2022

The Relationship Between First Case On-Time Starts, Turnover Times, and Operating Room Productivity

Rhafia Bucoy
Walden University

Walden University

College of Management and Technology

This is to certify that the doctoral study by

Rhafia Bucoy

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Michael Lavelle, Committee Chairperson, Doctor of Business Administration Faculty

Dr. Deborah Nattress, Committee Member, Doctor of Business Administration Faculty

Dr. Patsy Kasen, University Reviewer, Doctor of Business Administration Faculty

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

Walden University
2022

Abstract

The Relationship Between First Case On-Time Starts, Turnover Times, and Operating Room Productivity

by

Rhafia Bucoy

MSN, Walden University, 2011

BSN, Western Mindanao State University, 1994

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

Walden University

January 2023

Abstract

Operating room (OR) managers struggle to manage day-to-day surgical operations while meeting and exceeding organizational productivity amid the COVID-19 pandemic. The deferral of surgeries contributes to millions of backlogs of surgical case volume and unintended negative consequences. Grounded in the proposition that first-case on-time starts (FCOTS) and turnover time (TOT) are correlates of OR productivity, the purpose of this quantitative correlational study was to examine the relationship between FCOTS, TOT, and OR productivity. Archival data from 136 electronic surgical records were collected from two free-standing ambulatory surgery centers and analyzed using multiple regression. The results of the one-service, eye-specialized, ambulatory surgery center were significant, $F(2, 65) = 11.50$, $p = < .001$, $R^2 = .26$. In the final model, one predictor was significant, TOT ($t = 4.30$, $p = < .001$, $ß = 0.46$). The results of multiservice ambulatory center were significant, $F(2, 65) = 3.17$, $p = .024$, $R^2 = .09$. In the final model, one predictor was significant, FCOTS ($t = 2.31$, $p = .02$, $ß = 0.28$). A key recommendation is for OR leaders to recognize the importance of being on time by implementing process improvements incorporating oversight on key performance metrics. The implications for positive social change include process improvements in efficiency and productivity metrics, thereby delivering cost-effective services for better patient outcomes to healthcare stakeholders, such as government agents, employees, leaders, and patients.

The Relationship Between First Case On-Time Starts, Turnover Times, and Operating Room Productivity

by

Rhafia Bucoy

MSN, Walden University, 2011

BSN, Western Mindanao State University, 1994

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

Walden University

January 2023

Dedication

I dedicate this study to God Almighty; my spouse Rolando Jr; and my two daughters, Arabella Rana and Danna Alexandra. I also dedicate this study to my sisters, Razzia Manzur and Rhinda Mustafa. Last but not least, the study is also dedicated to my family who departed this earth, my only brother, Rauff Mustafa, and my parents, Abubakar Mustafa and Susie Mustafa.

Acknowledgments

I thank my God Almighty for providing me the wisdom, strength, and courage to get through the doctoral journey.

To my Chair, Dr. Michael Lavelle, words alone could not express how profoundly grateful I am for your continuous support, understanding, and guidance. I also thank all my fellow Grinders for their encouragement through the doctoral journey.

Table of Contents

List of Tables

List of Figures

Section 1: Foundation of the Study

Health care organizational sustainability is dependent upon operational effectiveness, efficiency, and excellence. Strategies to mitigate the predictive revenue loss and foreseeable surgical capacity constraints are beneficial in reducing the risk of surgical care disparities (Bose et al., 2021). Hensher and McGain (2020) described the effectiveness of performance metrics in promoting accountability, empowering management, and enhancing health care system performance. The goal of the current study was to investigate the potential impact of performance metrics of first case on-time starts (FCOTS) and turnover times (TOT) on operating room (OR) productivity. Understanding the drivers behind the business operations and performance is vital for an organization's continued success and growth.

Background of the Problem

The COVID-19 pandemic led to an unprecedented cessation of scheduled elective surgical procedures. Delays in surgery significantly impacted patient surgical outcomes, hospital revenues, training, research, and development (Fu et al., 2020; Pathak et al., 2022). The COVID-19 crisis generated a significant loss in financial revenue for surgical specialties due to delays and cancellations (Bose et al., 2021; Uimonen et al., 2021). Findling et al. (2020) found that in more than 54% of patients, the inability to get elective surgeries done resulted in adverse health consequences. The deferral of surgeries contributes to millions of backlogs of surgical case volume and unintended negative consequences.

The cornerstone of health care quality is ensuring timely access to patient care. The U.S. Department of Health and Human Services (2022) developed the Healthy People 2030 program to improve health care access and provide quality services for the population. Surgical throughputs improved by enhancing surgical capacity and creating a predictive surgical patient flow (Koushan et al., 2021). Collaborative efforts to reduce surgical backlog require understanding the impact of surgical performance metrics on OR productivity. de Jager et al. (2019) suggested that there was no established systematic way to measure surgical access disparities in a complex surgical system. A standardized measurable OR performance metric indicator can serve as a foundation of focused areas for interventions to ensure optimal access to surgical patients.

Problem Statement

The prevalence of unnecessary delays in the OR has a detrimental impact on a hospital's revenue (Fu et al., 2020). OR surgical delays cost an estimated $22.3 billion in U.S. national revenue loss (Bose et al., 2021). The general business problem was that OR productivity significantly impacts hospital profitability. The specific business problem was that the OR managers of some ambulatory surgery centers (ASCs) do not recognize the relationship between the FCOTS, TOT, and OR productivity.

Purpose Statement

In this quantitative correlation study, I examined the relationship between the FCOTS, TOT, and OR productivity. The independent variables were FCOTS and TOT, while the dependent variable was OR productivity. The target population consisted of ASCs located in northern California in the United States. The population was appropriate

for this study because California has the highest number of ASCs in the country (Definitive Healthcare, 2022). The implications for positive social change include the possibility for a reduction in surgical delays; an increase in profitability; and better sustainability of the hospital organizations in providing timely, efficient, affordable, and high-quality surgical health care services to the patients, their families, and the community.

Nature of the Study

I employed the quantitative method to examine the relationship between FCOTS, TOT, and OR productivity. Researchers use the quantitative method for data representation and statistical analysis to examine the relationships between variables (Saunders et al., 2019). I aimed to test the associations between surgical case times and OR productivity, thus justifying the quantitative method as the most appropriate method to use. Conversely, researchers use qualitative methods in seeking the answer to why and how to generate new concepts, while mixed methods explore the combined interpretative and statistical description of a phenomenon that goes beyond the needs of the study (Collins & Stockton, 2018; Saunders et al., 2019).

I used a cross-sectional, correlational research design in this study. Correlational designs are used to identify the strength of the relationships between the variables and not the cause and effect (Bloomfield & Fisher, 2019). A correlational design is used to determine the existence of the relationship and the direction and strength between variables (Barlett & Barlett, 2019). Comparing variables at a single point in time using cross-sectional designs makes the research less time consuming (Tainter et al., 2019).

The experimental and quasi-experimental designs are employed to infer the cause-and-effect relationships between variables (Rogers & Revesz, 2020). The only difference between the two designs is that the experimental design utilizes random assignment of participants, while the quasi-experimental design does not establish causality (Janssen & Kollar, 2021). Because my aim was to examine the relationship between surgical times and OR productivity, neither experimental nor quasi-experimental designs were appropriate for the study.

Research Question and Hypotheses

Research Question: Is there a relationship between the FCOTS, TOT, and OR productivity?

H_0: There is no statistically significant relationship between the FCOTS, TOT, and OR productivity.

H_a: There is a statistically significant relationship between the FCOTS, TOT, and OR productivity.

Theoretical Framework

A theoretical proposition is another lens scholars use in viewing a phenomenon (Kivunja, 2018). Reimann and Jain (2021) described research propositions as offering a set of proposals that can spur future research in a critical area. I formulated a proposition regarding the possible theoretical explanation for the impact of FCOTS and TOT on OR productivity using findings from extant pieces of literature. Chapman et al. (2020) demonstrated that FCOTS is a significant variable determining OR productivity. Cerfolio et al. (2019) showed TOT as an influential variable in increasing investment return.

Efficient scheduling reduces FCOTS and TOT delays (McIntosh et al., 2006). Halim et al. (2018) verified FCOTS and TOT as critical variables in determining OR efficiency and productivity. Reviewing previous and concurrent scholar's research assisted me in evaluating the potential relationship between the research variables.

In this doctoral study, the expectation that the predictor variables may indicate an impact on criterion variable was based on other studies. Park et al. (2010) examined performance metrics, such as FCOTS and TOT, as enabling tools to drive OR profitability, while Bejil (2020) purported that FCOTS and TOT are factors that affect OR productivity. FCOTS are foundational OR benchmarks in hospitals (van Veen-Berkx et al., 2014). Quaty and Berkenstock (2020) utilized FCOTS in determining OR efficiency and productivity. Reducing FCOTS delays drives increased revenue, productivity, and patient satisfaction (Frampton et al., 2022). Even in procedural areas, any improvement of the FCOTS metric affects surgical output (Fecteau et al., 2019). Olson et al. (2018) demonstrated a linear relationship of TOT to OR productivity. Other researchers established that there is a significant correlation between TOT and OR throughput (Dexter & Epstein, 2018). Drawing on this evidence from existing literatures, I proposed that FCOTS and TOT may predict OR productivity when using selected organization electronic data in this study.

Operational Definitions

Allocated OR time: Interval of OR time with specified start and end times on a specified day of the week assigned to a surgical service to schedule cases (McIntosh et al., 2006).

Elective surgery: Procedures performed on patients for scheduled surgery on the day of the operation (Mullen et al., 2017). Nonurgent (unlikely to deteriorate quickly), quality of life-related surgery. Surgery performed by choice is beneficial but not related to severe conditions and need not be fulfilled immediately (Cancer Treatment Centers of America, 2020).

FCOTS: The time when the patient is wheeled into the room for the operation of the first elective scheduled case in the room for the day occurs at or before the scheduled time (Foglia et al., 2017).

Idle time: Time not used for operation (Belkhamsa et al., 2018).

OR time: Time from the patient enters the OR room until the patient leaves the room (McIntosh et al., 2006).

OR productivity: Ratio of time spent on direct surgical patient care to the total OR available time (Eriksson et al., 2022; Ezzat & Hamoud, 2014).

OR workload: Total hours of cases, including turnover time (McIntosh et al., 2006).

Perioperative: Time period from when the patient goes into the hospital/clinic/medical office for surgery until the patient gets discharged. Perioperative has three phases: preoperative (preop), intraoperative (intraop), and postoperative (postop) that relate to before, during, and after surgical care, respectively (Myles et al., 2018).

TOT: Time between one patient exiting the room after surgery to when the next patient scheduled for the same room enters to begin surgery (Schock & Blickensderfer, 2019).

Assumptions, Limitations, and Delimitations

A scholar requires a solid understanding of boundaries, expectations, and omissions in a research study. Outlining assumptions, limitations, and delimitations substantiate the study's integrity (Theofanidis & Fountouki, 2018). In the following subsections, I laid out the study's assumptions and areas of limitations and delimitations to allow future scholars to fill any research gaps based on study restrictions.

Assumptions

Assumptions are factual statements without proof (Verma & Abdel-Salam, 2019). I made several assumptions in this study. One assumption was that all the staff's electronic documentation is accurate. I assumed the assigned staff are fully trained and know the specialty they assist in the OR. Another assumption was that surgical cases are accurately scheduled as elective cases. I also assumed that the team would work professionally and follow the standard protocols of the OR department. My final assumption was that delays of the FCOTS and TOT are the two factors that affect productivity.

Limitations

Limitations are unavoidable and uncontrollable conditions that might limit the study (Verma & Abdel-Salam, 2019). The first limitation I identified was that the team will be more efficient over time, and TOT improves with team experience. Another

limitation was that the return investment on the TOT would remain unproven. The lack of staff to turn around the rooms and start the case on time could have also been a limitation to the study. A variety of surgical procedures under service were being studied, which was another limitation. The final limitation I identified was no full engagement from the housekeeping or active participation from the OR staff to do a turnaround.

Delimitations

Delimitations are a self-imposed narrowing of scope in the study (Verma & Abdel-Salam, 2019). The first delimitation of the study was that it was restricted to the ambulatory spaces only, making the main OR out of scope. Another delimitation was that the focus of the study was on elective scheduled cases. The last delimitation was that the study included patients with outpatient classes and surgical procedures performed in all four stand-alone ambulatory centers of one nonprofit organization in northern California.

Significance of the Study

OR departments are high-cost departments, yet OR is also the top generating revenue contributor to the hospitals in health care. Currently, perioperative, the area where time is spent around the surgery, departments are faced with high operational costs while meeting all federal and state regulatory standards and requirements and mitigating the negative impact of budget pressure (Bose et al., 2021; Childers & Maggard-Gibbons, 2018). The study's findings may add information on the key factors that affect OR profitability, which has business, economic, financial, and social implications in California.

The Value to Business

The OR generates the most substantial revenue in the hospital. Being a significant contributor to the whole hospital's finances, any success or failure in OR efficiency can directly impact hospitals' profitability. OR managers can benefit from the study by increasing their knowledge of how to run the OR efficiently to prevent operational failures. The study's findings could also be of interest to hospitals to help build strategies around the key metrics of OR productivity, leading to the hospitals' success and sustainability.

Contribution to Business Practice

Hospitals are under tremendous pressure to adopt a value-based care model. Health care leaders need to implement a plan of action that increases access to high-quality care at a lower cost while maintaining organizational sustainability. The significant contribution of the current study to hospitals in general is an improvement in productivity by establishing efficient operational workflows to increase OR profitability while catering to the surgical care needs of patients. The study findings could help OR leaders determine factors affecting the departments' performance and aid in overcoming barriers to financial gain. The results from this study provided solutions to the pitfalls and challenges that create obstacles to achieving high efficiency as well as strategies for preventing revenue losses and attaining organizational resilience.

Implications for Social Change

This study on OR productivity could impact positive social change by providing knowledge and information on the relationship between FCOTS and TOT in the OR

productivity. The study findings may help improve OR department efficiency and increase profitability, thereby improving the hospital's sustainability to further contribute to health care employment, economic growth, and better living standards. The potential change could aid in providing a high quality of patient care and surgical outcomes, enhancing teamwork and positive collaboration, preventing hospital business failure, and improving the economy, benefiting hospital staff, patients, families, and the community they serve.

A Review of the Professional and Academic Literature

An OR is a challenging, dynamic, complex, resource-constrained working environment. Adaptive strategic planning and close coordination of expected and unexpected situations are vital in managing OR complexity while maintaining and enhancing productivity (Göras et al., 2020). Metrics for evaluating tasks in OR performance continue to focus on cost savings, satisfaction, and team morale improvement (Rothstein & Raval, 2018). OR critical metric performance is inherent in the industrial-organizational culture in the surgical arena. However, as I explored literature on OR-related metrics challenges impacting OR work productivity, I could not find a named theory to apply as the theoretical framework for the research study.

Use of a specific theoretical lens as a framework for explaining a phenomenon is common in research studies. Cloutier and Langley (2020) recently called for innovations in conceptual styles of developing theoretical contributions for the phenomenon that dynamically unfolds over time. Historically, researchers were allowed to use a traditionally literature-driven approach or an alternative phenomenon-driven approach

(Cotteleer & Wan, 2016). Regardless of the method, a literature review ultimately requires a logical process to synthesize all relevant research findings between professional and academic studies to support the doctoral research (Shoja et al., 2019). A literature review also helps identify knowledge gaps to justify the need for the research (Saunders et al., 2019). A professional and academic literature review is a systematic, thorough analysis of various research materials to support the content analysis of the proposed research (Khamitov et al., 2019). I researched and evaluated existing academic and professional sources associated with the criterion and predictor variables to support the developed theoretical proposition that FCOTS and TOT affect OR productivity. I begin this academic and professional literature review by discussing the theoretical proposition, including extant studies on identified variables in the proposition. That discussion is followed by a review of supporting and opposing views regarding the theoretical proposal and a synopsis of the literature reviewed.

Search Databases and Terms

The primary databases and search engines used to locate literature for this review were ProQuest, Google Scholar, ABI/INFORM Collection, CINAHL, Medline, Business Source Complete, National Library of Medicine, Academic Search Complete, Emerald Insight, and other Walden University Library online resources. I used the following discrete keyword terms or a combination of terms to search the academic and professional literature: *labor or work productivity, efficiency, effectiveness, throughput, operating room, hospital metrics, surgical theatre, peri-operative, turnover time, first case on-time start, on-time performance,* and *room or time delays*. The terms utilized

were related to examining the research topic's depth and theoretical proposition in testing the hypotheses. I also used different types of literature to explore the issues. The sources included peer-reviewed articles, authoritative books, government websites, and dissertations relating to OR productivity in the United States and other countries. Table 1 illustrates the number of reference types and percentages classified under peer-reviewed and non-peer-reviewed sources. It also displays several pieces of literature by being subdivided into the three variables used in the proposition. The study contains 237 references, 203 (86%) of which were published from 2017 to 2022.

Table 1

Number of Sources by Reference Type

Reference type	Peer Review %		Non-Peer Review %	
	< 2017	2017–2022	< 2017	2017–2022
Academic journal	24	144	2	12
Books	3	17	5	22
Government sources	1	0	0	2
Others	0	3	0	1
TOTAL	27	165 (86%)	7	38

Note. This table demonstrates that most references were published in the past 5 years.

Theoretical Proposition

A theory is composed of interdependent conceptual views grouped systematically to form a framework for a significant body of knowledge (Varpio et al., 2020). However,

a doctoral study can have an established theoretical framework or not. Collins and Stockton (2018) posited that there is an ongoing debate regarding the use of theory in knowledge production. Scholars can view research from different perspectives or lenses using a theoretical proposition in place of a named theory (Bengtsson & Kohl, 2020; Kanaparan & Strode, 2021). Evaluating the propositions' criteria and study's validity serves as the basis for scientific research (DePoy & Gitlin, 2019). Any simple propositional statement that goes beyond to prove scientific value becomes a theory (Kimmons, 2022). Technically, theoretical propositions are declared conceptual views that lay the foundation for scientific theories (Sautchuk & Fillus, 2020). In the current doctoral study, I developed a theoretical proposition to show the impact of FCOTS and TOT on OR productivity. I justified the potential theoretical explanation using extant literature sources to support my proposal on the relationship between the three variables.

