare. In this role, Luigi leads the operations of Perioperative Services, which include the Operating Rooms, Ambulatory Surgery Center, Surgical Admitting, Preoperative and Post-Anesthesia Care Unit, Perioperative Materials Management, and Sterile Processing Department. As Director, he is also responsible for the overall strategic planning of all surgical programs, enhancement of quality of patient care, and personnel or resource management.

Before joining CHLA, Luigi was the Chief of Perioperative and Procedural Services at the Department of Veterans Affairs (VA) – Greater Los Angeles Healthcare System. Immediately prior to working at the VA, he was the Director of Perioperative Services for the New York Eye Ear Infirmary location of the Mount Sinai Health System in New York City, where he helped drive and support various surgical projects and initiatives of the Mount Sinai Downtown transformation. Additionally, Luigi has held various perioperative leadership roles for several university hospitals and academic health systems, such as Keck Medicine of USC, UCLA Health System, UCI Health, and Cedars-Sinai Medical Center.

Luigi is a United States Navy Veteran who served in the prestigious Construction Battalion (SeaBee) of the U.S. Navy. He earned his Master's Degree in Health Administration at the University of Southern California, his Master of Business Administration from the University

of California – Irvine (UCI), his Registered Nurse First Assistant at the University of California – Los Angeles Extension, Bachelor of Science in Nursing from the Far Eastern University and a Diploma in Management from De La Salle University.

Luigi is board-certified in executive nursing administration and as a perioperative registered nurse. He is an active member of the American Organization for Nurse Leaders (AONL) and the Association of Perioperative Registered Nurses (AORN), where he is currently serving as a leadership mentor to the association members

CHAPTER ONE: INTRODUCTION

Every year, hospitals in the United States (U.S.) OR costs contribute to overall healthcare spending amounting to a staggering $3.5 trillion by inefficiently managing surgical supplies (Hellmann, 2018). This inefficiency results in wasted supplies due to expiration or niche item disposal, overspending on products, transportation, and labor-intensive inventory management processes (Chasseigne et al., 2018). However, potential savings lie in efficient supply chain management practices (Park & Dickerson, 2009).

Optimizing supply chain management is paramount for hospitals, promising substantial benefits such as cost reduction, waste minimization, and resource optimization (Ahmadi et al., 2018). Efficient supply chains ensure timely procurement at optimal costs, contributing to improved financial performance, patient care, and safety. Moreover, they streamline operations, reducing storage requirements, handling costs, and administrative burdens, ultimately enhancing workflow and staff productivity (Park & Dickerson, 2009).

Despite these opportunities, inefficient OR supply chain management persists, leading to excessive spending, stockouts, and administrative complexities (Malay, 2019). This challenge is particularly pronounced in the OR of an academic pediatric hospital in a large metropolitan area in California, where effective supply management is paramount. Therefore, optimizing the OR supply management processes through data analytics and innovative supply delivery systems became imperative.

The project aims to address these challenges by collaborating with a third-party supply chain company known for its innovative advanced data analytics. Leveraging analytics, the project aims to enhance supply restocking efficiency, reliability, and cost-effectiveness (Bhatia & Mittal, 2019). The project anticipates significant improvements in supply management by

optimizing restocking procedures, minimizing stockouts, and eliminating manual errors (Park & Dickerson, 2009). Furthermore, it seeks to reduce costs by eliminating excess inventory, identifying cost-saving opportunities, and reallocating savings to vital areas like patient care and research (Park & Dickerson, 2009). Partnering with an analytics solution provider ensures ongoing support and expertise, fostering sustained cost reductions and operational excellence in the OR.

Problem Statement

The previous OR supply chain process and inventory management system functioned under a labor-intensive framework prone to errors, manifesting in challenges such as surplus inventory, stockouts, and financial inefficiencies. These inefficiencies not only strained operational resources but also jeopardized patient care quality. The rationale for the change was rooted in the imperative to bolster supply chain efficiency, curtail costs, and reallocate resources toward enhancing patient care delivery. Recognizing the critical role of effective OR supply chain management in sustaining high-quality surgical services, the need for transformation became evident.

The deficiencies of the existing process underscored the urgency for an overhaul, necessitating a transition towards a more streamlined and data-driven approach to inventory management. The labor-intensive nature of the original process not only consumed valuable time and resources but also introduced a high degree of error susceptibility, leading to suboptimal inventory levels and frequent stockouts. These shortcomings posed significant challenges in maintaining seamless perioperative operations and posed potential risks to patient safety and care continuity.

Moreover, the financial implications of inefficient inventory management were substantial, with excess inventory tying up capital and recurrent stockouts disrupting procedures and necessitating costly rush orders. The prevailing circumstances demanded strategic intervention to optimize the supply chain, mitigate financial strain, and enhance operational efficiency. Thus, the decision to implement a data-informed, two-bin supply delivery system emerged as a proactive measure to address these pressing concerns and drive tangible improvements in OR supply chain management.

The project was implemented in the main OR of an academic pediatric hospital in a large metropolitan area in California. The department has fifteen OR suites where surgical care of vulnerable patient populations is entrusted, necessitating stringent adherence to efficiency and safety standards. By focusing on this setting, the project demonstrated the relevance and applicability of enhanced supply chain practices in optimizing surgical care delivery, serving as a model for similar healthcare institutions grappling with OR supply chain management challenges.