Productivity is a universally understood term measuring the work completed in a given amount of time. O'Donnell (2018) defined productivity as the ability to produce over time depending on the ratio of input and output. Hazzam and Lahrech (2018) argued that meaning of the term productivity remains ambiguous despite the concept being previously defined. The operationalization of productivity differs in a specific context or research activity (Daraio, 2019). Productivity has been considered one of the vital factors affecting organizational competitiveness (Rusu & Roman, 2018; Sureka et al., 2020). The evolution of the term productivity in the different arenas has led to different mathematical calculations being used to determine it. Most leaders frequently discuss productivity, but

the term productivity is rarely defined in a standard way due to differences in the measurable form of productivity.

Time is the most significant contributor to any form of productivity, and the OR is no different. Using practical judgment, most people say time affects productivity in any arena apart from the OR. Yet, no established theory supports that time delays and lost productivity are interconnected. Several views may exist on specific time management and labor productivity separately but not as a merged theory using both constructs. Often, a phenomenon that is simple to explain lacks some specific formalized theory to support its understanding. Time is a philosophical concept, yet one that is relatively measurable. There is no coherent theory on how time influences productivity directly or indirectly (Abbott, 2018). Real universal time is indivisible, but its meaning is the time duration in the human mind (Slavov, 2021). Intervals measure time from one point to another, and in relativity, the perception of time is captured by the measurement of the observer (Masursky et al., 2011). From a business perspective, time saved is cost saved (Mertens et al., 2020). As related to the current study, I applied the definition of time to understanding the effects of time metrics being used to predict and measure the amount of output that workers can produce. With that in mind, any delays in time for certain OR activities can impact the amount of production completed.

The concept of synopsis of OR overall performance is not new. A dashboard is a balanced scorecard used in health care to meet organizational goals and objectives (Park et al., 2010). The value of a dashboard is the ability to synthesize management information and condense extensive data to specific key indicators (Wang et al., 2018).

Indicators, also known as metrics, are the standard of measurement on changes in product count, the volume of services, and revenue signifying financial and administrative focus. The most common benchmarking and surgical performance metrics in OR dashboard is FCOTS, TOT, service block utilization, and OR utilization (Cerfolio et al., 2019; Park et al., 2010). The first two performance metrics involve time, while the latter two primarily focus on the utilization of resources. In the current study, I focused on the time-related metrics and their relationship to OR productivity. Scholars have previously used FCOTS and TOT as criterion variables in studies that showed specific significance on OR productivity (Cerfolio et al., 2019; Chapman et al., 2020). Chapman et al. (2020) verified punctual FCOTS as a significant contributor to OR hospital savings using a multivariable logistic regression model. Cerfolio et al. (2019) demonstrated that improvement in the OR TOT resulted in a substantial increase in the estimated investment return by 1,402%. The researchers utilized a statistical analysis of the nonparametric Mann-Whitney U test, which revealed a p value of < 0.05, which was considered significant. In another study, McIntosh et al. (2006) examined scheduling cases and demonstrated that reducing surgical FCOTS and TOT delays is a practical intervention to increase OR efficiency and productivity. Of the 3,504 elective patients in McIntosh et al.'s study, the existing delays in FCOTS and TOT showed a significant increase in labor costs of 3.0% with a 95% CI of (2.8%–3.3%) using a t distribution. Any reduction in the delays on FCOTS and TOT makes the OR productive. Critical analysis of the existing research studies helped me probe a possible significant relationship between the developed variables of FCOTS, TOT, and OR productivity.

FCOTS

Most studies found FCOTS as a critical metric that provides insight into surgical care delivery efficiency. Kocher et al. (2018) outlined the first case start time as part of the eight performance indicators in the OR. Likewise, Ernst et al. (2012) also noted that surgical suite management used FCOTS to determine OR efficiency. Coffey et al. (2018) expanded on Ernst et al.'s study that the primary outcome measure in most OR efficiency was on-time starts for elective first cases. FCOTS is consistent with part of the OR dashboard, and this enabling tool shows key OR performance metrics that offer data-driven decision-making information for operational sustainability and financial profitability (Allen et al., 2019; Park et al., 2010). An in-depth examination of initiative improvements on FCOTS delays may provide data to managers regarding OR efficiency outcomes as well as a critical analysis including FCOTS as a study variable.

FCOTS is not only used in the United States but also other countries. German hospitals found FCOTS delays as a determinant in the success of the OR management tools (Ernst et al., 2012). Australian hospitals also used FCOTS as an indicator to measure its impact on OR productivity (McIntosh et al., 2006). Furthermore, van Veen-Berkx et al. (2014) suggested that interventions decrease tardiness in elective first cases of the day, resulting in a nationwide OR benchmark in Denmark hospitals. Either productive or nonproductive time can be revenue generating for output and process metrics (Park et al., 2010). Previous studies proved that FCOTS is a reliable metric for quantifying efficiency in the OR surgical performance (Ernst et al., 2012; McIntosh et al., 2006).

Quantitative and qualitative researchers have linked FCOTS with positive or negative outcome measures. Coffey et al. (2018) stated that FCOTS delays were associated with various adverse outcomes, like decreased utilization, patient access, and patient and staff satisfaction. Foglia et al. (2017) posited that FCOTS delays caused OR cancellations, reducing family satisfaction and setting a negative tenor for surgical delays. Minor gradual improvements in the punctuality of elective surgical time can allow surgeons to perform more additional cases during any elective surgical day in hospitals (Coban et al., 2022; Hoffman et al., 2019). In addition, better prediction of OR procedures maximize throughputs and decrease wait times (Martinez et al., 2021). Getting the patients in the room on time provides better outcomes to patients' overall satisfaction, including the hospital surgical throughput.

Lack of knowledge of the impact of FCOTS on OR efficiency and productivity results in untoward consequences. Dexter et al. (2009) stated that there was a general lack of knowledge on the relevance of FCOTS tardiness to OR efficiency. Wakeman and Langham Jr (2018) supported the existence of this lack of awareness of the delay drivers that cause decreased throughput. Dexter and Epstein (2009) reported that increasing the awareness of the OR committee regarding a reduction in FCOTS tardiness benefits the hospital economically. The overall investment analysis sum of every minute delay in every surgery per room can cost the hospital more labor costs (Dexter et al., 2021; Hicks et al., 2020). Every 1 minute reduced in FCOTS delays can save 1 minute of overtime paid out to employees.

In the perioperative arena, tackling the FCOTS offers an immediate return on investment. Dexter and Epstein (2018) showed that the staff resources are optimized by starting the first case in the OR on time. The first case usually sets the stage in each OR and cascades to subsequent scheduled patients (Uri, 2020). Toldbod and van der Kolk (2020) illustrated how a change in initial management control triggers a cascade effect to cope with the shift. In physics, the first domino requires an initial start for the subsequent fall of toppling dominoes (Negrete & Oates, 2021; Roussel et al., 2019). FCOTS, with the other succeeding scheduled surgery, behaves like a domino effect (Reeves et al., 2021). With that said, the unfolding of the sequential reaction process provides unfavorable effects if the first case does not start on time, and managers must take care to avoid delays.

FCOTS is a commonly discussed metric that OR leadership continues to monitor. Dexter and Epstein (2009) stated that the most common issue in the OR is FCOTS tardiness. There is a lack of awareness of the scientific principles that affect OR efficiency and the psychological biases causing delays in the FCOTS (Dexter et al., 2009). FCOTS tardiness has economic revenue impacts (McIntosh et al., 2006). Therefore, intervention in reducing the FCOTS tardiness can provide savings if leaders want to focus on areas for enhancement in surgical productivity. Investigating processes that directly or indirectly impact the FCOTS is warranted.

FCOTS has five key drivers that are important to understand to achieve an on-time start of the first case of the day: (a) patient readiness, (b) preoperative surgical assessment, (c) anesthesia preoperative assessment, (d) paperwork completion, and (e)

OR readiness. Pashankar et al. (2020) stated that delays in the first case cause a downstream effect for the day. Identifying the key drivers and appropriate interventions helped improve the FOCTS in the pediatric OR (Pashankar et al., 2020). The delay means costly expenses and missed opportunity costs.

Patient Readiness. Preparing the patient to be ready for surgery is comprised of numerous tasks. The expectation is for patients to arrive in the OR at a specific time. Being on time allows sufficient time for the patient to be admitted to the hospital, getting to the OR suite preparation area, changing their clothes to hospital clothes, and completing other areas of surgical readiness on the day of surgery tests. Chaganty and Sharma (2021) stated one of the typical delays of FCOTS is the lack of preparedness of patients. Pashankar et al. (2020) discussed the importance of a standardized preoperative process to monitor patient readiness in the preoperative area. Patient readiness prevents surgical delays caused by patients not being ready for OR transport (Joos et al., 2021). Evaluating clinical activities contributing to the timeliness of patients arriving in the OR on time allows for focusing on the areas for improvement.

The psychological aspect of patient readiness has a mediating effect before and after surgery. In a correlational study, Torres et al. (2020) posited that there was an intermediary role between the patient being ready for surgery and the postoperative outcomes. They demonstrated that patients that were confident with their surgery led to them having lower pain and a better surgical experience. Patient preparedness also serves as a significant predictor of surgical outcomes (Jeney et al., 2022). A focus shift is occurring regarding the patients' role in surgery, and quality of life was correlated with

the determination of surgical success outcome (Robertson et al., 2021; Rogers et al., 2021). Beyond the physiological component of having surgery, the psychological preparedness of the patient equally influences the surgical experience.

Surgical Preoperative Assessment. Before surgery, surgeons meet with their patients before bringing them to the surgery room. Typically, the surgeon completes the patient's medical history and updates the interval history that covers the gaps of any changes from when the patient was seen in the office to the present time on the day of surgery. In addition, the surgeon discusses the surgical consent to obtain approval on the plan, asks patients for any questions regarding the surgery, and ends by ultimately marking the operative surgical sites. The surgical marking practices stem from the incidence of the wrong site surgery. Chilakapati et al. (2021) conveyed that marking the surgical site for operation reduces the overall risk of operating on the wrong body area. The goal behind the preoperative assessment is patient safety (Hepner et al., 2022). Providing all the necessary information about the surgery helps the patient and the peri-operative supporting staff determine the surgical needs for a smooth operation. Patient literacy on the surgical risk influences patients' acceptance of the risk outcome (Torres et al., 2020). Surgical preop assessment and patient readiness help prepare the patient for surgery.

Anesthesia Preoperative Assessment. Anesthesia is the utilization of medication that renders sleep or keeps the patient from feeling pain. Anesthesiologists who oversee maintaining the patients asleep and free of pain also do their tasks. On the day of operation, the anesthesiologist reviews the laboratory results ordered before surgery,

reviews patients' allergies, and discusses the anesthesia plan by explaining the type of anesthesia used for surgery. Preoperative assessment is essential for care in anesthesia (Hepner et al., 2022). This assessment aims to reduce mortality or morbidity brought about by anesthesia (Abbott & Gillies, 2021; Dillane & Finegan, 2021). The type of anesthesia used can shorten the time needed to wait for patients to wake up, indirectly contributing to additional surgical time available for the subsequent scheduled patients (Younis et al., 2021). Going over the preoperative assessment and completing it on time helps the patient be moved to the OR on its scheduled time and have the first patient in the room on time.

Most hospitals have started building and creating preoperative medicine clinics (POM). Preoperative assessment happens in the POM clinic before surgery. The core purpose of POM development is to optimize a patient's medical condition before a surgical procedure (Liu et al., 2021). The anesthesiologist-directed clinic prepares the patient before administering anesthesia and surgery, significantly reducing the cancellation and surgical delays (Gitterman et al., 2021). Patient-centered care is essential to medicine and surgery (Aronson et al., 2018). A proactive and integrated approach continues to evolve in clinical science to improve surgical throughput.

Paperwork Completion. Before patients are wheeled into the operating room, completing all necessary electronic documentation by accountable personnel is vital. Completing the tasks to adhere to the hospital policy helps run the OR on time (Chua et al., 2021). Health providers must comply with the required medical record documentation for patients undergoing care (U.S. Department of Health and Human Services, 2021b).

State and federal laws mandate legal and medical regulations for patient safety. When providing care, health care providers must complete and keep an accurate, clear medical record (Yaqoob et al., 2021). Yuan et al. (2021) discussed that the Act of 2009: The Health Information Technology for Economic and Clinical Health signed into law the widespread use of electronic health records. The completion of paperwork can be paper-based or electronic-based. Completing the tasks to adhere to the hospital policy helps run the OR on time.

OR Readiness. This task happens in parallel with other functions in the preoperative area. OR staff ensure all the necessary supplies, instruments, and equipment are ready for the patient once the OR nurse brings in the patient. OR managers enforce policy to set up a day before the first case gets into the room to get the patient in the room on time (Pashankar et al., 2020). OR readiness ensures that the OR surgical suite is suitable and ready for scheduled surgical procedures. Creating safe care and an environment in the OR are vital to the success of the surgery.

Other multiple factors affect OR efficiency. Aside from FCOTS, TOT is also a key performance metric used to measure OR performance. The time spent cleaning the room for another patient to come in, otherwise known as room turnover time, is another metric measured in the OR. Apart from the first and last cases, there is an allotted turnover for every case reserved for cleaning and room preparation for the next scheduled patient for the day. Evaluating success in meeting TOT can determine the impact on OR productivity.

TOT

Several authors stated that TOT is one of the traditional metrics in measuring OR efficiency. Olson et al. (2018) demonstrated that decreased turnover time maximized OR efficiency. The time saved in TOT between cases increased patient access by adding one more case per day, thereby increasing revenue for the organization (Olson et al., 2018). Likewise, Dexter and Epstein (2018) observed a significant correlation between one TOT to the next TOT ($p < 10 -4$). The previous study by Bradley et al. (2021) supported the claims that the TOT of series cases allows more added cases after eliminating cumulative TOT per OR per day. Walsh (2017) argued that FCOTS and TOT are not the best metrics as both FCOTS and TOT entail a small portion of the new time of 2.1% and 3.5%, respectively. Bottom line, multiple TOT delays cumulatively can decrease OR throughput.

Researchers conducted different initiatives to improve TOT, knowing how it affects OR efficiency. Lo et al. (2021) showed TOT reduction was one aspect that increased OR efficiency by providing dedicated staff. In their study, a two-tailed t test denoted a statistical significance of $p < .05$ of increased OR cases with dedicated staff doing TOT. Deshpande et al. (2021) supported the previous researcher's findings that surgical team TOT can increase OR efficiency with engaged surgical staff. Lo et al.'s study stated that working as a team reduced the nonoperative time intervals. Any initiatives implemented to improve TOT showed an increase OR productivity.

Surgical perceptions of TOT differ between professions. Masursky et al. (2011) surveyed surgeons and anesthesiologists on their perception of TOT. Surgeons

overestimated TOT, like an anesthesiologist focusing on patient care (Masursky et al., 2011). Similarly, nurses who maintained continuous activity have no target estimation with TOT. Opinions on TOT can, directly and indirectly, affect the timeliness in completing the TOT. Therefore, quantitative analysis is needed to understand the effect of true TOT on OR efficiency.

TOT is a non-value-added time yet an added cost to hospitals. Dexter et al. (2003) calculated average turnover between 10-19 mins is an added 2.5-4.0% staffing cost. Lee et al. (2019) correlated increased turnover to increase staffing costs due to overtime. Findings consistent in Europe estimated annual labor excess of $1.6 million due to inefficiency. In contrast, the TOT does not significantly impact the elective OR time if the scheduled OR volume for the day is set (Mazzei, 1994). TOT only affects the throughput if the OR is flexible to allow more additional surgeries on top of the schedule.

TOT always has an ongoing frustration amongst surgeons, anesthesia, and OR staff. Delays in turnover decrease employee and patient satisfaction. Eliminating the hospitals' dogmas can help improve TOT (Cerfolio et al., 2019). Process design using a system approach can improve TOT (Robertson et al., 2021; Tankard et al., 2018). Lean six sigma and value process map streamlining the critical contributors of TOT adds value to surgical output.

Numerous people are involved in the TOT room process. The process involves several groups completing basic tasks and procedures to prepare the next patient's room. OR TOT is highly important to hospital leadership (Schock & Blickensderfer, 2019). Sufficient staffing, workflow, and teamwork are essential elements in OR TOT.

Most complaints of surgeons are wait time between rooms. Tan et al. (2022) showed that OR time is wasted between patients' transfer out and into the rooms. Eliminating wasteful parts of the process can help streamline and improve the TOT (Eriksson et al., 2022). The three key group contributors of TOT, namely the anesthesia group, OR staff, and support staff, can streamline operations (Cerfolio et al., 2019).

Anesthesia Group. The group comprises an anesthesiologist, a certified registered nurse anesthetist, and an anesthesia technologist. Anesthesia groups play a part in any delays on TOT. An anesthesiologist or certified registered nurse anesthetist is involved in getting the preoperative assessments, updating anesthesia records, and getting the anesthetics and medications ready for surgery with or without the assistance of an anesthesia technologist (Cerfolio et al., 2019). Preparing the patient for sleep and waking them up from sleep are vital tasks of the group. They are fully involved and contribute to any prolonged TOT (Cerfolio et al., 2019). Any parallel work and removing non-value-added tasks can improve TOT.

OR Staff. The circulating staff registered nurse and certified surgical technologist comprise the OR staff. The registered nurse reviews the chart for preparedness and performs chart completion while the certified surgical technologist gathers supplies and instruments for surgery (Cerfolio et al., 2019). Kodali et al. (2014) reported that staff resistance to changes and lack of support are barriers to TOT reduction. Wyssusek et al. (2019) measured how initiatives improve turnaround time. Awareness of the obstacles that impede performance is valuable to improve efficiency.

Support Staff. Housekeeping, patient transporter, and patient support technicians are a group of personnel that helps manage room turnover. Cerfolio et al. (2019) outlined the tasks for housekeeping in cleaning and preparing the room for subsequent surgeries. Patient support technician obtains supplies, opens instrument trays, and moves equipment while patient transport arranges beds and wheelchairs before and after surgery (Cerfolio et al., 2019). Improving the process and eliminating waste help TOT efficiency.

Independently FCOTS and TOT may have minimal impact on the overall OR efficiency or productivity. However, these two variables of FCOTS and TOT may significantly impact OR productivity. The measurement of the time delays on either variable can affect the completed number of cases at a given time. The dependent variable of these two variables is OR productivity, the number of completed surgical cases.

OR Productivity

OR efficiency is commonly used interchangeably with OR productivity in health care. The concept of health being a commodity was farfetched in previous decades as it is now in the current health care era (Benach et al., 2019; Ephraim-Emmanuel et al., 2018). Chernov et al. (2018) stated that health care reform of cutting costs and increasing patient care and quality shifted medicine as a science, art, and business. Often, efficiency and productivity are the same in business. Both terminologies are remarkably similar as both involve the ratio of input and output, output as the denominator and input as the numerator. Efficiency is doing the same with less, while productivity is doing more with the same (Chernov et al., 2018). However, as researchers we investigate the strategic

approach, differences between the two terms may be evident. Efficiency is shrinking the denominator, the input, while productivity expands the numerator, output.

The concept between efficiency and productivity continues to be a debate on which is best to use in the business industry. After three decades, most significant companies shifted from efficiency to productivity. Stack (2019) described efficiency as a measurable concept yet not clear enough to show how things are done well without affecting quality. Productivity, on the other, is also a quantifiable concept that equates to the number of products or output created (Stack, 2019). Productivity is focused on quantity while efficiency is on quality, which shows that productivity is tied to performance, while efficiency is how well the organization performs.

Furthermore, productivity is an unaltered measure, while efficiency is a refined measure. Actual productivity is a combination of productivity and efficiency. Without efficiency in productivity, it can be a business pitfall as productivity is just an output. In contrast, efficiency has a built-in quality control to ensure that the products produced to fit the requirement (Stack, 2019). Quantity and quality must go hand in hand for sustainability and success in a health care organization. Efficiency and productivity are a choice of measures of what is available and desirable. Both should be intertwined or inextricably linked to achieving the true essence of productivity in health care. It is not just about producing more surgeries but surgeries with excellent possible outcomes.

The history of productivity goes back to the 18th century. Productivity started in the agricultural industry, and as defined by Littre in 1883, the term defined as faculty to produce (Miguel et al., 2015). In the 19th century, the National Commission on

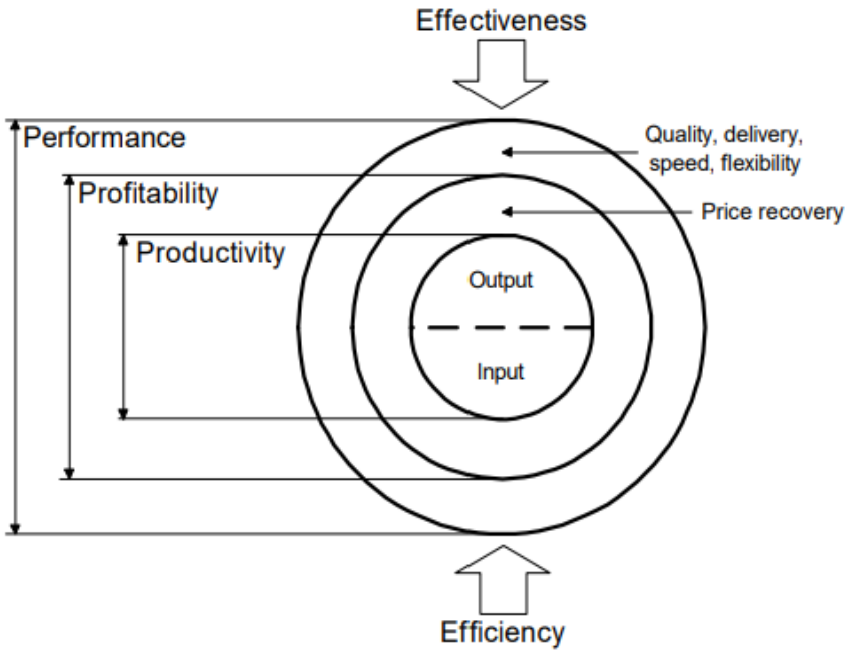
Productivity started in 1970 with the top priority on the private sector (Bouckaert, 1990; Fuglie et al., 2019). There was an upswing in the movement on several levels in the 1980s. Measuring productivity became essential to evaluating improvement. The formula was simple as the relationship between outputs and units of inputs. Units of information are capital, labor, and materials, while output units are products and pricing.

After a decade, the government by the efficient was born (Bouckaert, 1990). The productivity-related terminology changed from the old systematic chain-oriented nomenclature of expenditure – effort – performance – result to a contemporary system-oriented terminology of input – throughput – outcome. Productivity considered with efficiency and effectiveness shifted to a definition of performance (Urban Institute & Hatry, 1977). For several centuries, the operationalization and use of the terminology continued to change. The context of productivity has expanded through the years. Zantal-Wiener (2021) emphasized that productivity is the ability to generate goods and services in an economic context. It is no longer about measuring output but getting more production in a short amount of time. Janssen and Estevez (2013) even expressed that the U.S. government is implementing a program of doing less with more by squeezing every bit of output. In the modern context, every industry focus on boosting productivity with less input or employees doing the job.

The concept of productivity became multidimensional. It is common to misunderstand the term productivity despite its wide use with performance, profitability, efficiency, and effectiveness. Tangen (2005) demystified and tried to simplify the concept of productivity, as shown in Figure 1.

Figure 1

Triple P Model.



Note. Adapted from "Demystifying Productivity and Performance", by S. Tangen, 2005, *International Journal of Productivity and Performance Management*, *54*(1), 34–46. (https://doi.org/10.1108/17410400510571437).

The triple p model described the relationship between the three terminologies of productivity, profitability, and performance. Productivity is the fundamental, straightforward core concept of the output ratio per input. The overlay of price recovery to productivity changes it to another term called profitability. The added monetary factor to productivity drives how the company becomes profitable. Adding quality, speed, delivery, and flexibility to productivity and profitability makes up the term performance. The bottom line, the core commonality of the three ideas is the output per input.

Profitability is a ratio of revenue and cost that can be interdependent with productivity. Tangen (2005) measured profitability as productivity plus price recovery. Bernolak, in 1997 measured profitability as output volume per input volume (output volume/input volume); (Rifai et al., 2022). In contrast to profitability, output volume multiplied by output unit price over input volume multiplied by input unit costs (output volume *output unit price/ input volume * input unit cost). In short, profitability is a combined effect of productivity and price unit factors.

On the other hand, two related terms of effectiveness and efficiency are somewhat cross-functional with the three terms. Effectiveness and efficiency are more process-oriented terms, while productivity, profitability, and performance are the entire process's outcome or output. However, the terminologies are similar, but they are not the same. Effectiveness is entirely different from efficiency. If effectiveness is about doing the right things, efficiency is about doing something right. Elston et al. (2018) stated that a single focus on efficiency is not a fruitful way to increase productivity. Centobelli et al. (2019) showed that an effective system could be inefficient and an efficient method to be ineffective. Effectiveness is to achieve the desired result, while efficiency is the transformation process. Effectiveness is proactive, while efficiency is reactive. However, the combination of efficiency and effectiveness in the transformation process leads to high productivity.

Another way to look at productivity is at the state level. Tangen (2005) stated that a leader's productivity comes in two ways. Analysis entails comparing the standards at one point or the changes over time. The level of productivity depends on the point of

measurement. A system can be productive against a standard benchmark with a typical effort for the same output based on the industry standards. Another concept called cross-productivity is associated with catching up with change and innovation (Aparicio et al., 2020).

Furthermore, productivity change is not by a distance from the efficient frontier baseline but by the movement of frontiers between progressive periods. The measurement of productivity has evolved through a health care crisis that a leader may call productive but not from the perspective of the other. The new approach discriminates the basis of productivity in a steady-state and ongoing industrial changes.

Effective OR management and efficient use of surgical capacity to its fullest potential remains a tremendous challenge. The existing surgical delays in OR compounded by the COVID-19 pandemic led to unprecedented elective surgery shutdown that continues to challenge hospitals. In a study by Bose et al. (2021), the United States has an estimated $22.3 billion loss of national revenue due to the cessation of major elective surgeries in the nation's hospitals. The concern on the high degree of COVID-19 uncertainty limits the design of surgical strategies as the standard of care requires to entail cautionary measures and be under a reasonable degree of prudence. Systems to mitigate the impact of the COVID-19 pandemic are critical to decreasing patient and hospital financial risks. The Lancet Rheumatology (2021) stated no simple solutions to extended surgical wait times as part of the myriad issues brought about by COVID-19. The pandemic disruptions pose an opportunity for OR leadership to rethink how to address many aspects of health care.

The health care delivery system struggles to balance and sustain the shift of the U.S. health care system from volume to value. Value exceeds price cost on care services with quality and extraordinary reputation (Aronson et al., 2018). The simultaneous pursuit of triple aim in care, health, and cost remains focused (Browne et al., 2018). In 2020, the United States hit an all-time high of 19.7% of gross domestic product devoted to health care (Centers for Medicare & Medicaid Services, 2021). Whether in a crisis or not, affordability and timeliness of care are paramount to health care industries (Schneider et al., 2021). Access to care is crucial to improving and sustaining the quality of life in the human population.

One primary shared goal of all OR leadership is utilizing the surgical capacity to its full potential. With the increasing surgical backlog, the substantial struggle to optimize productivity, keep patients and staff happy, grow surgical volume, and generate hospital revenue exists. Benchmarking and performance dashboard metrics are commonly used in the OR to measure and monitor efficiency and productivity (Charlesworth & Pandit, 2020). A well-designed and structured executive dashboard can bring immediate return on investment (Bucklin et al., 2022). The focus of the research is to gain insight into OR benchmark metrics related to time and productivity. Research on the impact of OR performance time metrics will support the doctoral study's objective of how FCOTS and TOT relate to OR productivity.

Supporting and Alternative Theories

Theories are developed over time to explain a phenomenon. In developing my proposition, I used a theoretical probability definition to express the likelihood of

something occurring based on reasoning using existing solid theories. Theories are sets of lenses and hypotheses that influence the perception and understanding of phenomena. A proposition is a hypothetical expectation of an event based on the knowledge of a situation in the OR. The two established theories which support my theoretical propositions are dynamic systems theory (DST) and theory of constraints (TOC).

In contrast, I found one alternative theory relevant to the study: chaos theory (CT), also called the butterfly effect. However, I also found a view that entails the basic concepts interplay of my theoretical proposition. Using all the possible theories indirectly related to the proposed framework helps me explain the phenomenon behind the OR productivity using variables of time elements.

DST

Dynamic systems (DS) refer to a living or non-living system that undergoes behavioral change over time. In 1984, Henri Poincare developed DST from mathematics and physics (Bielinskyi et al., 2022). Fundamental tenets of the theory include (a) multilevel and multicausality in the study of change; (b) self-organization, emergence of new forms, and nonlinearity; and (c) attractor as a metaphor of states and transitions; (d) embedded multiple timescales and developmental trajectories. DST is a theoretical framework that helps predict and understand constantly moving phenomena and changing processes within a complex system (Connell et al., 2017; Thurner et al., 2018). The operating room in a health care system is comparable to a dynamic system with multilevel, multidisciplinary actions of the team that keeps on reorganizing and changing over time.

DST discusses the interconnection of various parts and transforms through time. Lunkenheimer (2018) addressed how new forms arise and stabilize from the internal operation of a complex system. The evolution comes from interacting with multiple subsystems from within as it contacts the external system (Smith & Thelen, 2003). DST describes the system evolution in adaptation to external or internal forces. Technically, DST is like a mathematical equation on system change.

DST encompasses several theories. Lunkenheimer (2018) postulated that DST is not a simple theory but a metatheory. DST principles reflect developmental system changes within an environment applicable in mathematics, human development, or organizations. A dynamic system has a principle of change in a system of a whole body of connecting elements (van Geert, 2019). DST discusses how different system parts interact openly at different timescales, leading to self-organization (Papera et al., 2019). Lunkenheimer (2018) outlined the principles of DST as an open system, self-organization, time scale, nonlinear, or variability. The tenets of the theory explain the phenomenon that happens to a particular organization.

Open System. The state of openness allows the exchange and interaction of the system with the surrounding environment, creating a change in direction that constitutes the dynamic character. Larsen–Freeman (2019) described DS as an active system with a constant relationship with the helpful environment for its maintenance. Preiser et al. (2018) supported the attribute as an ongoing flow of energy, information, and matter in and out of the system. The interacting processes that affect the outcome are DST's fundamental tenet (Connell et al., 2017). The exchange can be a form of an energy-based

or information-based interaction. From a causal point of view, the interaction allows the system for balance and stability, ultimately changing for adaptation.

Self-organization. One of the characteristics of a self-organized system is the relative stability or instability of its state with a series of evolving or dissolving patterns (Soulaine et al., 2021). The self-organized matter has supramolecular chemistry and mechanically interlocked molecular architecture that allows complete characterization to bear a diverse array of contacts (Black et al., 2013; Yu et al., 2019). Dynamic systems produce cohesive patterns to any condition.

Timescale. Timescale changes over at different times. Connell et al. (2017) stated multilevel interaction between various elements over time. Time intervals are different timescales of seconds, minutes, and even hours. Embedded multiple timescales and developmental trajectories correspond to changes in the system (Connell et al., 2017). How processes of other times influence, each outer system is another tenet of DST.

Variability/Nonlinear. Highly nonlinear, sometimes called 'sensitivity to initial conditions, means that small changes in one or more dynamic system components can lead to reorganization and significant differences in behavior. Various patterns portray a classic illustration of behavioral change of state (Connell et al., 2017). DST has three secular organizations fixed, cyclic, and chaotic (Qiu et al., 2019). The change of input is not proportional to the evolution of output.

The main characteristic of DST is predictability. However, any dynamical system that exhibits chaotic behaviors has inherent unpredictability. Unpredictability entails erratic and random diversity, and multiple interconnected elements of a system contribute

to complexity (Turner & Baker, 2019). The OR is a complex dynamic system with high predictability and unpredictability based on internal or external factors.

The characteristic of a dynamic system follows the aspect of mathematical models. In mathematics, DST. has a time dependence of a point in geometrical space. DST has distinctive contrasting characteristics of variable or parameter, discrete or continuous, and deterministic or stochastic. Variables change in time while parameters remain unchanged; Being constant is discrete. Stochastic has a one-to-many relationship, while deterministic is limited to a one-to-one relationship. DS is a process where motion occurs. By nature, DS constantly moves and must change states to be helpful. Research by Dean and Wellman (1991) stated DS has three broad categories: predictive, diagnostic, and objective. The system predicts future conditions through observations of the past and present. DS harbors diagnostic characteristics that infer what possible past states of the system might have led to the present state and, finally, an objective that neither predicts the future nor explains the past but provides a current theory for the physical phenomena (Li et al., 2021). These three categories correspond roughly to the need to predict, present, and understand biological phenomena.

TOC

The TOC improves throughput due to developing processes around a bottleneck point (Cox & Goldratt, 2004). Goldratt introduced TOC in the 1980s with three core principles of (a) convergence, (b) consistency, and (c) respect. The principle of convergence implies the behavior of a complex system. The focus on consistency means the product has known flawed activity. The principle of respect implies the human factor.

Using the lens of TOC, all core principles outlined are in a relationship and support to explain time metrics, staff factors, and throughput in the operating room. Looking into the constraints, leaders can predict the performance of the system. The seven steps to implement the TOC process are (a) identify the goal; (b) decide the measure of system performance; (c) know the constraints; (d) decide how to exploit the constraints, (e) subordinate Step 4; (f) elevate the constraints; and (g) if previous steps continue to break, go back doing the Step 3 (Blackstone, 2010; Ikeziri et al., 2019). Overall, the TOC has three principles and seven steps. TOC focuses on addressing the weakest chain link to improve the system's performance by managing the constants. Removing constraints helps reduce delays and uncertainties in the system process.

In health care crises today, demand exceeds supply, and identifying the delay in the system is vital to reduce wait times. The use of TOC on the scheduling system design is to help improve throughput. Cox and Boyd (2018) conducted research to use TOC to validate any existence of causality in the scheduling system. TOC provides a different perspective in determining and addressing the core problem of an organization (Cox & Boyd, 2018). TOC showed a rigorous systematic, and logical framework for identifying scheduling delays.

TOC is structured and managed in parts rather than a whole. TOC application removes a specific barrier that prevents everyone from working together as a whole integrated system (Modi et al., 2019). Addressing the missing link in the system provides substantial improvements in TOC (Sproull, 2019). Any disruption in the estimated chain of activities impacts the overall system performance, thus implying all activities are

linked together (Tutuba, 2021). Managers must ensure no break in the system's chains and add some buffer to the chain, thereby reducing system delays, overspending, and unreliable effects on business performance.

TOC is a management approach to low productivity. TOC manages breakthrough change by addressing the constraint using the three core principles. TOC focuses on improving the day-to-day operations to gain an advantage over rivals (Simsit et al., 2014). The theory is a practical approach to the performance management system. The tenets of TOC are convergence, consistency, and respect. The principle of convergence discusses that any complex system is easy to manage as correction on one aspect will impact the whole system. The belief is that a change in one area feeds into a shift in the entire system (Blackstone, 2010). The principle of consistency comes with flawed assumptions that result in internal conflicts. The logical coherence and relationship between the variables indicate internal consistency (Naor et al., 2013; Nguyen et al., 2018). TOC satisfies the virtue of stability in applying steps, making it a functional theory. The principle of respect entails that despite staff mistakes, the concern for staff and people, in general, should remain intact. The focus on respect suggests everyone inherently desires to be efficient and good at what they do. Humans must be considered a factor in success, such as error or constraint. Thus, flexibility in management is important in business operations. This principle bridges the gap between process and humanity (Renshaw et al., 2019).