PICOT Question

In this DNP scholarly project, the problem, intervention, comparison, outcome, and time (PICOT) question was identified to examine the use of data analytics through a third-party supply chain company to turn data into actionable information that supports decision-making and effectively implement the changes as a result of those decisions. The PICOT question is: In surgical patients of the hospital's main operating room (P), how does the use of data analytics (I) compared to no data analytics (C) affect supply chain efficiency and reduce costs (O) during a 10-week period (T)?

CHAPTER TWO: THEORETICAL FRAMEWORK

Many hospitals have adopted Lean Six Sigma methodologies as their process improvement framework (D'Andreamatteo et al., 2015). LSS combines Lean principles, emphasizing waste reduction and process efficiency, with Six Sigma's statistical methods for process variation reduction. While industries like manufacturing and automotive have successfully utilized LSS methodologies to improve operational performance substantially, healthcare organizations can also benefit from its adaptability. Lean thinking emphasizes creating value while minimizing waste and emphasizes purpose, process, and people (Lean Enterprise Institute, 2022). LSS is a mindset that seeks to achieve optimal value with fewer resources and less waste, promoting continuous experimentation to achieve excellent value with zero waste (Lean Enterprise Institute, 2022).

The development of LSS methodologies can be attributed to Taiichi Ohno's articulation of the Toyota Production System, which aimed to enhance efficiency by eliminating specific types of waste that consume time and resources without adding value. LSS aims to transform how organizations think and operate, focusing on problem-solving and establishing processes requiring minimal human effort and time while minimizing defects. The overarching goal of lean is to foster a culture of continuous improvement and empower individuals at all levels of the organization to identify and address inefficiencies (Tagge et al., 2017).

This DNP scholarly project is aimed at improving OR supply chain management through the use of data analytics. LSS methodologies, which adopted the Plan-Do-Study-Act (PDSA) framework as its problem-solving cycle, are suitable for this project because the model incorporates a scientific method of proposing a change in a process, implementing the change, measuring the results using data, and taking action (Butts & Rich, 2022).

CHAPTER THREE: REVIEW OF LITERATURE

This evidence search identified relevant literature on data analytics as an intervention to improve supply chain efficiency in the OR and reduce costs using data analytics. The comprehensive search gathered valuable insights into the topic and informed the development of evidence-based recommendations for the project.

Two scholarly databases were used for related literature using data analytics to improve supply chain efficiency and reduce costs in the OR. The databases used were Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus with Full-Text and PubMed. The search strategy incorporated relevant keywords and terms related to supply chain, efficiency, data, analytics, cost reduction, operating room, and Lean. The inclusion criteria for articles consisted of studies published in peer-reviewed journals within the last fifteen years that focused on using data analytics in the OR setting to improve supply chain efficiency and reduce costs. Studies not available in English or irrelevant to the research question were excluded. The search yielded twenty-one articles after removing duplicates, but only six were used for this paper.

Synthesis of Literature Review

The reviewed literature highlighted several key findings regarding using data analytics to improve supply chain efficiency and reduce costs in the main OR. The studies indicated that implementing data analytics tools and using Lean as a framework positively influenced decision-making processes, operational efficiency, and financial outcomes. Data analytics enabled real-time monitoring of inventory levels, demand forecasting, and optimization of supply chain logistics, leading to reduced stockouts, decreased waste, and improved inventory management. By leveraging data analytics, healthcare organizations were able to identify trends, patterns, and potential inefficiencies within the supply chain, allowing for proactive decision-making and cost-

saving opportunities. Moreover, data analytics facilitated the identification of pricing variations, contract negotiation opportunities, and the assessment of vendor performance, contributing to cost reduction efforts.

Bhatia and Mittal (2019) explored the potential of big data analytics (BDA) in healthcare supply chain settings for quality improvements and better patient care. The authors discussed adopting BDA tools, their impact on operational efficiency, and reducing human errors. The article also discussed the paradigm shift in healthcare organizations towards supply chain management (SCM) strategies to address challenges such as rising costs, poor quality, nursing shortages, and employee dissatisfaction. The authors emphasize that healthcare supply chain management can lead to substantial cost savings and margin improvements, similar to its impact in other industries.

Furthermore, the authors employed a descriptive and explanatory approach to explain supply chain management concepts and the potential role of big data analytics in healthcare settings. It outlined the various players in the healthcare supply chain, including manufacturers, purchasers, and healthcare providers. It discussed the importance of effective collaboration among these entities to create an efficient and effective supply chain. The authors highlighted using BDA to transform the healthcare supply chain by analyzing vast data from various sources, including sensors, patient records, and clinical data.

The study's strengths lie in its comprehensive overview of the challenges and opportunities associated with implementing BDA in the healthcare supply chain. It provided a detailed classification of advanced analytics (descriptive, predictive, and prescriptive) and emphasized the need for data integration, real-time analysis, and data quality in healthcare

settings. The authors also examined obstacles such as data confidentiality, lack of experts, and incompatible data systems.

However, the article lacked empirical evidence or original research data to support its claims. It primarily served as a theoretical exploration of the potential benefits and challenges of incorporating big data analytics into healthcare supply chain management. Additionally, the article does not provide specific statistical information or methodologies used in data collection and analysis. This article is relevant to this project on improving OR supply chain efficiency and cost reduction using data analytics. It highlights the growing importance of supply chain management in healthcare and the potential impact of big data analytics. The article's lack of empirical evidence and specific methodologies may limit its direct applicability as primary evidence for the project.

Chasseigne et al. (2018) examined the costs of disposable and reusable supplies wasted during surgeries. The study employed an observational and prospective design to analyze the cost of wasted medical supplies during surgical procedures. It combined quantitative cost assessments with qualitative investigations into the reasons for wastage. The research demonstrated the potential for significant cost savings by reducing wasted supplies in the OR. Anticipating surgeon needs was identified as a common reason for wastage. Reducing waste improved cost efficiency and had a positive ecological impact.

The study's findings directly supported the evidence base of the DNP scholarly project aimed at enhancing OR supply chain efficiency and cost reduction. The study aligns with the project’s data-driven supply chain management improvement objective by quantifying the wastage cost and identifying its reasons. The identified potential cost savings underscored the importance of optimizing supply utilization to reduce financial burden.

While the study provides valuable insights, specific gaps suggest avenues for future research. Exploring variations in wastage patterns across healthcare institutions or countries could provide a broader perspective. Additionally, examining the impact of interventions to reduce wastage and enhance supply chain efficiency could offer practical solutions. The research article critically analyzes the economic implications of wastage in surgical supplies. Despite limitations, its insights contribute to understanding supply-related costs in surgical procedures. The study's alignment with the project's goals makes it a valuable source of evidence for implementing data-driven strategies to optimize OR supply chain efficiency and cost reduction.

Cozzoli et al. (2022) explored the application of big data analytics in healthcare organization management. The authors identified common elements across studies, including the potentialities of big data analytics, resource management, health surveillance system management, and technology for healthcare organization management. The review emphasized the need for standardization, integration of devices, and data analysis protocols to enhance healthcare organization performance.

Malay (2019) emphasized the influence of costs associated with materials and implants used in the OR. The author highlighted surgeons' impact on procedure costs by selecting items used in the operation. The importance of surgeons being aware of costs and selecting cost-effective items was stressed to enhance population-level outcomes and control healthcare expenditures.

Millett et al. (2020) addressed the pressing issue of containing healthcare costs while maintaining quality care, particularly in high-cost procedures like knee replacements, through a pilot study investigating the impact of a novel technology that automates surgical processes and integrates with hospital data systems. The integration aimed to streamline OR workflows, reduce

waste, and enhance efficiency. The study employed a pilot design, deploying the technology across three hospitals and involving three surgeons. While the pilot design provided preliminary insights, it limits generalizability. Furthermore, the study's lack of detailed demographic and clinical data hampered a comprehensive comparison between traditional and automated patient cohorts. Nonetheless, the study's real-world data and focus on supply cost reduction make its findings relevant to the project's objectives. The study's strengths lie in its real-world applicability and integration of innovative technology, resonating with the project's emphasis on data analytics. However, the absence of detailed surgical time data and the lack of a control group pose limitations. These gaps align with the project's rationale, emphasizing the importance of using data analytics to enhance OR supply chain management. Overall, the study underscored the potential effectiveness of technology-driven approaches in improving supply chain efficiency and cost reduction, aligning well with the project's aims.

Park and Dickerson (2009) explored the significance of supply management in ORs, mainly focusing on its economic impact. The article presented a review paper rather than a primary research study. It synthesized existing information on supply management in ORs and outlined potential strategies for achieving cost savings. The authors discussed supply management in the OR, focusing on perpetual inventory systems and their benefits over periodic inventory systems. Park and Dickerson also outlined operational management concepts, including perpetual inventory system utilization, linking scheduling and supply order systems, just-in-time delivery, utilization patterns, inventory turnovers, standardization of surgical practices, and vendor consignment. They also suggested applying Lean principles to supply management.

The article emphasized the potential benefits of a perpetual inventory system and outlined strategies for supply management improvement. However, it lacks concrete data or case studies demonstrating these strategies' implementation and effectiveness in achieving cost savings. Future research could involve empirical studies examining the strategies' outcomes. While its lack of empirical data is a limitation, its focus on operational management principles and practical strategies makes it relevant for healthcare professionals aiming to optimize supply chain efficiency and reduce costs. Its alignment with the project's goals underscores its value as a source of evidence-based guidance.

The literature synthesis reveals a comprehensive exploration of healthcare supply chain efficiency and cost reduction, drawing from diverse studies. The reviewed literature collectively underscored the critical role of supply chain management in contemporary healthcare settings. Notably, Bhatia and Mittal (2019), Chasseigne et al. (2018), and Park and Dickerson (2009) emphasized the pivotal significance of supply chain optimization for enhancing cost-effectiveness, quality improvements, and, ultimately, patient care. These studies resonate with the increasing recognition of supply chain management's pivotal role in addressing escalating costs and ensuring optimal resource allocation.

An overarching theme from the synthesis is the potential of data analytics and technology integration in revolutionizing healthcare supply chain practices. Bhatia and Mittal (2019), Millett et al. (2020), and Park and Dickerson (2009) stressed the transformative influence of data analytics, massive data analytics, in refining supply chain operations. These studies align with the contemporary emphasis on leveraging data-driven insights to streamline operations, reduce waste, and achieve significant cost savings.

Despite these commonalities, distinctions among the studies' focus and methodologies offer a nuanced perspective. While Chasseigne et al. (2018) and Millett et al. (2020) delved into empirical investigations, emphasizing quantification of wastage costs and piloting innovative technologies, Bhatia and Mittal (2019) and Park and Dickerson (2009) adopt a more theoretical approach, focusing on theoretical discussions and comprehensive reviews. Such methodological differences point out the multifaceted nature of the field and the diverse avenues through which supply chain optimization can be approached.