TOC is a management philosophy that emerged in the 1980s. Cox and Boyd (2018) described three branches of TOC, namely operational strategy tools, performance

management systems, and thinking process tools. The benefit of TOC increases work efficiency and includes increased throughput, reduction of lead times, inventories that lead to higher profits, and customer satisfaction (de Jesus et al., 2019). TOC developed a systematic methodology for identifying problems and barriers and implementing solutions (Gaspar et al., 2019). The evolution of TOC primarily focused on managing change and steps for an ongoing improvement process.

CT

No matter how much researchers learn to predict events, unpredictability still happens. The powerful paradigm that studies the complexity of the systems is CT. Karaman et al. (2019) discussed the theory that goes back to ancient civilizations. Shaukat et al. (2020) supported that CT was traced back to the works of Henry Poincare in the 19th century. However, CT was revisited by Edward Lorenz in 1972, illustrating the phenomenon of the "butterfly effect"; thus, he became the official discovery of the CT. The consequence of the flap of the butterfly wings is unpredictability. The butterfly effect has sensitive dependence on initial conditions that drive a small change. Synonymously, the butterfly effect is like a trigger's consequence, outcome, or result. The application of CT is relevant to a complex system. In short, a chaotic system is a dynamic system highly sensitive to the initial conditions. CT helps to resolve an apparent theoretical contradiction.

CT states there are underlying patterns in a chaotic, complex system. The evolution of CT started from the roots of modern science, the birth, and rebirth of CT, and ended up in the golden age of CT (Oestreicher, 2007). CT has several tenets, namely:

(a) bifurcation, (b) initial conditions sensitivity and unpredictability, and (c) time irreversibility and nonreplicability of a past situation. The principles behind the theory help understand how ORs are faced with chaotic conditions day by day.

The first principle of TOC is a bifurcation that entails abrupt changes that can arise from minor changes. Shaukat et al. (2020) called the evolution of small changes to sudden changes bifurcation. Brown and Eisenhardt (1998) worked on small- and big-scale changes strategies. Small-scale benchmarking of small areas for changes and big scale using acquisitions. Kiran and Haritha (2019) also purported that little change to big change happens to dispute systems. Strategies are not one big bang fix to the industry, but now is a minor continuous revision and evolution that occurs over time. The second principle behind CT is initial conditions sensitivity and unpredictability. Lorenz, in 1972 popularized that a small change in one variable can impact the evolution of a system on a large scale. Two similar systems can significantly differ, yet those small changes in the trajectories can differ (Shaukat et al., 2020). We can determine the end effect if we apply it to global forecasting. The drivers behind those significant changes can vary, leading to the unpredictability in finding solutions and actions driving to the same end goal. Day-to-day operations can be predictable regarding the processes that happen during the day. Unfortunately, the company cannot expect the same results daily. The last principle deals with a past situation's time, irreversibility, and non-replicability. Theoretically, any system can go back to its initial state. However, the probability of having the same trouble twice can be low; thus, hard to replicate the same outcome. Miller (1992) applied

the same steps to solve a problem yet failed. Successful strategies that work currently in the workplace could be a recipe for failure.

Institutional issues arise from complex interactions. Mahaffy et al. (2018) described a complex organization as a combination of interdependent parts that make up a whole environment. Zhou and Wang (2020) stated that chaos occurs in three different system types, namely (a) conservative, (b) dissipative, and (c) quantum. Management can apply CT in tracking unpredictability in an organization. In hypothesis testing, the results can always go in two different ways. One agrees with what the researcher thinks is the result, and the other goes against the expectation. Understanding two possible outcomes using contrasting theories can help explain such results.

Management Science Theory

Management science theory (MST) is another scientific method that explains a management business phenomenon. Japhet (2021) addressed scientific management theory (SMT) as transforming business factors into variables and identifying their correlation to management effectiveness. MST is an entirely different theory from scientific management theory. The theory applies statistical and mathematical problem-solving techniques and analysis to solve complex business problems. MST theory has three management science branches which include quantitative management; operation management; and management information systems. A combined approach that uses objective tools using innovative methods to address business operations. The theory excludes human factors, subjective elements, or non-quantifiable factors, thus not an

excellent substitute for any management functional duties—operational research with computing.

Management science (MS) focuses on decision-making. MS is a scientific approach that uses quantitative analysis extensively for decisions (Anderson et al., 2019). Explosive data growth with computer technology provides extensive problem-solving and decision-making access. Quantitative research requires managers' knowledge and expertise. In using a quantitative approach, leaders have to examine data associated with the situation, develop mathematical expressions that describe the relationship of the variables, and judge which scientific method provides a solution. It takes a considerable effort to transform a complex issue into a well-defined problem to make an essential contribution to the decision-making process.

MST has underlying assumptions that sometimes fall short in real-world situations. Japhet (2021) discounts the importance of human factors, personal or professional relationships, and other non-quantifiable factors that account for the unpredictability of some human elements. Talib et al. (2013) argued that these factors are essential to management theory. An established theory comprises relevant factors and variables that explain the phenomenon.

Both MST and SMT terms are frequently interchanged and confused. Theories may have similar words but are entirely different regarding the principles involved. Anderson et al. (2019) defined MST as an approach to better decision-making. Schutts (2011) described MST as utilizing operational management techniques coupled with quantitative and innovative tools to analyze how to maximize resource utilization to

produce services and goods in the business. MST is a model incorporating scientific-practical methods, systematic computing, and analysis of problems at hand. In contrast, the SMT founded by Frederick Winslow Taylor focuses on the scientific approach to solving specific management problems (Japhet, 2021). MST is an expanded SMT that added an operational research approach and quantitative management tools.

The principles of MST have three main branches. This theory provides a new way to manage complex problems in an organization. Japhet (2021) described MST as a technical way of solving complex operational issues using a mathematical equation or statistical techniques. MST combines quantifiable mathematical approaches, operations research, and computer technology in making decisions and solving problems. MST emphasizes documented information security, risk, and information control for asset protection (Chen, 2019). MST builds a comprehensive theory that can predict outcomes.

The first branch of MST is quantitative management, which uses mathematical and analytical tools to assist managers in strategic decision planning (Japhet, 2021). Managers can observe historical numerical data and its relationship to informed decision-making. In talent management, quantitative analysis clarifying the multilevel staffing workforce requires a dynamic approach (Ebrahimpour et al., 2021). The quantitative techniques involve statistics, information models, and simulation tools for management decisions (Rebekah & Ravindran, 2018). The next branch is operations research, covering processes that analyze business operations to increase efficiency. Imhanzenobe et al. (2021) posited that managers overcome challenges and seize business improvement opportunities through an integrated learning experience in day-to-day operations.

Williams and Radnor (2021) utilized an operation research technique to manage hospital units in Greece by operating a framework with limited resources and maintaining staff optimal performance. Development of learning skills occurs over time through experience when dealing with system constraints. The third principle is a management information system. This principle refers to collecting various information systems on internal or external factors.

The organization needs a strategic way of getting information to achieve competitive advantages. With the advent of technology, management information systems are one of the strategic tools developed in the current era. Japhet (2021) specified that having information reduces uncertainty. The mere visibility of information help managers assess the situation accurately and drive informed decision-making. This branch of MST utilizes more computer applications than quantitative tools. The last principle of MST is total quality management (TQM). Puspitawati (2021) described TQM as developed by the company to achieve optimal competitiveness. The strategic tool used to continuously improve products or services offered by the company, TQM, has the philosophy of delivering non-defective products.

MST started in Great Britain during the second world war. Robert McNamara conducted the industrial application of MS at Ford motors company in 1950. The theory expanded to linear programming for business decision-making (Weihrich, 2000). Over the years, several branches of MST developed based on the nature of the problems that tools can address. Technically, MST goes back to the 1970s, when management science improved an organization's effectiveness by using rigorous quantitative analytical tools

for resource allocation, decision-making, and design of management information systems (Zand & Sorensen, 1975). MST is not a mere tool that can improve the efficiency and effectiveness of business operations—gaining access to health care information to provide solutions while analyzing the effects of strategies adopted by different competitors (Navarro, 2015; Sestino et al., 2020). The practical application of MST is relevant in addressing contemporary issues for small and large businesses.

Literature Synopsis

The potential evidence of the study may provide OR leaders and managers the tool to make a data-driven informed decision in enhancing OR productivity. To reduce patient wait time, the study examines the relationship between FCOTS, TOT, and OR productivity. By identifying and validating the correlations of the three-performance metrics, OR management can focus on OR processes affecting the metrics, thereby improving productivity and increasing profitability. This study may offer scholars additional information to fill the knowledge gaps and be valuable to future studies.

Transition

Section 1 of this quantitative study laid out the foundational framework of the study that includes the problem statement, purpose statements, nature of the study, research question, significance of the study, and theoretical proposition. The focus of this study included topics on OR metrics and OR productivity. Moreover, the literature review included FCOTS and its contributors, TOT and its contributors, OR productivity, and various theories supporting the theoretical proposition. This quantitative correlational

study explored the relationship between the FCOTS, TOT, and OR Productivity that leaders can utilize to optimize surgical throughput.

In Section 2, I focused on the project by discussing the researcher's role, the participants' demographics, the research methodology and design, and population sampling. Also included in this section are the data collection instruments, techniques, ethical research, and the data analysis and observations. Finally, I discussed the reliability and validity of the study. In Section 3, I discussed the research findings and the significance of the study.

Section 2: The Project

The productivity trajectory in the OR is vexing. Productivity is a crucial component of hospitals delivering access to constrained resources; however, there is no consensus on which metrics to use as standard. Leaders cannot manage what they cannot measure (Ezzat & Hamoud, 2014; Kaydos, 2020). There are multiple options for OR performance metrics, and the choice of metric to monitor and evaluate OR performance is imperative (Oh et al., 2011; Robertson et al., 2021). One of the challenges in OR is quantifying productivity. In this quantitative correlational study, I examined the relationship between the three variables of FCOTS, TOT, and OR productivity. I begin this section by presenting the purpose statement, followed by explanations of the role of the researcher, participants, research method, and design. This section also includes a discussion of the population, sampling, ethical research, data collection instrument and techniques, data analysis, and the reliability and validity of the study.

Purpose Statement

In this quantitative correlation study, I examined the relationship between the FCOTS, TOT, and OR productivity. The independent variables were FCOTS and TOT, while the dependent variable was OR productivity. The target population consisted of ASCs located in northern California in the United States. The population was appropriate for this study because California has the highest number of ASCs (Definitive Healthcare, 2022). The implications for positive social change include the possibility for a reduction in surgical delays; an increase in profitability; and better sustainability of the hospital

organizations in providing timely, efficient, affordable, and high-quality surgical health care services to the patients, their families, and the community.

Role of the Researcher

The type of research method and design determines the role of the researcher. Kelly et al. (2018) emphasized that choosing the right plan is imperative, and the kind of role the researcher plays is integral to the study's success. In quantitative research, the role of a researcher is more of one with an outsider view than an insider view as compared to qualitative research (Holmes, 2020; Žukauskas et al., 2018). Punch (1998) supported the notion that the role of the researcher in quantitative studies is nonexistent as if the researcher is not even there. When conducting quantitative research, the assumptions consist of positivist and objectivist research strategies (Holmes, 2020). The researcher has the responsibility to perform a role distinct from quantitative analysis.

A researcher must also choose a valid, reliable, and appropriate method. Data collection in research is one of the essential steps in the research process. Sadan (2017) posited that the technique and quality of data collection dictates the accuracy and validity of the data findings. Quantitative data collection is structured, and picking an ideal method leads to accuracy and sensitivity in capturing constructs (Polit & Beck, 2017; Sadan, 2017). In generating evidence, understanding the role I had to play was vital. My role as a researcher was to ensure that I employed the appropriate method to collect the data relevant to a correlational study on FCOTS, TOT, and OR productivity.

I also had the role of following the guidelines and ethical principles presented in *The Belmont Report*. In 1978, *The Belmont Report* outlined three basic ethical principles:

respect for persons, beneficence, and justice (Jefferson et al., 2021). My role as a researcher was to safeguard, protect, and forbid the exploitation of vulnerable populations. In demonstrating the principle of respect for persons, the four key domains included participant interactions; open communication with the participants; participants' access to clear procedures; and consent authorization and ensuring privacy protection (Kraft et al., 2021). I did not use active human participation in this study, eliminating the need to substantiate the four domains. However, in collecting archival data records of time-stamped surgical case records in the electronic documentation system, I had to protect the privacy of the patients' information. I worked for the organization where all the data were collected from. I ensured that I only captured data relevant to the correlational study. Despite the first principle being irrelevant because the study did not involve human interactions, the other two principles applied to this study.

Beneficence is a bioethical principle that connotes the act of doing good and promoting the best interests of a more significant population (Jefferson et al., 2021). The two rules to complement beneficent actions are (a) do no harm and (b) maximize benefits and minimize risk/harm to participants (U.S. Department of Health and Human Services, 2021a). The two research aspects of this principle include (a) the right to freedom from harm and (b) the right to protection from exploitation (Barrow et al., 2021). Under the principle of beneficence, the researcher must consider a concealed data collection that prevents any protected health information exposure. As a researcher, I implemented protections to avoid exploiting the participants' data as well as adhered to the beneficence

principle to promote the welfare and safety of participants and ensure their confidentiality.

The Belmont Report's ethical principle of justice pertains to fair treatment. Data collection must be done systematically without prejudice or bias (Barrow et al., 2021). The data collection method is based on research needs, not on the ease or convenience of the researcher. My role as the researcher was to ensure fairness by having inclusion and exclusion criteria and maintaining the anonymity of participant-data connections. In this way, I upheld the obligation to provide equitable findings to the community.

From the ethical perspective, the researcher and the university/institution must adhere to *The Belmont Report*'s protocol. The researcher is responsible for applying and maintaining an unbiased, honest, and ethical approach to the study. On the other hand, Walden University carries the same commitment. Through the office of Research and Doctoral Services website, Walden University (2022) provides resources, direction, and guidelines to ensure students comply with research standards. The Institutional Review Board (IRB) conducts ethics reviews and ensures that all research complies with U.S. federal regulations and school standards. The study's breadth will benefit the professional practice and existing academic research in the surgical arena while promoting a sense of trust in the data findings.

Participants

Since I used archival company data from a selected health care organization, I did not include human participants in this study. Archival data are data that exist in a database kept in an archive. Deller (2019) showed that research could deepen the

understanding of phenomena related to business issues using archival data. Researchers can obtain data from an organization pertinent to the study, which enables more meaningful research. Eligibility criteria are significant factors used for population representativeness (Sen et al., 2017). The predetermination of the eligibility criteria is fundamental in the research review process (Peled-Raz et al., 2021). The inclusion criteria in this study were ASCs doing business in northern California for 5 years. The selection of data elements was specific to the FCOTS, TOT, and OR productivity. Using archival data is pertinent if the variables and population of the archival data are appropriate to the research question.

The health care institution selected for the study is an integrated, managed care company that operates in California. My professional affiliation with the company provided me a legitimate access to the company's data; therefore, I used the company as the study site. I obtained permission to access the data set necessary to answer the research question of the study. The Walden University (2022) IRB determined if a partner organization's letter of cooperation was required.

Researchers using existing data sets have advantages and disadvantages. Using an existing database can reduce the threats to internal validity like bias (Friedman et al., 2022). However, the data may have had some limitations regarding the data elements needed for the study. With the advent of advanced technology, the digital archival collection provides a broad range of access and is easily accessible (Force & Wiles, 2021). I created a strategic data collection framework and rules for precise eligibility for valid representation in the study.

Research Method and Design

A researcher can choose from three types of research methodology: quantitative, qualitative, and mixed method. The right methodological approach is essential for determining the quality and success of the research study (Edmonds & Kennedy, 2016; Kalman, 2019). To select the correct approach for this study, I considered the characteristics of each type of research methodology as outlined in the following subsections.

Research Method

The quantitative method is a structured and empirical approach to testing and confirming a hypothesis (McCusker & Gunaydin, 2015). With this method, researchers use mathematical and statistical analysis and the processing of numeral data to investigate a phenomenon (Basias & Pollalis, 2018). Quantitative data in the form of numbers are known for efficiently testing hypotheses (Ahmad et al., 2019; McCusker & Gunaydin, 2015). With this method, researchers tend to stay objective rather than subjective. The quantification of relationships provides the nonsubjective linking of practical captured information and statistical expression on the analyzed data.

The qualitative method is an in-depth analytical approach to understanding concepts, thoughts, and experiences. Hamilton and Finley (2019) posited that the qualitative method describes the phenomenon without relying on statistical analysis. Qualitative researchers employ data analytical processes through interpretative techniques to tell a story (Basias & Pollalis, 2018; Cassell & Bishop, 2019). Qualitative data in the nonnumerical form are descriptive and provide more insights (Cassell &

Bishop, 2019). The description of the attributes and properties of data provides a robust way to make sense of how things are because numbers do not always tell a story. However, in this study I focused on examining the relationship of three variables, which made the qualitative method inappropriate.

The mixed-method approach is a combination of quantitative and qualitative methods in conducting research. Anguera et al. (2018) described mixed methods as an alternative to solely quantitative or qualitative research. Combining quantitative and qualitative methods is complementary and augmentative to make sense of a phenomenon (Frasso et al., 2018). Integrating both methodological approaches broaden the ability to generate of new knowledge. My objective in this study was to purely test the hypothesis; therefore, the mixed-method approach did not align with the intent of the research.

The processing of big data was necessary to verify the hypothesis in the current study. Guida (2019) posited that examining large-scale numeric data on variables requires statistical and mathematical analysis. The quantitative method follows a top-bottom approach using deductive reasoning from one or more statements/premises to reach a logical conclusion (Farghaly, 2018). Since the study focused on hypothesis testing related to a phenomenon in which FCOTS, TOT, and OR productivity have a relationship, the quantitative approach was the best choice as research method.

Research Design

The translation of the research problem into the form of analytical data to provide answers is the essence of a research design. Asenahabi (2019) confirmed that the research design elects the type of analysis to achieve the desired results. A range of different

designs exists in quantitative research, including descriptive, correlational, experimental, and quasi-experimental designs (Bloomfield & Fisher, 2019; Siedlecki, 2020). Researchers use the quantitative method to investigate the presence or absence of a relationship between two or more variables (Ahmad et al., 2019). Knowing that there is no ideal design, a scholar can choose one that matches the study's intent. I determined that a correlational design was appropriate to analyze the impact of FCOTS and TOT on OR productivity.

Descriptive

The descriptive design is one of the nonexperimental quantitative designs and it quantifies the description of variables and interprets the data (Bloomfield & Fisher, 2019). The descriptive design is valuable in examining the frequency of the existence of a variable to explain a phenomenon (Kumatongo & Muzata, 2021). Thereby, the objective of the design is to provide a scientific method with quantifiable results that produce output generalizable to the community (Sidel et al., 2018). Using this design, the researcher generates an analysis from existing data to describe the phenomenon.

Correlational

The correlational design is another type of nonexperimental quantitative design. This design is used when seeking to discover if there is a relationship between two or more variables (Bloomfield & Fisher, 2019). Researchers use this design to examine the relationship between predictive and criterion variables; however, this design does not determine causality. For generalizability to the population and prediction, researchers need to apply regression analysis (Emmert-Streib & Dehmer, 2019). The primary intent

of the current study was to determine the existence of the relationship between variables; therefore, a correlational design was suitable for the study.

Experimental

The experimental design is used to determine the cause-and-effect association between variables (Bloomfield & Fisher, 2019). Using this design, researchers manipulate randomized variables to create causal inferences (Asenahabi, 2019). The independent variable is manipulated to show an effect on one or more variables, whereby the independent variable is the cause while the dependent variable is the effect. Since the primary objective of the current study was only to examine the relationship and not causality, the experimental design was not suitable for the current study.

Quasi-Experimental

Like the experimental design, the quasi-experimental design is used to examine the causality of the variables. The lack of randomization of variables is the main difference between the quasi-experimental and experimental designs (Asenahabi, 2019). In addition, there is no proper control group in the quasi-experimental design (Rogers & Revesz, 2020). The test of a causal hypothesis and lack of randomization of variables necessary for this design made it inappropriate for the current study.

Population and Sampling

The population for the research was archival data from existing free-standing ASCs of the study site health organization in northern California. I used the company archival data to choose OR retrospective data from ASC locations within the last 5 years. The procured archive contained time-stamped metrics of case tracking events of FCOTS,

TOT, and OR productivity (i.e., total cases completed for the day). Moreover, the data included surgery dates, scheduled times, and actual times, so I could compute the difference in minutes between the real and the scheduled times. Research samples for analysis and interpretation were derived from this data set.

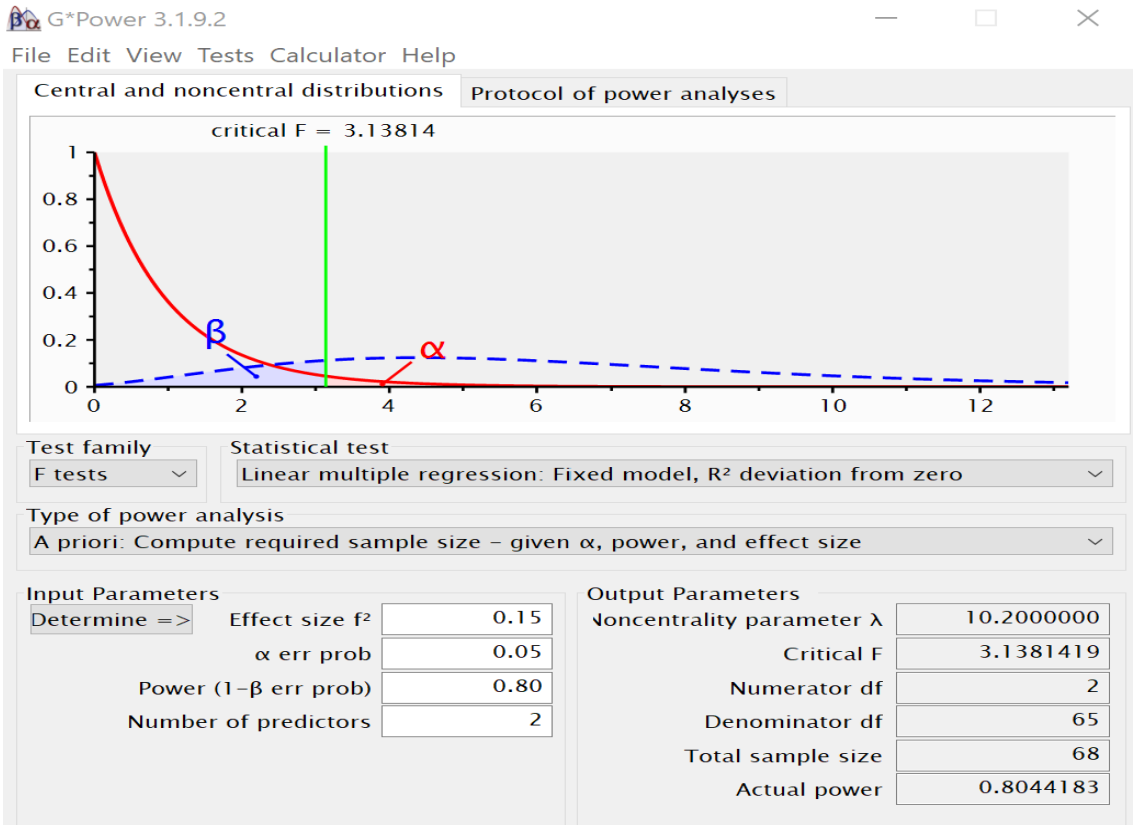
In a scholarly study, researchers need to determine the kind of sampling method to use and the size of the sample population. The technique and type of sample are crucial factors affecting the overall external validity of the findings (Erba et al., 2018). There are four probability sampling techniques: simple random, stratified, systematic, and cluster sampling (Erba et al., 2018). Out of the available methods, I chose simple random probability sampling for this study. Simple random selection provides an equal chance to be part of the sample population (Sarstedt et al., 2018). This approach allowed for unbiased and valid results.

For statistical interference, scholarly research requires a targeted population of interest for generalization. The sample size helps conclude a larger population (Hendrickson et al., 2019). The greater the sample size, the higher the robustness of generalization (Schmidt et al., 2018). The determination and evaluation of the sample size will require software applications. Statistical Package for Social Sciences (SPSS) Version 27 will determine the statistical significance of the relationship of variables. The three things that need to be mindful of incoming up sample size are the power, effect size, and significant level. The G power 3.1.9.2 software in SPSS uses the *F* test for sampling (Kang, 2021). In Figure 2, I illustrated the sample size for the research.

Using the medium effect size of 0.15, with 5% probability power of 80% on two predictor variables, the total sample size for statistical analysis was 68. In Cohen's table, a power of 80% is the conventional choice for most research (Cohen et al., 2022). Since the study involved two ASCs, a sum of 136 data archives were analyzed. The higher the power, the higher the sample size, decreasing variance.

Figure 2

*G*Power Size Calculation*



Note. This figure demonstrate the set parameters on two tested predictors.

Ethical Research

The data used for analysis was from archival records with no inclusion of personal health information from selected health care organizations. I acquired approvals from the Institutional Review Board of Walden University with IRB approval number of 07-28-22-0141104 and the chosen health care organization to adhere to the ethical standards. I requested permission from the decision-maker to authorize an official letter of cooperation to begin data collection of data archives. Both parties had mutual confidentiality agreement on the proposed study.

There was no compensation from the company of choice or the employee. In the correspondence, I outlined the requirements for any withdrawal of the study. I maintained safety and professionalism while capturing and handling the entire data. In addition, I utilized an encrypted and password-protected computer to store archival data and ensure safety. Protected patient health information was not part of the dataset for analysis.

Data Collection Instruments

The data collection instrument must be purposeful and relevant to the research study. However, archival research involves analyzing previously gathered data before the start of research (Mills & Helms Mills, 2018). In business, archival data research is the most empirical method that ensures corporate social responsibility assurance (Velte, 2020). Roh et al. (2021) postulated the integration of machine learning opens opportunities for new research on data acquisition and improvement in the use of archival data. Since I used archival data, I did not require standardized traditional data collection instruments such as surveys, interviews, or observation. Upon retrieving the archive data,

I screened, analyzed, and organized data for outliers, missing fields, anomalies, and incomplete data points. Upon the receipt of the information, I processed the data analysis of the two predictor variables of FCOTS and TOT using an interval scale of measurement. The criterion variable of OR productivity is continuous with a ratio scale of measurement.

The archival data consisted of patient ID, case class, patient class, type of procedure, scheduled date/ time of surgery, actual date/time of surgery, and an indication of the case if it is the first scheduled case in the room for the day or subsequent case, an indicator whether the first case or subsequent cases started late or on-time. In addition, the data contained dependent variable information of the total number of cases for the data and the total surgery hours completed for the day. Ruggiano and Perry (2019) pointed out that primary data designation applies if data were used first for a specific research question. I was the primary data collection source in the study despite being an archived data.

Using SPSS, I measured the FCOTS and TOT in the time interval. I also included a nominal category of an independent variable using a 0/1 scoring system: the FCOTS variable, 0 as on time and 1 as late. The same approach goes to the TOT variable is 0 as on time and 1 as late. I measured the continuous criterion variable of OR productivity by calculating the difference between the targeted scheduled cases and the total actual completed cases for the entire day. I used the 0/1 scoring system for OR productivity variable, 0 as nonproductive if total actual cases were less than the scheduled target and 1 as productive if total actual cases met the target.

Data Collection Technique

Quantitative research can use various surveys, observations, and archive databases to collect reliable and valid data. The retrieval of data archives through scrutiny was the data collection technique used in this research. Brière (2021) stated that the digitalization of data in the advent of technology makes archival research more popular. There is more to discover in the existing relationship using real time and archival data (Das et al., 2018; Stehle & Kitchin, 2020). The decision to utilize the data archives were to use my professional affiliation for ease of data availability, minimal costs, and convenience. In addition, the current professional setup ensures the security and privacy of the obtained archival dataset used for research analysis.

Data Analysis

Data analysis in research is essential because it provides a strategic plan for ensuring data accuracy and helps study the data seamlessly. A researcher hinges upon selecting a data analysis process appropriate for the research design. Choosing the correct data analysis technique enhances understanding the study's findings (Sizemore et al., 2019). Knowledge extraction and its creation enrich the value of the research discipline (Ploder & Kohlegger, 2018). The following section will outline the research question, hypotheses, and the data analysis.

Research Question

The quantitative research question is: Is there a relationship between the FCOTS, TOT, and OR productivity? The following hypotheses are:

Hypotheses

H_0: There is no statistically significant relationship between the FCOTS, TOT, and OR productivity.

H_a: There is a statistically significant relationship between the FCOTS, TOT, and OR productivity.

Data analysis is a process that involves data inspection, cleaning, transformation, and retrieval of relevant information to provide conclusions. Out of the two most common data analysis methods, descriptive and inferential analysis, I focused more on inferential data analysis. The descriptive statistical analysis describes basic features and summaries of data samples and measures such as mean, median, mode, percentage, frequency, and range (Mishra et al., 2019). On the other hand, inferential statistics, as the name implicates, makes inferences on a sample data population (Pyrczak & Oh, 2018). Inferential statistical analysis shows complex analysis to illustrate the relationship between variables in predicting and generalizing the results. The type of analysis favors inferential statistics as the type of data analysis used in the doctoral study.

The two commonly used models in inferential statistics are ANOVA and regression models. Multiple regression is a common inferential statistical technique that analyzes the relationship between two or more predictor variables and one criterion variable (Plonsky & Ghanbar, 2018). In contrast, the ANOVA *F* test determines three or more groups (Liu & Wang, 2021). In terms of variables, ANOVA uses a categorical predictor variable while regression uses a continuous predictor variable. Since the study intends to determine the relationship between three variables, multiple regression is

appropriate. The data analysis of the archival data records in the survey uses various regressions using the *F* test with three variables.

With the advent of technology, I utilized SPSS to clean data and screen data errors and missed data. There is a likelihood of missing data through electronic transfer during data retrieval. The first step was to reextract the archived data and connected with the company liaison officer on data definitions and assumptions to calculate the multivariate multiple analysis variables (Denis, 2018).

Study Validity

Threats to the study's validity depend on the study's research design. Internal validity examines causality or causal inferences (Westreich et al., 2019). Therefore, threats to internal validity apply to experimental or quasi-experimental studies (Flannelly et al., 2018). Since the research study is a non-experimental design, internal validity is not appropriate for correlational studies.

I used probabilistic random sampling in the study. A random sample mitigates the validity threats (Murad et al., 2018). Enhancing validity increases the generalizability to a more significant population and attempts to address applicability. Conversely, the non-probability sampling approach is not relevant to the study on hand. That said, threats to statistical conclusions validity are of concern in the research.

In correlational design, statistical conclusion validity (SCV) is of concern, and mitigations to the threats are vital. SCV ensures designs are correct and variables are appropriate. The basis of the dependability of research findings is adequate data analysis (Staron, 2020). SCV ensures the quality of the statistical data and error rate analysis (Foy

et al., 2019). SCV technically determines the reliability and the approximate truth of the research findings.

Study validity determines the researcher's ability to generalize the findings to the population. Addressing the common threats to SCV, instrument reliability, data assumptions, and sampling size ensures accurate inferences. Sürücü and Maslakçi (2020) stated the essential factors to consider for beneficial results are validity and reliability. As a researcher, being objective and detach from the subject matter contributes to the reliability of the study. The data are assumed to be unbiased and represent close to the truth (Flake & Fried, 2020). The instrument's internal consistency is reliable, valid, and replicable with Cronbach alpha measures. Taber (2018) postulated Cronbach statistics serve as evidence in determining the instrument quality and appropriateness of sample size and add to the study's validity. I ensured the use of SPSS and G*Power tools in the calculation of reliable coefficients and appropriate sample size.

Transition and Summary

This quantitative study aims to explore the existence of the relationship between FCOTS, TOT, and OR productivity. In Section 2, I started by providing the project overview and the purpose of the study. I followed with the discussion on the role of the researcher and study participants. I presented the process in the selection of the research methodology and design. I also provided the population and sampling, ethical research, data collection instruments, techniques, and analysis in the same section. I ended the section by addressing the reliability and validity of the study. In Section 3, I discussed the evidence findings of the research study.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this quantitative study was to examine the impact of FCOTS and TOT on OR productivity. The predictor variables were FCOTS and TOT, and the criterion variable was OR productivity. The null hypothesis was that FCOTS and TOT did not impact the OR productivity, and the alternative hypothesis was that FCOTS and TOT did impact the OR productivity. The results of the multiple linear regression analysis indicated statistical significance; therefore, I rejected the null hypothesis that both FCOTS and TOT did not have an impact on OR productivity.

Presentation of the Findings

Descriptive Statistics

The research analysis included a total of 136 archival records from the two free-standing ambulatory centers of the study site health care organization in the state of California. The first analysis comes from the one-service, eye-specialized ambulatory surgery center (ASC1), which only does one type of surgical service with 68 archival records. The second analysis comes from the multiservice ambulatory surgery center (ASC2) that caters to different types of surgical services with another 68 archival records for research. Both analyses from the two free-standing ASCs comprised three nominal variables. Table 2 shows the descriptive statistics by categorical nominal variables for ASC1, and Table 3 depicts the descriptive statistics of ASC2 that offers multiple services. Tables 4 and 5 show the descriptive statistics of the means, standard deviations, and the

number of observations for the continuous scale variables for both ASC1 and ASC2, respectively.

Table 2

Frequencies and Percentages by Nominal Level of ASC1

Nominal Variables	Nominal level	*f*	%
Gender	Female	50	73.5%
	Male	18	26.5%
	Total	68	100.0%
Age category	Working age	4	5.9%
	Elderly	64	94.1%
	Total	68	100.0%
Surgery year	2018	12	17.6%
	2019	17	25.0%
	2020	14	20.6%
	2021	12	17.6%
	2022	13	19.1%
	Total	68	100.0%
Surgical service	Ophthalmology	68	100.0%
	Total	68	100.0%

Note. This table demonstrate the distribution of variables at one service ASC1.

Table 3

Frequencies and Percentages by Nominal Level of ASC2

Nominal Variables	Nominal Level	*f*	%
Gender	Female	46	67.6%
	Male	22	32.4%
	Total	68	100.0%
Age category	Working age	68	100.0%
	Total	68	100.0%
Surgery year	2018	10	14.7%
	2019	12	17.6%
	2020	14	20.6%
	2021	19	27.9%
	2022	13	19.1%
	Total	68	100.0%
Surgical service OR1	Head and neck	54	79.4%
	Orthopedics	1	1.5%
	Urology	2	2.9%
	No case	1	1.5%
	Total	68	100.0%
Surgical service OR2	General surgery	37	54.4%
	Gynecology	1	1.5%

	Pediatric general surgery	9	13.2%
	Urology	20	29.4%
	No case	1	1.5%
	Total	68	100.0%
Surgical service OR3	Gynecology	47	69.1%
	Head and neck	1	1.5%
	Ophthalmology	2	2.9%
	Orthopedics	7	10.3%
	Plastics	4	5.9%
	Vascular	5	7.4%
	No cases	2	2.9%
	Total	68	100.0%
Surgical services OR4	General surgery	11	16.2%
	Orthopedics	5	7.4%
	Podiatry	48	70.6%
	Urology	1	1.5%
	No cases	3	4.4%
	Total	68	100.0%

Note. This table demonstrate the distribution of variables in multiservice ASC2.