However, these studies also present certain limitations that create opportunities for the project. Notably, the absence of empirical evidence in Bhatia and Mittal's (2019) and Park and Dickerson's (2009) studies emphasizes the need for robust empirical investigations to substantiate the theoretical frameworks discussed. Furthermore, the interdisciplinary nature of supply chain management, ethical considerations related to material selection, and the influence of leadership roles warrant further exploration. These gaps align with the project's focus on utilizing data analytics to enhance OR supply chain efficiency and cost reduction, offering valuable avenues for further research and practical implementation.

CHAPTER FOUR: METHODS

Ethical Considerations

The project adhered to the guidelines set by the Institutional Review Board (IRB) of Children’s Hospital Los Angeles (CHLA) as the identified project implementation site. The IRB determined that the project does not require IRB review because the protection of human subjects does not apply to the quality improvement activities related to the project (see Appendix A). Furthermore, no patient data or protected information was used throughout the project.

Additionally, ethical considerations related to the allocation of resources and cost-reduction efforts were carefully examined to ensure equitable and responsible implementation.

Project Design

This QI project was designed to enhance processes and outcomes in the OR, specifically focusing on improving supply chain efficiency and reducing costs. The methodology for this project was structured around the Lean Six Sigma framework, a well-established approach for process improvement in healthcare (Lean Enterprise Institute, 2022). Lean Six Sigma combines Lean principles, emphasizing waste reduction and process efficiency, with Six Sigma's statistical methods for process variation reduction.

Sample and Setting

The project was conducted in the Main OR of an academic pediatric hospital in Los Angeles, California. The hospital's OR serves as the primary setting for various surgical procedures, offering a diverse and dynamic environment for process improvement initiatives. The sample for this project will include OR supply data and financial data related to OR supplies. An additional sample includes key stakeholders and participants involved in the OR supply chain, such as OR staff. While patients were not directly involved in the project, patient outcomes and experiences were indirectly impacted by the efficiency improvements achieved through this project.

Implementation

The implementation phase involved pre-implementation activities such as workflow revisions, space engineering, and mock events (see Appendix B). After completing these activities, the project focused on introducing the two-bin supply delivery system into the OR environment and seamlessly integrating data analytics tools. This phase marked a significant

shift towards real-time monitoring of inventory levels, demand forecasting, and optimizing supply chain logistics to enhance efficiency and reduce costs.

Introducing the two-bin supply delivery system revolutionized the traditional approach to supply replenishment. This system, characterized by its simplicity and effectiveness, involved organizing supplies into two bins: one for active use and another for backup stock. When the active bin was depleted, staff would automatically switch to the backup bin, triggering a reorder for replenishment. This approach minimized stockouts, reduced manual errors, and ensured a continuous supply of essential items during surgical procedures.

In parallel, integrating data analytics involved deploying sophisticated software capable of analyzing vast amounts of data from various sources within the OR supply chain. This tool enabled the project team to gain insights into supply usage patterns, identify trends, and pinpoint potential inefficiencies in the supply chain process. The project facilitated proactive decision-making and streamlined supply management processes by harnessing the power of data analytics.

Furthermore, ongoing collaboration with the analytics solution vendor was crucial in supporting the implementation process. The vendor provided technical expertise, guidance, and support throughout the deployment of the data analytics tool, ensuring smooth integration with existing systems and workflows. Additionally, the vendor offered training sessions to OR supply chain staff, equipping them with the necessary skills to leverage the new technology effectively (see Appendix C).

As the implementation phase progressed, the project team closely monitored KPIs to assess the effectiveness of the interventions. Metrics such as item availability, fill rate or supply replenishment efficiency, stockouts, and stat calls or immediate requests were tracked to measure

the impact of the implemented changes. Regular feedback was received from OR staff to gather qualitative insights into their experiences with the new systems and processes.

Overall, the implementation phase represented a pivotal stage in the project, marking the transition from planning to action. The project aimed to drive tangible improvements in OR supply chain efficiency by implementing the two-bin supply delivery system and leveraging data analytics, ultimately enhancing patient care and operational effectiveness.

Data Collection

Data collection occurred throughout the project implementation using the third-party analytics solution, which pulls supply chain data from the hospital's enterprise resource planning (ERP) system. This includes data on scanning frequency, inventory levels, stockouts, item utilization, stat calls, and fill rate. After implementation, data was continuously monitored to assess the sustained impact on supply chain efficiency and cost reduction.

Analysis

Upon completing the project, the intended outcome is to improve supply replenishment efficiency, reduce costs through inventory reduction, and enhance staff satisfaction. The insights and findings will contribute significantly to the decision-making processes and refining supply chain management in the OR.

Quantitative data was analyzed using descriptive statistics and trend analysis to identify improvements in the KPIs identified.

CHAPTER FIVE: RESULTS

Five-week data in the Main, Ophthalmology and Otolaryngology (ENT) supply rooms show substantially improved supply chain management metrics. A total of 993 unique items were successfully integrated into the new system, demonstrating a comprehensive transition.

Notably, 223 items, constituting 18% of the total items in the supply room, were eliminated during this process, streamlining the inventory and reducing unnecessary items.