Table 4

Mean and Standard Deviation by Scale Variables for ASC1

Descriptive Statistics			
	M	*SD*	*N*
OR productivity	.5918	.16007	68
FCOTS	.7132	.31524	68
TOT	.8199	.12471	68

Note. This table demonstrate descriptive statistics of the three variables for ASC1.

Table 5

Mean and Standard Deviation by Scale Variables for ASC2

Descriptive Statistics			
	M	*SD*	*N*
OR productivity	.5979	.14512	68
FCOTS	.6801	.32117	68
TOT	.3745	.11952	68

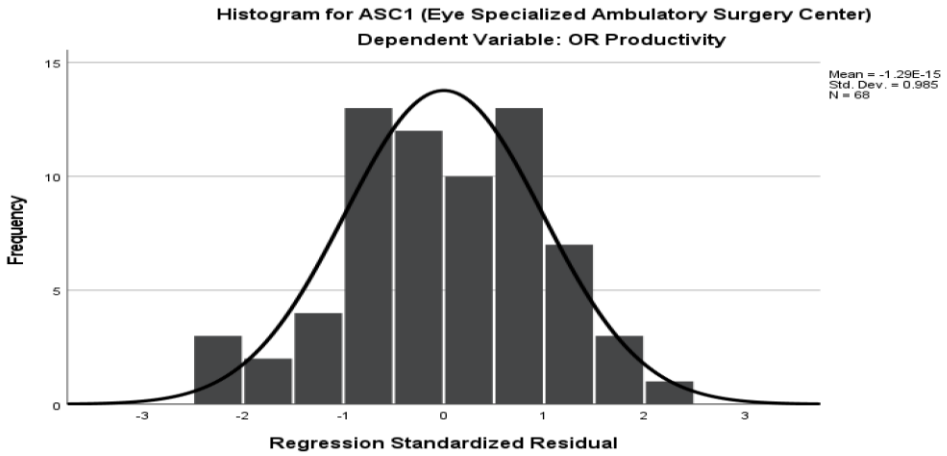
Note. This table demonstrate descriptive statistics of the three variables for ASC2.

Assumptions Testing

I used the ANOVA assumption to test equality of variance and normality, which was highly significant at $p = < .001$ for ASC1 and significant at $p = 0.049$ for ASC2, as shown in Tables 7 and 10, respectively. The normality assumption is depicted in Figure 3 for ASC1 and Figure 4 for ASC2.

Figure 3

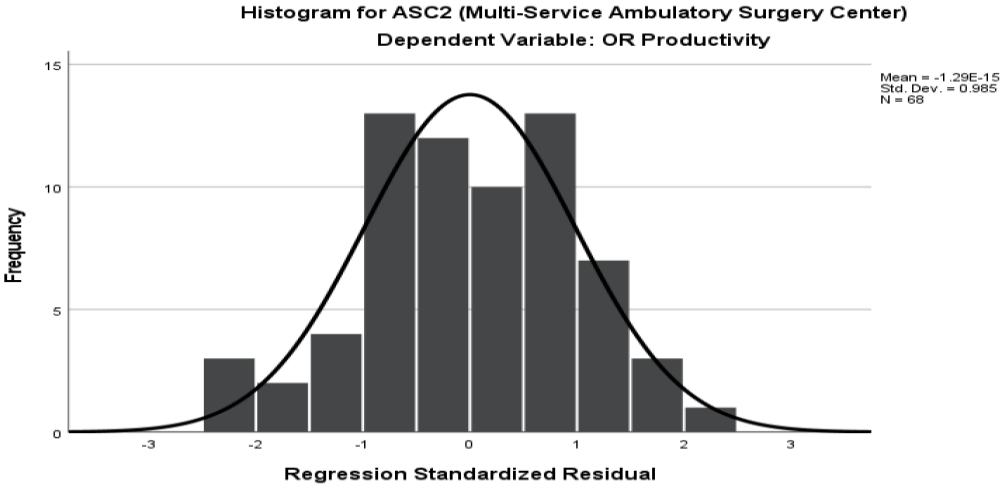
Histogram of OR Productivity Frequency for ASC1



Note. This figure demonstrates frequency distribution of OR productivity for ASC1.

Figure 4

Histogram of OR Productivity Frequency for ASC2



Note. This figure demonstrates frequency distribution of OR productivity for ASC2.

Inferential Statistics

I conducted this study to determine if FCOTS and TOT influence OR productivity. The established hypothesis was that FCOTS and TOT would positively

predict the OR productivity. To test this hypothesis, I used multiple linear regression analysis. Results showed a significant effect on OR productivity (F = 11.495 (2,65), p = < .001 with R^2 = 0.261, suggesting that the prediction of 26.1% of the variation comes from the two listed factors of FCOTS and TOT for ASC1.

Table 6

Coefficient of Determination for ASC1

Model Summary[b]				
Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate
1	.511[a]	.261	.239	.13968

[a] Predictors: (Constant), TOT, FCOTS.
[b] Dependent Variable: OR Productivity.

Table 7

Analysis of Variance for ASC1

ANOVA[a]						
Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	.449	2	.224	11.495	<.001[b]
	Residual	1.268	65	.020		
	Total	1.717	67			

[a] Dependent Variable: OR Productivity.
[b] Predictors: (Constant), TOT, FCOTS.

Table 8

Regression Coefficients for Predicting OR Productivity for ASC1

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	*t*	Sig.
1	(Constant)	.042	.117		.363	.718
	FCOTS	.091	.054	.179	1.672	.099
	TOT	.591	.138	.460	4.296	<.001**

Note. This table demonstrates statistical significance of TOT for ASC1.
[a] Dependent Variable: OR Productivity.
** $p < .01$.

The same results for ASC2 showing a significant effect on OR productivity (F = 3.171(2,65), p = .024 with R^2 = .089, which implies that the FCOTS and TOT account for 8.9% of the variation for ASC2. The probability value for each predictor variable shows significance in both ASCs.

Table 9

Coefficient of Determination for ASC2

Model Summary[b]				
Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate
1	.298[a]	.089	.061	.14063

[a] Predictors: (Constant), TOT, FCOTS.
[b] Dependent Variable: OR Productivity.

Table 10

Analysis of Variance for ASC2

ANOVA[a]						
Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	.125	2	.063	3.171	.049[b]
	Residual	1.286	65	.020		
	Total	1.411	67			

[a] Dependent Variable: OR Productivity.
[b] Predictors: (Constant), TOT, FCOTS.

Table 11

Regression Coefficients for Predicting OR Productivity for ASC2

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	.481	.063		7.685	<.001
	FCOTS	.126	.054	.278	2.310	.024*
	TOT	.083	.146	.068	.569	.571

[a] Dependent Variable: OR Productivity.
*$p < .05$.

Analysis of Findings

The theoretical framework I used was a theoretical proposition supported by existing theories, such as DST, TOC, CT, and MST, to determine if FCOTS and TOT impacted OR productivity. I developed theoretical constructs to formulate a model to assess the significant impacts between FCOTS, TOT, and OR productivity. The first variable, FCOTS, was not significant in the study at the ASC1 but was significant in

ASC2, as shown in Tables 8 and 11. Earlier researchers' analysis showed a statistically significant relationship between FCOTS and OR productivity (Cerfolio et al., 2019; Chapman et al., 2020; Halim et al., 2018). In the current study, I failed to reject the null hypothesis because the results showed no statistical significance between FCOTS and OR productivity in ASC1 (see Table 8). However, in contrast, ASC2 results showed statistical significance between FCOTS and OR productivity (see Table 11). Awareness and understanding of the relationship between FCOTS and OR productivity allows OR managers to focus on the FCOTS metric to make operational workflow process improvements. The second variable, TOT, was statistically highly significant with OR productivity at ASC1 (shown in Table 8), conforming with the alternative hypothesis, which supports the previous studies showing statistically significant (Cerfolio et al., 2019; Halim et al., 2018). However, TOT was not statically significant at all in ASC2, as shown in Table 11. Regression analysis revealed that only FCOTS significantly predicted OR productivity in the ASC1, while TOT was highly significant in predicting the OR productivity in ASC2

Although independent variables yield different results on the statistical significance in various types of ASCs, the study findings revealed the need to focus on the on-time performance metrics and be included in the priorities for a health care organization to meet the surgical demands of the OR. The current study findings indicated that FCOTS impacts the OR productivity in ASC1, and TOT highly impacts the OR productivity in ASC2. The rationale behind the difference in the results was out of scope for this doctoral study. Overall, the results showed that both predictor variables,

FCOTS and TOT, showed statistical significance in impacting the OR productivity in the surgical field.

Applications to Professional Practice

Since the start of the COVID-19 pandemic, surgical demand has increased with the pandemic generating a huge surgical backlog, resulting in more delays in delivering surgical services (Gomez et al., 2022). Most hospitals struggle to keep up with the demand, provide patient and staff satisfaction, and maintain financial stability (Bose et al., 2021; Findling et al., 2020). The exhaustion of the clinical providers to provide care and staffing shortages continue. To achieve OR sustainability, focusing on efficiency and creating an automated tool like a performance metrics dashboard to help leaders make informed decisions is critical at these times. Moreover, doing more with less staff requires effective strategies and continuous improvement in the current workflow processes.

The OR managers may apply the findings of this study to make operational process improvements and use technological advancements in building automated reports to show performance metrics in ORs. Based on the results, I found that the theoretical proposition provided an analysis of the impact of the on-time performance metrics on the specific outcome of OR productivity. The association between existing and current research studies supports the significant effects of FCOTS and TOT on OR productivity. The current study offers OR managers and health care industry leaders relevant results regarding efficiency, profitability, sustainability, and value.

The health care industry is evolving, and technologically advanced predictive analysis has infiltrated the health care sector of the market. An OR manager's ability to minimize nonproductivity and maximize utilization of the existing resources by meeting the established target on the on-time performance metrics may increase surgical access, profitability, and intrinsic value. Understanding the relationship of OR performance metrics to productivity will make OR managers strive to have FCOTS and TOT on target by always being on time. Moreover, the study results can be used to establish efficient, effective, and successful OR health care operations. The findings support the need for OR managers to restructure relevant workflow processes to increase efficiency in getting all scheduled cases on time. Knowing the importance of the performance metrics, making continuous improvements, and meeting established targets in reducing service delays to the daily operations may deliver improved results in OR productivity.

Implications for Social Change

Our society faces growing educational, economic, political, and health care challenges during the pandemic. The COVID-19 pandemic effect on geopolitical, socioeconomic, and environmental factors were evident in the rise of surgical demand and backlog impacting patient access. No hospital sector has been unaffected by the effects of COVID-19; surgery included. The change mechanisms that stimulate behavioral change and transform organizational practices affected positive social change from the outcome of transformation (Stephan et al., 2016). The OR has shifted resources and changed tremendously to handle COVID-19 pandemic on an unprecedented scale.

Moreover, researchers discussed the effects of the pandemic in the surgery arena (Fu et al., 2020; Pathak et al., 2022). COVID-19 will leave a permanent mark on all aspects of society. By mitigating the pandemic risk, the study's findings can offer strategies to improve productivity, positive workflow changes, and provide more surgical services by the organization to society. Social change driven by the health care industry from the unexpected crisis will continue to transform in meeting to provide essential health services, including surgery, to the community.

Health is the most valuable asset of an individual in their entire life. Fu et al. (2020) discussed the performance of surgical operations and the consequences of delaying elective surgery that impacted patient health outcomes, hospital finances, and resources. OR managers can utilize this study to understand better ways to improve overall surgical access to the community by changing the employees' an organization's culture and behavior in providing timely services. This study's propositions for positive social change include the possibility of delivering value to health care stakeholders, leaders, patients, employees, and government agents. Moreover, process improvement in effectiveness and efficiency enhances productivity, improves access to health care, builds a stronger social relationship, and reduces costs by minimizing preventable wastes, thereby improving profitability and organizational sustainability.

Recommendations for Action

High productivity is the most common goal in all community-based and service-based organizations. The results from the doctoral study are highly relevant to the OR manager. I recommend that health care leaders and decision-makers continue to research

and undergo continuous improvement that focuses on improving productivity and reducing waste. The predictor variables, FCOTS and TOT, reflect on time performance metrics, efficiency, and maximized capacity utilization, while the criterion variable is vital to profitability, waste, and cost reduction.

Implementing process improvements incorporating oversight performance metrics may improve the employee-organization relationship to achieve the common goal, collaboration, and accountability. Moreover, working together as a team will enhance patient and staff satisfaction. To improve OR productivity and throughput, OR leadership and decision-makers should apply the study findings to organizational workflow processes. Previous research and current study results support the need for health care leaders to consider the importance of on-time performance metrics and find ways to improve the FCOTS and TOT to make OR work efficiently and effectively and increase the organization's intrinsic value by being productive.

I will share my doctoral study results with the partner organization. Upon further approval from the partner health care organization, I intend to share the finding with other colleagues and professionals within the health care discipline through scholarly journal publications. Additionally, I will share the results through seminars and paper submissions with consent from the partner organization. I intend to assist institutional health care leaders in reducing waste and cost and improving patient care access by improving OR productivity, thereby increasing organizational profitability, sustainability, and value to the stakeholders.

Recommendations for Further Research

I call for future research on OR performance metrics impacting OR productivity. My recommendation for further research includes identifying additional performance metrics such as OR block/room utilization, surgical scheduling, and cancellation rates, allowing other types of statistical analysis like multivariate regression analysis. In addition, a future scholar could build high efficiency/OR capacity maximum utilization as the independent variable. The further recommendation includes an extensive data set, expansion to venues such as hospital operating rooms or procedural areas, and multiple organizations to replicate the statistical significance of this study.

In addition, future scholars should include urgent and emergent cases not covered in the scope of this study. Performing future studies on OR productivity could help health care leaders with the information necessary to make executive decisions in improving service to surgical patients. Moreover, since this study focuses on a single health care institution in California, future scholars should acquire data sets outside the state to compare any statistical significance or relevance.

Reflections

The DBA journey was an unforgettable and humbling experience. It was challenging to manage time and balance work, home, and school while experiencing and recovering from the COVID pandemic. Each process requires meticulous work to ensure that I met and exceeded the Walden University requirements. Attention to detail was necessary to complete the requirements and advance each step of the doctoral journey. The overall process of committee meeting/approval, IRB rigorous process, and adherence

to the American Psychological Association guidelines reflect Walden University being a higher academic recognized university.

My investment to investigate OR productivity is a personal objective of mine, considering my employment in health care. As a perioperative business consultant for over 5 years, the topic of productivity is essential in determining the efficiency of the OR and leads to better patient surgical access. The results that pertain to the predictor variables were typical of my personal experiences in northern California. The OR productivity amid the COVID-19 pandemic has been deteriorating.

Conclusion

The explicit goal of this doctoral study is to determine if FCOTS and TOT impacted OR productivity. The study results showed that I rejected the null hypothesis and accepted the alternative hypothesis as it offered statistical significance between variables in two ASCs. Moreover, the study's results reinforced the theoretical proposition and supportive theories. The data yielded statistical significance and confirmed that the predictor variables affect OR productivity. The findings may lead to further research on improving productivity in the operating room. The general idea to improve OR productivity was to improve the overall value of the health care organization to all stakeholders.

References

Abbott, M. (2018). Productivity: A history of its measurement. *History of Economic Thought and Policy, 0*(1), 57-80. https://doi.org/10.3280/spe2018-001003

Abbott, T. E., & Gillies, M. A. (2021). The PREVENNT randomised, double-blind, controlled trial of preoperative intravenous iron to treat anaemia before major abdominal surgery: An independent discussion. *British Journal of Anaesthesia, 126*(1), 157-162. https://doi.org/10.1016/j.bja.2020.08.053

Ahmad, S., Wasim, S., Irfan, S., Gogoi, S., Srivastava, A., & Farheen, Z. (2019). Qualitative vs. quantitative research – A summarised review. *Journal of Evidence Based Medicine and Healthcare, 6*(43), 2828-2832. https://doi.org/10.18410/jebmh/2019/587

Allen, R. W., Taaffe, K. M., Neilley, V., & Busby, E. (2019). First case on-time starts measured by incision on-time and no grace period: A case study of operating room management. *Journal of Healthcare Management, 64*(2), 111-121. https://doi.org/10.1097/jhm-d-17-00203

Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., Cochran, J. J., Fry, M. J., & Ohlmann, J. W. (2019). *An introduction to management science: Quantitative approach*. Cengage.

Anguera, M. T., Blanco-Villasenor, A., Losada, J. L., Sánchez-Algarra, P., & Onwuegbuzie, A. J. (2018). Revisiting the difference between mixed methods and multimethods: Is it all in the name? *Quality & Quantity, 52*(6), 2757-2770. https://doi.org/10.1007/s11135-018-0700-2

Aparicio, J., Ortiz, L., Pastor, J. T., & Zabala-Iturriagagoitia, J. M. (2020). Introducing cross-productivity: A new approach for ranking productive units over time in data envelopment analysis. *Computers & Industrial Engineering*, *144*, 1-15. https://doi.org/10.1016/j.cie.2020.106456

Aronson, S., Westover, J., Guinn, N., Setji, T., Wischmeyer, P., Gulur, P., Hopkins, T. J., Seyler, T. M., Lagoo-Deendayalan, S., Heflinm, M. T., Thompson, A., Swaminathan, M., & Flanagan, E. (2018). A perioperative medicine model for population health: An integrated approach for an evolving clinical science. *Anesthesia & Analgesia*, *126*(2), 682-690. https://doi.org/10.1213/ANE.0000000000002606

Asenahabi, B. M. (2019). Basics of research design: A guide to selecting appropriate research design. *International Journal of Contemporary Applied Researches*, *6*(5), 76-89. http://ijcar.net/assets/pdf/Vol6-No5-May2019/07.-Basics-of-Research-Design-A-Guide-to-selecting-appropriate-research-design.pdf

Barlett, N. D., & Barlett, C. P. (2019). Money and job worries as a function of emerging adulthood markers: An analysis of college-aged and adult populations using correlational and longitudinal designs. *Journal of Adult Development*, *26*(2), 116-128. https://doi.org/10.1007/s10804-018-9302-4

Barrow, J. M., Brannan, G. D., & Khandhar, P. B. (2021). Research ethics. *StatPearls [Internet]*. StatPearls Publishing.