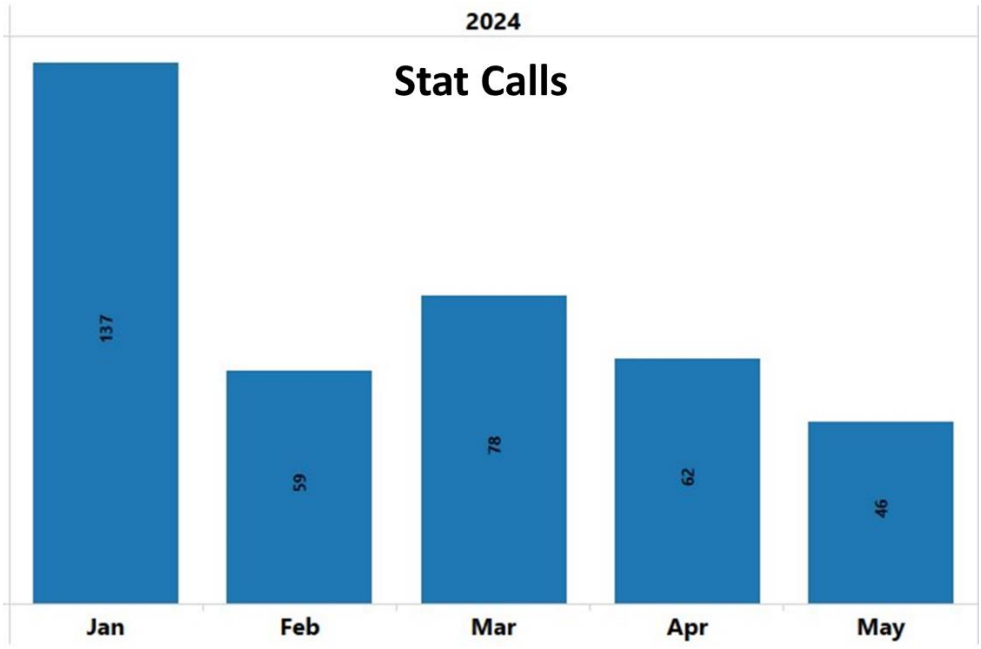
KPIs indicated notable enhancements in supply replenishment efficiency, with a fill rate of 86.31% achieved. Additionally, the occurrence of stockouts decreased significantly, with only 158 total instances recorded during the five weeks. The high item availability rate of 99.59% underscored the new system's effectiveness in ensuring a continuous supply of essential items (see Figure 1).

Figure 1: *Daily Management Dashboard*

Furthermore, the project reduced stat calls or immediate requests from the OR staff, indicating improved responsiveness and proactive management of supply needs (see Figure 2). By leveraging data analytics, the project team identified trends, patterns, and potential inefficiencies within the supply chain, enabling informed decision-making and targeted interventions. These

results highlighted the tangible benefits of implementing the two-bin supply delivery system and data-driven strategies in enhancing supply chain efficiency and reducing costs within the OR.

Figure 2: *Stat Calls*



CHAPTER SIX: DISCUSSION

The implementation of the project was not without its challenges, yet effective strategies were employed to overcome barriers to change. Interdisciplinary collaboration was pivotal in facilitating communication and cooperation among various stakeholders. Ongoing support from the analytics solution vendor was instrumental in addressing technical issues and ensuring the smooth integration of data analytics tools.

Key lessons learned from the project can benefit the OR supply chain team and the clinical staff. One of the lessons learned is the importance of adaptability in navigating a complex healthcare environment. Flexibility in approach allowed the project team to respond to unforeseen challenges, such as the need for pre-implementation activities, and adjust

implementation strategies as needed. Additionally, a culture of continuous improvement was fostered, encouraging feedback and reflection to refine processes iteratively.

The project's positive outcomes, including improved operational efficiency and cost reduction, provided compelling evidence to implement a permanent change in the process. The demonstrated improvements in supply replenishment efficiency, reduced stockouts, and decreased surgical supply costs underscored the tangible benefits of the new system.

It is essential to sustain the momentum gained from the project and ensure ongoing monitoring and evaluation of the implemented changes. Continued collaboration among stakeholders was crucial in addressing emerging challenges and optimizing the new process further.

The project's success in overcoming barriers to change and achieving significant improvements in supply chain management supports the decision to implement a permanent change. By fostering a culture of adaptability and continuous improvement, healthcare organizations can effectively navigate change and realize sustainable operational efficiency and cost reduction improvements.

Implications for Practice

The project promises to bring significant advancements to clinical practice and offers substantial avenues for future research endeavors. Furthermore, this project addresses a critical issue plaguing healthcare facilities – the inefficient management of supply chain in the OR.

At the core of this project, it seeks to revolutionize how OR supplies are managed. The project showed supply restocking as a highly efficient process by leveraging data analytics and implementing a two-bin supply delivery system. The potential for substantial cost savings is significant. These savings are not just numbers on a balance sheet. They can be reinvested in

vital areas such as patient care, research, and development. Ultimately, this project presented marked improvements in significant efficiency within the OR, directly impacting the hospital's financial health.

Limitations

Limitations of this methodology include the potential for resistance to change among OR staff, the need for ongoing support and training, and the challenge of sustaining process improvements over the long term. These limitations were addressed through regular communication, education, and ongoing monitoring and evaluation.

CONCLUSION

The project’s positive implementation of data-driven approaches in perioperative supply chain management has led to transformative outcomes, exemplifying the potential of leveraging analytics in healthcare operations. The improvements observed in supply chain efficiency and cost reduction underscored the significant impact of data analytics on enhancing healthcare resource allocation and operational efficiency. This project has gained valuable insights into the effectiveness of data-driven strategies in optimizing perioperative supply management processes. These findings contribute to the broader objectives of improving healthcare operations and highlight the importance of continued investment in data-driven initiatives for sustained improvements in patient care delivery. Moving forward, ongoing commitment to continuous improvement and interdisciplinary collaboration will be crucial in maximizing the benefits of data-driven approaches and driving further advancements in OR supply chain management. This project served as a compelling demonstration of the potential of data analytics to revolutionize healthcare operations. It underscored the importance of embracing innovative solutions to meet the evolving needs of healthcare delivery.