Basias, N., & Pollalis, Y. (2018). Quantitative and qualitative research in business & technology: Justifying a suitable research methodology. *Review of Integrative*

Business and Economics Research, 7(1), 91-105.

Bielinskyi, A. O., Kiv, A. E., Prikhozha, Y. O., Slusarenko, M. A., & Soloviev, V. N. (2022). Complex systems and physics education. *CEUR Workshop Proceedings*, 56-80. http://ceur-ws.org/Vol-3085/paper17.pdf

Bejil, C. (2020). *Evaluating an incentive program to improve teamwork and productivity in the operating room* (Publication No. 28089487). [Doctoral Dissertations & Theses, Walden University]. ProQuest One Academic.

Belkhamsa, M., Jarboui, B., & Masmoudi, M. (2018). Two metaheuristics for solving no-wait operating room surgery scheduling problem under various resource constraints. *Computers & Industrial Engineering, 126*, 494-506. https://doi.org/10.1016/j.cie.2018.10.017

Benach, J., Pericàs, J. M., Martínez-Herrera, E., & Bolíbar, M. (2019). Public health and inequities under capitalism: Systemic effects and human rights. In J. Vallverdú, A. Puyol, & A. Estany (Eds.), *Philosophical and methodological debates in public health*. Springer. https://doi.org/10.1007/978-3-030-28626-2_12

Bengtsson, B., & Kohl, S. (2020). Incremental change in housing regimes: Some theoretical propositions with empirical illustrations. *Critical Housing Analysis, 7*(1), 15-24. https://doi.org/10.13060/23362839.2020.7.1.500

Black, S. P., Stefankiewicz, A. R., Smulders, M. M., Sattler, D., Schalley, C. A., Nitschke, J. R., & Sanders, J. K. (2013). Generation of a dynamic system of three-dimensional tetrahedral polycatenanes. *Angewandte Chemie, 125*(22), 5861-5864. https://doi.org/10.1002/ange.201209708

Blackstone, J. (2010). Theory of constraints. *Scholarpedia*, *5*(5), 10451. https://doi.org/10.4249/scholarpedia.10451

Bloomfield, J., & Fisher, M. J. (2019). Quantitative research design. *Journal of the Australasian Rehabilitation Nurses' Association*, *22*(2), 27–30. https://doi.org/10.33235/jarna.22.2.27-30

Bose, S. K., Dasani, S., Roberts, S. E., Wirtalla, C., DeMatteo, R. P., Doherty, G. M., & Kelz, R. R. (2021). The cost of quarantine: Projecting the financial impact of canceled elective surgery on the nation's hospitals. *Annals of Surgery*, *273*(5), 844-849. https://doi.org/10.1097/sla.0000000000004766

Bouckaert, G. (1990). The history of the productivity movement. *Public Productivity & Management Review, 14*(1), 53-89. https://doi.org/10.2307/3380523

Bradley, D. F., Romito, K., Dockery, J., Taylor, L., ONeel, N., Rodriguez, J., & Talbot, L. A. (2021). Reducing setup and turnover times in the OR with an innovative sterilization container: Implications for the COVID-19 era military medicine. *Military Medicine, 186*(2), 35-39. https://doi.org/10.1093/milmed/usab214

Brière, C. (2021). Archival research. *Research Methods in the Social Sciences: An AZ of Key Concepts*. Oxford University

Brown, S. L., & Eisenhardt, K. M. (1998). *Competing on the edge: Strategy as structured chaos*. Harvard Business School Press.

Browne, A. J., Varcoe, C., Ford-Gilboe, M., Wathen, C. N., Smye, V., Jackson, B. E., Wallace, B., Pauly, B., Herbert, C. P., Lavoie, J. G., Wong, S. T., & Blanchet Garneau, A. (2018). Disruption as opportunity: Impacts of an organizational

health equity intervention in primary care clinics. *International Journal for Equity in Health, 17*(1), 1-16. https://doi.org/10.1186s12939-018-0820-2

Bucklin, B. R., Li, A., Rodriguez, M. M., Johnson, D. A., & Eagle, L. M. (2022). Pay-for-performance: Behavior-based recommendations from research and practice. *Journal of Organizational Behavior Management*, 1-28. https://doi.org/10.1080/01608061.2022.2047868

Cancer Treatment Centers of America (2020). *What is an elective procedure? Not your cancer care*. https://www.cancercenter.com/community/blog/2020/12/covid-elective-procedures?msclkid=dae6c9b5b89e11ecb9b2f0692e53681d

Cassell, C., & Bishop, V. (2019). Qualitative data analysis: Exploring themes, metaphors and stories. *European Management Review, 16*(1), 195–207. https://doi.org/10.1111/emre.12176

Centobelli, P., Cerchione, R., & Esposito, E. (2019). Efficiency and effectiveness of knowledge management systems in SMEs. *Production Planning & Control, 30*(9), 779-791. https://doi.org/10.1080/09537287.2019.1582818

Cerfolio, R. J., Ferrari-Light, D., Ren-Fielding, C., Fielding, G., Perry, N., Rabinovich, A., Saraceni, M., Fitzpatrick, M., Jain, S., & Pachter, H. L. (2019). Improving operating room turnover time in a New York city academic hospital via lean. *The Annals of Thoracic Surgery*, *107*(4), 1011-1016. https://doi.org/10.1016/j.athoracsur.2018.11.071

Chaganty, S. S., & Sharma, H. (2021). Factors influencing peri-operative delays in neurosurgery operating theatres: A prospective study. *Perioperative Care and*

Operating Room Management, *23*, 100160. https://doi.org/10.1016/j.pcorm.2021.100160

Chapman, W. C., Luo, X., Doyle, M., Khan, A., Chapman, W. C., Kangrga, I., Martin, J. Jr., & Wellen, J. (2020). Time is money: Can punctuality decrease operating room cost? *Journal of the American College of Surgeons*, *230*(2), 182-189. https://doi.org/10.1016/j.jamcollsurg.2019.10.017

Charlesworth, M., & Pandit, J. J. (2020). Rational performance metrics for operating theatres, principles of efficiency, and how to achieve it. *British Journal of Surgery*, *107*(2), e63-e69. https://doi.org/10.1002/bjs.11396

Chen, Z. (2019). Grand challenges in construction management. *Frontiers in Built Environment*, *5*(5), 31. https://doi.org/10.3389/fbuil.2019.00031

Chernov, M., Vick, A., Ramachandran, S., Reddy, S., Leyvi, G., & Delphin, E. (2018). Perioperative efficiency vs. quality of care–Do we always have to choose? *Journal of Investigative Surgery*, *33*(3), 265-270. https://doi.org/10.1080/08941939.2018.1492049

Chilakapati, M., Loudin, N. N., Yen, K. G., & Coats, D. K. (2021). Strabismus surgical time-out: An illustrated whiteboard modification. *Journal of American Association for Pediatric Ophthalmology and Strabismus*, *25*(2), e1–72. https://doi.org/10.1016/j.jaapos.2020.10.014

Childers, C. P., & Maggard-Gibbons, M. (2018). Understanding costs of care in the operating room. *JAMA surgery*, *153*(4), e176233-e176233. https://doi.org/10.1001/jamasurg.2017.6233

Chua, M. M., Lewis, K., Huang, Y. A., Fingliss, M., & Farber, A. (2021). A successful organized effort to improve operating room first-case starts in a tertiary academic medical center. *The American Surgeon, 87*(2), 259-265. https://doi.org/10.1177/0003134820951430

Cloutier, C., & Langley, A. (2020). What makes a process theoretical contribution? *Organization Theory 1*(1), 1-32. https://doi.org/10.1177/2631787720902473

Coban, E., Kayış, E., & Dexter, F. (2022). The effect of few historical data on the performance of sample average approximation method for operating room scheduling. *International Transactions in Operational Research*, 1-25. https://doi.org/10.1111/itor.13101

Coffey, C., Cho, E. S., Wei, E., Luu, A., Ho, M., Amaya, R., Pecson, M., Dalton, F. V., Kahaku, D., Spellberg, B., & Sener, S. F. (2018). Lean methods to improve operating room elective first case on-time starts in a large, urban, safety net medical center. *The American Journal of Surgery*, *216*(2), 194–201. https://doi.org/10.1016/j.amjsurg.2018.05.002

Cohen, T. N., Anger, J. T., Shamash, K., Catchpole, K. R., Avenido, R., Ley, E. J., Gewrtz, B., & Shouhed, D. (2022). The application of human factors engineering to reduce operating room turnover in robotic surgery. *World Journal of Surgery*, *46*. 1-8. https://doi.org/10.1007/s00268-022-06487-z

Collins, C. S., & Stockton, C. M. (2018). The central role of theory in qualitative research. *International Journal of Qualitative Methods*, *17*(1), 1-10.

https://doi.org/10.1177/1609406918797475

Connell, J. P., DiMercurio, A., & Corbetta, D. (2017). Dynamic systems theory. In J. Vonk, & T. Shackelford (Eds.), *Encyclopedia of animal cognition and behavior*. Springer. https://doi.org/10.1007/978-3-319-47829-6_1594-1

Cotteleer, M. J., & Wan, X. (2016). Does the starting point matter? The literature-driven and the phenomenon-driven approaches of using corporate archival data in academic research. *Journal of Business Logistics*, *37*(1), 26–33. https://doi-org/10.1111/jbl.12114

Cox, J., & Goldratt, E. M. (2004). *The goal*. North River Press.

Cox III, J. F., & Boyd, L. H. (2018). Using the theory of constraints' processes of ongoing improvement to address the provider appointment scheduling system design problem. *Health Systems*, *9*(2), 124-158. https://doi.org/10.1080/20476965.2018.1471439

Centers for Medicare & Medicaid Services. (2021). *NHE fact sheet.* https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NHE-Fact-Sheet

Daraio, C. (2019). Econometric approaches to the measurement of research productivity. In W. Glänzel, H. Moed, U. Schmoch, & M. Thelwall (Eds.), *Springer handbook of science and technology indicators*. Springer. https://doi.org/10.1007/978-3-030-02511-3_24

Das, R., Jain, K. K., & Mishra, S. K. (2018). Archival research: A neglected method in organization studies. *Benchmarking: An International Journal, 25*(1), 138-

155. https://doi.org/10.1108/BIJ-08-2016-0123

de Jager, E., Levine, A., Udyavar, N. R., Burstin, H. R., Bhulani, N., Hoyt, D. B., Ko, C. Y., Weissman, J. S., Britt, L. D., Haider, A. H., & Gibbons, M. A. M. (2019). Disparities in surgical access: A systematic literature review, conceptual model, and evidence map. *Journal of the American College of Surgeons, 228*(3), 276-298. https://doi.org/10.1016/j.jamcollsurg.2018.12.028

de Jesus Pacheco, D. A., Pergher, I., Junior, J. A. V. A., & Vaccaro, G. L. R. (2019). Exploring the integration between lean and the theory of constraints in operations management. *International Journal of Lean Six Sigma, 10*(3), 718-742. https://doi.org/10.1108/ijlss-08-2017-0095

Dean, T., & Wellman, M. (1991). *Planning and control*. Morgan Kaufmann Publishers

Definitive Healthcare (2022, August 25). *Outpatient clinics are in!* https://www.definitivehc.com/blog/outpatient-clinics-are-in

Deller, C. (2019). Reflections on obtaining archival data from the field. *Journal of Financial Reporting, 4*(1), 25–36. https://doi.org/10.2308/jfir-52336

Denis, D. J. (2018). *SPSS data analysis for univariate, bivariate, and multivariate statistics*. John Wiley & Sons.

Deshpande, N. G., Witmer, H. D., Keceli, Ç., Adelman, D., & Turaga, K. K. (2021). Surgical team familiarity and waste generation in the operating room. *The American Journal of Surgery, 222*(4), 694-699. https://doi.org/10.1016/j.amjsurg.2021.05.009

DePoy, E., & Gitlin, L. N. (2019). *Introduction to research E-book: Understanding and*

applying multiple strategies. Elsevier Health Sciences.

Dexter, F., Abouleish, A. E., Epstein, R. H., Whitten, C. W., & Lubarsky, D. A. (2003). Use of operating room information system data to predict the impact of reducing turnover times on staffing costs. *Anesthesia & Analgesia, 97*(4), 1119-1126. https://doi.org/10.1213/01.ane.0000082520.68800.79

Dexter, E. U., Dexter, F., Masursky, D., Garver, M. P., & Nussmeier, N. A. (2009). Both bias and lack of knowledge influence organizational focus on first case of the day starts. *Anesthesia & Analgesia*, *108*(4), 1257-1261. https://doi.org/10.1213/ane.0b013e31819a6dd4

Dexter, F., & Epstein, R. H. (2009). Typical savings from each minute reduction in tardy first case of the day starts. *Anesthesia & Analgesia*, *108*(4), 1262-1267. https://doi.org/10.1213/ane.0b013e31819775cd

Dexter, F., & Epstein, R. H. (2018). Treating surgical turnover times as statistically independent events when testing interventions and mobile applications. *Mhealth*, *4*(7), 23-23. https://doi.org/10.21037/mhealth.2018.06.08

Dexter, F., Epstein, R. H., Schwenk, E. S., & Marian, A. A. (2021). Average number of anesthetics still in progress in the early evening increased at least proportionally to the numbers of anesthetizing locations in the morning: A retrospective, long-term longitudinal study at two large hospitals. *Perioperative Care and Operating Room Management, 25*, 100213. https://doi.org/10.1016/j.pcorm.2021.100213

Dillane, D., & Finegan, B. A. (2021). Preoperative assessment and optimization. In D. Dillane, & B. Finegan (Eds.), *Preoperative Assessment*. Springer.

https://doi.org/10.1007/978-3-030-58842-7_1

Ebrahimpour, S. M., Rahimnia, F., Pooya, A., & Pakdaman, M. (2021). Multi-level nursing workforce planning considering talent management in healthcare with a dynamic quantitative approach. *Kybernetes*, 1-25.https://doi.org/10.1108/K-04-2021-0261

Edmonds, W. A., & Kennedy, T. D. (2016). *An applied guide to research designs: Quantitative, qualitative, and mixed methods*. Sage Publications.

Elston, T., MacCarthaigh, M., & Verhoest, K. (2018). Collaborative cost-cutting: Productive efficiency as an interdependency between public organizations. *Public Management Review, 20*(12), 1815-1835. https://doi.org/10.1080/14719037.2018.1438498

Emmert-Streib, F., & Dehmer, M. (2019). Evaluation of regression models: Model assessment, model selection and generalization error. *Machine Learning and Knowledge Extraction, 1*(1), 521-551. https://doi.org/10.3390/make1010032

Ephraim-Emmanuel, B. C., Adigwe, A., Oyeghe, R., & Ogaji, D. S. (2018). Quality of health care in Nigeria: A myth or a reality. *International Journal of Research in Medical Sciences, 6*(9), 2875-2881. https://doi.org/10.18203/2320-6012.ijrms20183621

Erba, J., Ternes, B., Bobkowski, P., Logan, T., & Liu, Y. (2018). Sampling methods and sample populations in quantitative mass communication research studies: A 15-year census of six journals. *Communication Research Reports, 35*(1), 42-47. https://doi.org/10.1080/08824096.2017.1362632

Ernst, C., Szczesny, A., Soderstrom, N., Siegmund, F., & Schleppers, A. (2012). Success of commonly used operating room management tools in reducing tardiness of first case of the day starts: Evidence from German hospitals. *Anesthesia & Analgesia*, *115*(3), 671-677. https://doi.org/10.1213/ANE.0b013e31825c0486

Eriksson, J., Fowler, P., Appelblad, M., Lindholm, L., & Sund, M. (2022). Productivity in relation to organization of a surgical department: A retrospective observational study. *BMC Surgery*, *22*(1), 1-9. https://doi.org/10.1186/s12893-022-01563-6

Ezzat, A. E., & Hamoud, H. S. (2014). How to assess the productivity of operating rooms. *International Journal of Health Sciences and Research*, *4*(10), 261-267.

Farghaly, A. (2018). Comparing and contrasting quantitative and qualitative research approaches in education: The peculiar situation of medical education. *Education in Medicine Journal*, *10*(1), 3-11. https://doi.org/10.21315/eimj2018.10.1.2

Fecteau, D., Reid, S., Green, S., Hanselman, R., Nayak, S., Tyzik, S., & Sparks, A. (2019). *Increasing first case on time starts in an ambulatory surgery center*. https://knowledgeconnection.mainehealth.org/cgi/viewcontent.cgi?article=1025&context=opex

Findling, M. G., Blendon, R. J., & Benson, J. M. (2020). Delayed care with harmful health consequences - Reported experiences from national surveys during coronavirus disease 2019. *Journal of the American Medical Association Health Forum*, *1*(12), e201463-e201463. https://doi.org/10.1001/jamahealthforum.2020.1463

Flake, J. K., & Fried, E. I. (2020). Measurement schmeasurement: Questionable

measurement practices and how to avoid them. *Advances in Methods and Practices in Psychological Science, 3*(4), 456-465. https://doi.org/10.1177/2515245920952393

Flannelly, K. J., Flannelly, L. T., & Jankowski, K. R. (2018). Threats to the internal validity of experimental and quasi-experimental research in healthcare. *Journal of Health Care Chaplaincy, 24*(3), 107-130. https://doi.org/10.1080/08854726.2017.1421019

Foglia, R. P., Ruiz, J. E., & Burkhalter, L. S. (2017). An evolutionary change in first case on time starts using perioperative process improvement, communication and enhanced data integrity. *Global Journal of Perioperative Medicine, 1*(1), 013-016. https://doi.org/10.17352/gjpm.000004

Force, D., & Wiles, B. (2021). "Quietly incomplete": Academic historians, digital archival collections, and historical research in the web era. *Journal of Contemporary Archival Studies, 8*(1), 18. https://elischolar.library.yale.edu/jcas/vol8/iss1/18

Foy, T., Dwyer, R. J., Nafarrete, R., Hammoud, M. S. S., & Rockett, P. (2019). Managing job performance, social support and work-life conflict to reduce workplace stress. *International Journal of Productivity and Performance Management, 68*(6), 1018-1041. https://doi.org/10.1108/IJPPM-03-2017-0061

Frampton, A., Simmons, V. C., Thompson, J. A., Weston, C., & Tola, D. H. (2022). Increasing on-time starts of neurology procedures in interventional radiology. *Journal of Radiology Nursing*, 1-5.

https://doi.org/10.1016/j.jradnu.2022.02.010

Frasso, R., Keddem, S., & Golinkoff, J. M. (2018). Qualitative methods: Tools for understanding and engaging communities. In R. Cnaan, & C. Milofsky (Eds.), *Handbook of community movements and local organizations in the 21st century*. Springer. https://doi.org/10.1007/978-3-319-77416-9_32

Friedman, C. P., Wyatt, J. C., & Ash, J. S. (2022). Designing and carrying out correlational studies using real-world data. In evaluation methods in biomedical and health informatics. *Health informatics.* Springer. https://doi.org/10.1007/978-3-030-86453-8_13

Fu, S. J., George, E. L., Maggio, P. M., Hawn, M., & Nazerali, R. (2020). The consequences of delaying elective surgery: Surgical perspective. *Annals of Surgery*, *272*(2), e79-e80. https://doi.org/10.1097/sla.0000000000003998

Fuglie, K., Gautam, M., Goyal, A., & Maloney, W. F. (2019). *Harvesting prosperity: Technology and productivity growth in agriculture*. World Bank Publications.