APPENDICES

Appendix A: CHLA IRB Review Notice

Apr 16, 2024, 11:17am

To: Santino Estrera, MBA, MHA, BSN, RN, NEA-BC, CNOR
CLINICAL SERVICES - CHLA

From: Children's Hospital Los Angeles Institutional Review Board

Re: CHLA-24-00097 Santino Estrera, MBA, MHA, BSN, RN, NEA-BC, CNOR
Improving Operating Room Supply Chain Efficiency and Cost-Reduction Using Data Analytics (Improving Operating Room Supply Chain Efficiency and Cost-Reduction Using Data Analytics)

NNOTICE OF REGULATORY DETERMINATION: NOT RESEARCH – QUALITY IMPROVEMENT

Review from: 4/16/2024

The above-named submission was reviewed by the CHLA IRB.

This opinion is based on federal regulation 45 CFR 46 and associated guidance. Per 45 CFR 46.102(l), the definition of research includes "…a systematic investigation, including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge. Activities that meet this definition constitute research for purposes of this policy, whether or not they are conducted or supported under a program that is considered research for other purposes…"

The Office of Human Research Protection has issued guidance indicating that quality improvement projects do not meet the definition of research. This guidance states:

Question 2: Do the HHS regulations for the protection of human subjects in research (45 CFR part 46) apply to quality improvement activities conducted by one or more institutions whose purposes are limited to: (a) implementing a practice to improve the quality of patient care, and (b) collecting patient or provider data regarding the implementation of the practice for clinical, practical, or administrative purposes?

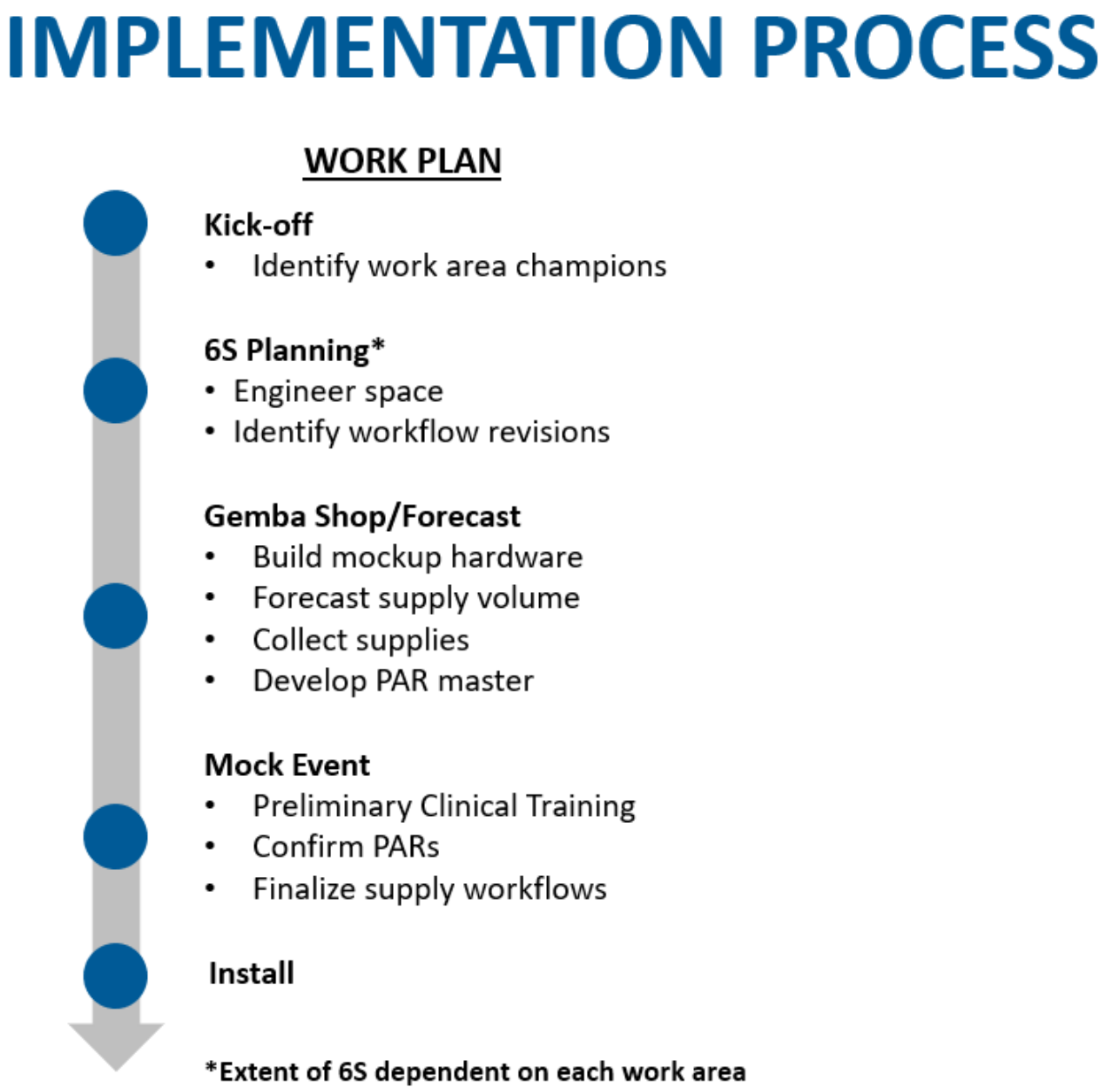
Answer: No. Such activities do not satisfy the definition of "research" under 45 CFR 46.102(d), which is "…a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge…" Therefore the HHS regulations for the protection of human subjects do not apply to such quality improvement activities, and there is no requirement under these regulations for such activities to undergo review by an IRB, or for these activities to be conducted with provider or patient informed consent.

This project seeks to streamline operational processes and curtail unnecessary expenditures by leveraging advanced data analytics and implementing a two-bin supply delivery system. Therefore, the CHLA HSPP has determined this project is not research and does not require IRB review.

This regulatory determination is granted based on the IRB submission describing the activity. Please note that any future changes to the project may affect its determination, and you may want to contact the CHLA Human Subjects Protection Program (HSPP) office. CHLA does not impose an expiration date on its determinations of research.

This is an auto-generated email. Please do not respond directly to this message using the "reply" address. A response sent in this manner cannot be answered. If you have further questions, please contact iStar Support at (323) 276-2238 or istar@usc.edu.

Appendix B: Implementation Process Flow



Appendix C: BlueBelt Training Overview

BlueBelt Training

Primary Function:

- Maintenance of the BlueBin system
- Build of the BlueBin System
- Keeper of the Standards

Blue Belts are Responsible for:

- Kanban quantity adjustments
- Adds & Removals
- QCN management
- Rounding audits
- General Node maintenance
- Stage rounding & maintenance
- HuddleBoard updates
- Visual standards compliance
- Reports issues for App as needed
- Builds new Nodes as needed
- Explains process to clinical staff (trains)
- Communicate program status to leadership
- Responds to program errors w/needed urgency
- Misc. post-install projects
- Ensures all administrative files within BlueQ App are up to date

TABLE OF EVIDENCE

Author, Year	**Purpose**	**Sample & Setting**	**Methods** **Design** **Interventions** **Measures**	**Results**	**Discussion, Interpretation, Limitation of Findings**
Bhatia, A., & Mittal, P. (2019, January). Big data driven healthcare supply chain: understanding potentials and capabilities. *SRN Electronic Journal*. doi:10.2139/ssrn.3464217	To explore the potential and capabilities of implementing big data analytics in the healthcare supply chain.	The article does not provide specific information about a sample or a particular setting.	The article employs a descriptive and explanatory approach to convey its concepts. It discusses supply chain management principles, the roles of various stakeholders, and the potential of big data analytics. The article does not involve empirical research or interventions, and therefore, does not have a specific research design, measures, or interventions.	The article does not present empirical research results in terms of numerical data or statistical analysis. Instead, it presents a discussion of the potential benefits, challenges, and opportunities associated with implementing big data analytics in the healthcare supply chain.	- Big data analytics holds potential to transform healthcare supply chain management. - Descriptive, predictive, and prescriptive analytics offer valuable insights for improving patient care and operational efficiency. - Challenges include unstructured data, patient data confidentiality concerns, lack of expertise, and data system compatibility. - Despite its potential, the article lacks empirical evidence and original research data. - The absence of specific methodologies and empirical results limits the article's concrete findings. - The discussion centers on the potential benefits and challenges of integrating big data analytics into healthcare supply chains. - Big data analytics could enhance patient care quality and efficiency, but practical implementation requires addressing existing gaps.

Author, Year	Purpose	Sample & Setting	Methods Design Interventions Measures	Results	Discussion, Interpretation, Limitation of Findings
Chasseigne, V., Leguelinel-Blache, G., Nguyen, T. L., de Tayrac, R., Prudhomme, M., Kinowski, J. M., & Costa, P. (2018, May). Assessing the costs of disposable and reusable supplies wasted during surgeries. *International journal of surgery, 53*, 18-23. doi:https://doi.org/10.1016/j.ijsu.2018.02.004	To evaluate the cost and reasons for wasted supplies in the OR during surgical procedures.	Sample: 50 routine procedures and five non-scheduled procedures - digestive (n = 20) - urologic (n = 20) - gynecologic surgery (n = 15) Setting: Operating Room (OR) of a French university hospital with a total of 1980 beds.	Methods/Design: - Observational and prospective study to evaluate the cost and reasons for wasted supplies in the OR. - Single-site observational study conducted in a French university hospital between July and August of 2015. Measures/Instruments used: - Cost of Wasted Supplies - Reasons for Wastage - Circulator Retrievals - Perception Survey	The study observed a total of 55 surgical procedures, including 50 routine procedures and 5 non-scheduled procedures.	- The median cost of open unused devices (wasted supplies) per surgical procedure was €4.1, representing up to 20.1% of the total cost allocated to surgical supplies. - The study highlights the significant impact of wasted supplies on hospital expenditure and the potential for cost savings by addressing wastage. - Strength: The study used direct observation by a trained pharmacist to collect data, enhancing the reliability of the findings. - Limitation: The study was conducted in a single-site French university hospital, limiting generalizability to other healthcare settings. - Weakness: The lack of a control group or comparison group limits the ability to establish causal relationships.

Author, Year	Purpose	Sample & Setting	Methods Design Interventions Measures	Results	Discussion, Interpretation, Limitation of Findings
Cozzoli, N., Salvatore, F. P., Faccilongo, N., & Milone, M. (2022, June). How can big data analytics be used for healthcare organization management? Literary framework and future research from a systematic review. *BMC health services research, 22*(1), 809. doi:https://doi.org/10.1186/s12913-022-08167-z	To investigate and understand the impact of Big Data Analytics (BDA) on healthcare organization management.	34 scientific contributions obtained through a systematic literature review (SLR) from the Scopus database. <u>Setting</u>: The studies included in the review were India, UK, USA, China, and others.	- Systematic Literature Review (SLR). - The design of the study is based on a descriptive analysis of the selected literature related to BDA in healthcare organizations. - used content analysis as a measure to identify the most relevant characteristics of BDA-based management systems in healthcare organizations. - Descriptive analysis was used to examine the time distribution of the selected studies and the incidence of BDA research in different years.	- The systematic literature review (SLR) revealed a growing interest in the adoption of BDA-based management systems in healthcare organizations from 2016 to 2021. - The positive relationship between BDA and healthcare organization management has been established.	- Big Data Analytics (BDA) is becoming crucial in healthcare organizations, and there is a growing interest in its adoption from 2016 to 2021. - Limitations: The field of BDA is rapidly evolving, making it challenging to keep up with the latest developments in research. - Strengths: The systematic literature review provides a comprehensive overview of BDA applications in healthcare organizations. - Weaknesses: The sample size of 34 studies may not fully represent the

					entire range of BDA research in healthcare. - Healthcare managers should consider implementing BDA-based management systems to improve decision-making and patient care. - Future research should focus on standardizing BDA procedures and techniques for healthcare management. - BDA is transforming healthcare organizations and has the potential to revolutionize decision-making processes.

Author, Year	**Purpose**	**Sample & Setting**	**Methods Design Interventions**	**Results**	**Discussion, Interpretation,**

			Measures		**Limitation of Findings**
Malay, D. S. (2019, May). The far-reaching influence of the costs of materials and implants used in the operating room. *The Journal of foot and ankle surgery, 58*(3), 409. doi:https://doi.org/10.1053/j.jfas.2019.03.001	To emphasize the significant contribution of surgical costs to the overall price of healthcare in the United States and to highlight the role of surgeons in influencing these costs.	No specific sample <u>Setting</u>: No specific setting	The journal article did not mention specific methods, designs, interventions, or measures used.	The article did not present any specific research results, data, or findings.	The article did not contain any specific research findings, interpretations, limitations, implications, or conclusions.

Author, Year	Purpose	Sample & Setting	Methods Design Interventions Measures	Results	Discussion, Interpretation, Limitation of Findings
Millet, C., Chimento, G., Barrette, W., & Dasa, V. (2020, May). Can automating surgical processes reduce operating room supply costs? A pilot study of a novel OR based technology. *Journal of Orthopaedic Experience & Innovation, 1*(1). doi:https://doi.org/10.60118/001c.12626	To investigate whether the implementation of a novel technology that automates surgical processes and creates a dynamic digital surgical preference card can reduce operating room (OR) supply costs for knee replacement surgeries.	<u>Sample:</u> 1023 knee replacement surgeries were reviewed over 3 years by 3 surgeons at 3 different hospitals within the Academic Health System. <u>Setting</u>: The study was conducted at an Academic Health System in New Orleans, LA	A pilot study using innovative technology (SIGHT Medical, Alexandria LA) aimed to digitize surgical processes and integrate with hospital data systems. The study measured surgical supply costs, including med/surg (routine) supplies and billable medical supplies, length of stay, and the number of cases. These outcomes were aggregated and deidentified for analysis. Automated and traditional surgeries were compared across various categories, surgeons, and hospitals.	Out of a total of 1023 knee replacement surgeries, 560 were traditional surgeries and 463 were automated surgeries. Automated surgeries showed an average cost savings of $78 in med/surg supply costs and $2216 in billable medical supply costs compared to traditional surgeries. The length of stay for automated surgeries was slightly lower (1.18 days) compared to traditional surgeries (1.53 days). The variation in supply costs was smaller in automated surgeries, suggesting more consistent and controlled cost outcomes.	- The digitization of surgical processes using the novel technology is associated with reduced supply costs and potential efficiency improvement. - The study lacks detailed demographic and clinical data to ensure comparability between traditional and automated patient cohorts. - OR times were not available in the cost dataset, and further prospective time studies are needed for accuracy. - Additional research across a wider range of patient cohorts, implant selections, and surgeons is required to validate these pilot findings.

Author, Year	**Purpose**	**Sample & Setting**	**Methods Design Interventions Measures**	**Results**	**Discussion, Interpretation, Limitation of Findings**
Park, K. W., & Dickerson, C. (2009, April). Can efficient supply management in the operating room save millions? *Current opinion in anaesthesiology, 22*(2), 242-248. doi:https://doi.org/10.1097/ACO.0b013e32832798ef	To bring attention to the topic of supply management in the operating room (OR).	- The article did not explicitly mention a specific sample of patients or participants. - It is not a research study with empirical data. <u>Setting</u>: ORs in a tertiary academic medical center.	The article did not mention the specific methods, designs, interventions, or measures used.	The article did not include specific results or findings.	- The text does not present any empirical data or research findings, limiting the ability to draw concrete conclusions. - It lacks specific data on the actual implementation and success of the proposed strategies, making it challenging to assess their effectiveness. - The text highlights the importance of supply management in the operating room, raising awareness of the financial impact of supply expenses. - The absence of empirical evidence and research data weakens the validity of the proposed

					strategies and their potential impact. - Supply expenses in the operating room play a significant role in the overall budget of healthcare institutions. - The text emphasizes the need for effective supply management to achieve cost savings in the operating room. - Strategies such as perpetual inventory systems, linking scheduling and supply orders, standardizing practices, and applying Lean principles can be explored to improve supply management efficiency.

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