Gaspar, M., Cristovão, L., & Tenera, A. (2019, May). Theory of constraints thinking processes on operational lean programs management improvement: An energy producer company case. *Doctoral Conference on Computing, Electrical and Industrial Systems*. Springer. https://doi.org/10.1007/978-3-030-17771-3_11

Gomez, D., Nantais, J., Telesnicki, T., de Mestral, C., Wilton, A. S., Stukel, T. A., Urbach, D. R., & Baxter, N. N. (2022). A population-based analysis of the COVID-19 generated surgical backlog and associated emergency department presentations for inguinal hernias and gallstone disease. *Annals of*

Surgery, *275*(5), 836–841. https://doi.org/10.1097/SLA.0000000000005403

Gitterman, A., Klaus, J., Williams, K., & Murphy, J. (2021). Peripartum optimization and coordination of collaborative care practice: A critical role for the obstetric anesthesiologist in combating maternal morbidity and mortality. *Current Opinion in Anesthesiology*, *34*(3), 205-211. https://doi.org/10.1097/aco.0000000000000984

Göras, C., Nilsson, U., Ekstedt, M., Unbeck, M., & Ehrenberg, A. (2020). Managing complexity in the operating room: A group interview study. *BioMed Central Health Services Research 20*(440), 1-12. https://doi.org/10.1186/s12913-020-05192-8

Guida, T. (2019). *Big data and machine learning in quantitative investment*. John Wiley & Sons.

Halim, U. A., Khan, M. A., & Ali, A. M. (2018). Strategies to improve start time in the operating theatre: A systematic review. *Journal of Medical Systems*, *42*(9), 1-11. https://doi.org/10.1007/s10916-018-1015-5

Hamilton, A. B., & Finley, E. P. (2019). Qualitative methods in implementation research: an introduction. *Psychiatry Research, 280*, 112516. https://doi.org/10.1016/j.psychres.2019.112516

Hazzam, J., & Lahrech, A. (2018). Health care professionals' social media behavior and the underlying factors of social media adoption and use: Quantitative study. *Journal of Medical Internet Research*, *20*(11), e12035. https://doi.org/10.2196/12035

Hendrickson, A. T., Perfors, A., Navarro, D. J., & Ransom, K. (2019). Sample size, number of categories and sampling assumptions: Exploring some differences between categorization and generalization. *Cognitive Psychology, 111*, 80-102. https://doi.org/10.1016/j.cogpsych.2019.03.001

Hensher, M., & McGain, F. (2020). Health care sustainability metrics: Building a safer, low-carbon health system. *Health Affairs, 39*(12), 2080–2087. https://doi.org/10.1377/hlthaff.2020.01103

Hepner, D., Harrop, C. M., Whinney, C., & Gulur, P. (2022). Pro-con debate: Anesthesiologist-versus hospitalist-run preoperative clinics and perioperative care. *Anesthesia & Analgesia, 134*(3), 466-474. https://doi.org/10.1213/ane.0000000000005877

Hicks, K. B., Glaser, K., Scott, C., Sparks, D., & McHenry, C. R. (2020). Enumerating the causes and burden of first case operating room delays. *The American Journal of Surgery, 219*(3), 486–489. https://doi.org/10.1016/j.amjsurg.2019.09.016

Hoffman, C. R., Horrow, J., Ranganna, S., & Green, M. S. (2019). Operating room first case start times: A metric to assess systems-based practice milestones? *BioMed Central Medical Education, 19*(1), 1-4. https://doi.org/10.1186/s12909-019-1886-2

Holmes, A. G. D. (2020). Researcher positionality--A consideration of its influence and place in qualitative research--A new researcher guide. *Shanlax International Journal of Education, 8*(4), 1-10. https://doi.org/10.34293/education.v8i4.3232

Ikeziri, L. M., Souza, F. B. D., Gupta, M. C., & de Camargo Fiorini, P. (2019). Theory of

constraints: Review and bibliometric analysis. *International Journal of Production Research, 57*(15-16), 5068-5102. https://doi.org/10.1080/00207543.2018.1518602

Imhanzenobe, J., Adejumo, O., & Ikpesu, O. (2021). A review of knowledge management and its application in the contemporary business environment. *African Journal of Business Management, 15*(10), 274-282. https://doi.org/10.5897/ajbm2021.9223

Janssen, M., & Estevez, E. (2013). Lean government and platform-based governance-Doing more with less. *Government Information Quarterly*, *30*(1), S1-S8. https://doi.org/10.1016/j.giq.2012.11.003

Janssen, J., & Kollar, I. (2021). Experimental and quasi-experimental research in CSCL. *International handbook of computer-supported collaborative learning*. Springer.

Japhet, I. (2021). A review of the management science theory and its application in contemporary businesses. *African Journal of Business Management, 15*(4), 133–138. https://doi.org/10.5897/ajbm2021.9211

Jefferson, K., Stanhope, K. K., Jones-Harrell, C., Vester, A., Tyano, E., & Hall, C. (2021). A scoping review of recommendations in the English language on conducting research with trauma-exposed populations since publication of the Belmont report; Thematic review of existing recommendations on research with trauma-exposed populations. *Public Library of Science One, 16*(7), e0254003. https://doi.org/10.1371/journal.pone.0254003

Jeney, S. E., Whitcomb, E. L., Ihara, J., Guaderrama, N., Mukhtar, F., & Heliker, B. D.

(2022). A randomized controlled trial evaluating the effect of an educational video on patient understanding of midurethral sling. *Female Pelvic Medicine & Reconstructive Surgery*, *28*(3), e73-e79. https://doi.org/10.1097/spv.0000000000001154

Joos, C., Bertheau, S., Hauptvogel, T., Auhuber, T., Taube, C., Bauer, M., & Schuster, M. (2021). Case delay in the OR morning start in hospitals of different size and academic status. *Der Anaesthesist*, *70*(1), 23-29. https://doi.org/10.1007/s00101-020-00842-2

Kalman, M. (2019). "It requires interest, time, patience and struggle": Novice researchers' perspectives on and experiences of the qualitative research journey. *Qualitative Research in Education, 8*(3), 341-377. https://doi.org/10.17583/qre.2019.4483

Kanaparan, G., & Strode, D. (2021). A theory of coordination: From propositions to hypotheses in agile software development. *In Proceedings of the 54th Hawaii International Conference on System Sciences*. https://doi.org/10.24251/hicss.2021.815

Kang, H. (2021). Sample size determination and power analysis using the G*Power software. *Journal of Educational Evaluation for Health Professions, 18*(17), 1-12. https://doi.org/10.3352/jeehp.2021.18.17

Karaman, A., Demir, M. S., & Oztekin, S. D. (2019). Chaos theory and nursing. *International Journal of Caring Sciences, 12*(2), 1223-1127. http://www.internationaljournalofcaringsciences.org/

Kaydos, W. (2020). *Operational performance measurement: Increasing total productivity*. CRC press.

Kelly, M., Dowling, M., & Millar, M. (2018). The search for understanding: The role of paradigms. *Nurse Researcher, 25*(4), 9-13. https://doi.org/10.7748/nr.2018.e1499

Khamitov, M., Wang, X., & Thomson, M. (2019). How well do consumer-brand relationships drive customer brand loyalty? Generalizations from a meta-analysis of brand relationship elasticities. *Journal of Consumer Research*, *46*(3), 435-459. https://doi.org/10.1093/jcr/ucz006

Kimmons, R. (2022). *Theories*. Education Research.

Kiran, E. U., & Haritha, M. (2019). Functional group structure in a novel chaos theory diverging non-linear significant functions with counters-residues pattern in singular integral–derivative applications. *Journal of Statistics and Mathematical Engineering, 5*(3), 28-36. http://doi.org/10.5281/zenodo.3404756

Kivunja, C. (2018). Distinguishing between theory, theoretical framework, and conceptual framework: A systematic review of lessons from the field. *International Journal of Higher Education*, *7*(6), 44-53. https://doi.org/10.5430/ijhe.v7n6p44

Kocher, N. J., Schilling, A. L., & Raman, J. D. (2018). PD28-03 Early impact of a preoperative safety checklist attestation on first case on-time start rate and operating room utilization. *The Journal of Urology, 199*(4S), e563-e563. https://doi.org/10.1016/j.juro.2018.02.1366

Kodali, B. S., Kim, D., Bleday, R., Flanagan, H., & Urman, R. D. (2014). Successful

strategies for the reduction of operating room turnover times in a tertiary care academic medical center. *Journal of Surgical Research, 187*(2), 403-411. https://doi.org/10.1016/j.jss.2013.11.1081

Koushan, M., Wood, L. C., & Greatbanks, R. (2021). Evaluating factors associated with the cancellation and delay of elective surgical procedures: A systematic review. *International Journal for Quality in Health Care, 33*(2), 1-7. https://doi.org/10.1093/intqhc/mzab092

Kraft, S. A., Rothwell, E., Shah, S. K., Duenas, D. M., Lewis, H., Muessig, K., Opel, D. J., Goddard, K. A., & Wilfond, B. S. (2021). Demonstrating 'respect for persons' in clinical research: Findings from qualitative interviews with diverse genomics research participants. *Journal of Medical Ethics, 47*(12), e8-e8. http://doi.org/10.1136/medethics-2020-106440

Kumatongo, B., & Muzata, K. K. (2021). Research paradigms and designs with their application in education. *Journal of Lexicography and Terminology, 5*(1), 16-32. https://library.unza.zm/index.php/jlt/article/download/551/482/N

The Lancet Rheumatology. (2021). Too long to wait: The impact of COVID-19 on elective surgery. *The Lancet Rheumatology, 3*(2), e83. https://doi.org/10.1016/S2665-9913(21)00001-

Larsen–Freeman, D. (2019). On language learner agency: A complex dynamic systems theory perspective. *The Modern Language Journal, 103*(1), 61-79. https://doi.org/10.1111/modl.12536

Lee, D. J., Ding, J., & Guzzo, T. J. (2019). Improving operating room efficiency. *Current*

Urology Reports, *20*(6), 1-8. https://doi.org/10.1007/s11934-019-0895-3

Li, J., Wang, R., Alhodaly, M. S., Huang, J., & Qi, L. (2021). The use of nonlinear dynamic system and deep learning in production condition monitoring and product quality prediction. *Fractals*, *30*(2), 22400681-224006813. https://doi.org/10.1142/s0218348x22400680

Liu, S., Lu, X., Jiang, M., Li, W., Li, A., Fang, F., & Cang, J. (2021). Preoperative assessment clinics and case cancellations: A prospective study from a large medical center in China. *Annals of Translational Medicine*, *9*(19), 1501–1501. https://doi.org/10.21037/atm-21-4665

Liu, Q., & Wang, L. (2021). t-Test and ANOVA for data with ceiling and/or floor effects. *Behavior Research Methods*, *53*(1), 264-277. https://doi.org/10.3758/s13428-020-01407-2

Lo, E. Y., Bowler, J., Lines, T., Melton, C., Volkmer, R., Majekodunmi, T., & Krishnan, S. G. (2021). Operating room efficiency and cost reduction in shoulder arthroplasty: Is there an advantage of a dedicated operating room team? *Seminars in Arthroplasty: JSES 31*(1), 125-130. https://doi.org/10.1093/milmed/usab214

Lunkenheimer, E. S. (2018). *The SAGE encyclopedia of lifespan human development*. SAGE Publications. https://doi.org/10.4135/9781506307633.n254

Mahaffy, P. G., Krief, A., Hopf, H., Mehta, G., & Matlin, S. A. (2018). Reorienting chemistry education through systems thinking. *Nature Reviews Chemistry*, *2*(4), 1-3. https://doi.org/10.1038/s41570-018-0126

Martinez, O., Martinez, C., Parra, C. A., Rugeles, S., & Suarez, D. R. (2021). Machine

learning for surgical time prediction. *Computer Methods and Programs in Biomedicine*, *208*, 1-8. https://doi.org/10.1016/j.cmpb.2021.106220

Masursky, D., Dexter, F., Isaacson, S. A., & Nussmeier, N. A. (2011). Surgeons' and anesthesiologists' perceptions of turnover times. *Anesthesia & Analgesia*, *112*(2), 440-444. https://doi.org/10.1213/ane.0b013e3182043049

Mazzei, W. J. (1994). Operating room start times and turnover times in a university hospital. *Journal of Clinical Anesthesia, 6*(5), 405-408. https://doi.org/10.1016/S0952-8180(05)80011-X

McCusker, K., & Gunaydin, S. (2015). Research using qualitative, quantitative or mixed methods and choice based on the research. *Perfusion*, *30*(7), 537-542. https://doi.org/10.1177/0267659114559116

McIntosh, C., Dexter, F., & Epstein, R. H. (2006). The impact of service-specific staffing, case scheduling, turnovers, and first-case starts on anesthesia group and operating room productivity: A tutorial using data from an Australian hospital. *Anesthesia & Analgesia, 103*(6), 1499-1516. https://doi.org/10.1213/01/ane.0000244535.54710.28

Mertens, L., Müller, E. C., Schwarm, N., Vogt, F. J., Wolbeck, L., Santos, D., & Marques, I. (2020). A simulation framework to evaluate time savings in operating rooms. *Pacific Asia Conference on Information Systems 2020 Proceedings*, *153*. https://aisel.aisnet.org/pacis2020/153

Miguel, S. E., Romano, C. A., Guillem, J. M. A., & Gato, M. E. P. (2015). Productivity from the viewpoint of lighting companies in Valencia. *Business and Management*

Research, 4(4), 43-53. https://doi.org/10.5430/bmr.v4n4p43

Miller, D. (1992). *The Icarus paradox: How exceptional companies bring about their own downfall.* HarperCollins.

Mills, A. J., & Helms Mills, J. (2018). Archival research. *The Sage handbook of qualitative research methods in business and management*. SAGE.

Mishra, P., Pandey, C. M., Singh, U., Gupta, A., Sahu, C., & Keshri, A. (2019). Descriptive statistics and normality tests for statistical data. *Annals of Cardiac Anaesthesia, 22*(1), 67–72. https://doi.org/10.4103/aca.ACA_157_18

Modi, K., Lowalekar, H., & Bhatta, N. M. K. (2019). Revolutionizing supply chain management the theory of constraints way: A case study. *International Journal of Production Research, 57*(11), 3335-3361. https://doi.org/10.1080/00207543.2018.1523579

Mullen, M. G., Michaels, A. D., Mehaffey, J. H., Guidry, C. A., Turrentine, F. E., Hedrick, T. L., & Friel, C. M. (2017). Risk associated with complications and mortality after urgent surgery vs elective and emergency surgery: Implications for defining "quality" and reporting outcomes for urgent surgery. *Journal of the American Medical Association Surgery, 152*(8), 768-774. https://doi.org/10.1001/jamasurg.2017.0918

Murad, M. H., Katabi, A., Benkhadra, R., & Montori, V. M. (2018). External validity, generalisability, applicability and directness: A brief primer. *BMJ Evidence - Based Medicine, 23*(1), 17. https://doi.org/10.1136/ebmed-2017-110800

Myles, P. S., Boney, O., Botti, M., Cyna, A. M., Gan, T. J., Jensen, M. P., Kehlet, H.,

Kurz, A., De Oliveira Jr., G. S., Peyton, P., Sessler, D. I., Tramèr, M.R., Wu, C. L., Grocott, M., Biccard, B., Blazeby, J., Chanm M., Diouf, E., Fleisher, L., … Wijeysundera, D. (2018). Systematic review and consensus definitions for the standardised endpoints in perioperative medicine (StEP) initiative: Patient comfort. *British Journal of Anaesthesia*, *120*(4), 705-711. https://doi.org/10.1016/j.bja.2017.12.037

Naor, M., Bernardes, E. S., & Coman, A. (2013). Theory of constraints: Is it a theory and a good one? *International Journal of Production Research*, *51*(2), 542-554. https://doi.org/10.1080/00207543.2011.654137

Navarro, M. (2015). Management science [PowerPoint slides]. Slideshare. https://www.slideshare.net/MaruNavarro4/management-science49559359

Negrete, J., & Oates, A. C. (2021). Towards a physical understanding of developmental patterning. *Nature Reviews Genetics*, *22*(8), 518-531. https://doi.org/10.1145/3306346.3322977

Nguyen, H. T., Zhang, Y., & Calantone, R. J. (2018). Brand portfolio coherence: Scale development and empirical demonstration. *International Journal of Research in Marketing*, *35*(1), 60-80. https://doi.org/10.1016/j.ijresmar.2017.11.003

O'Donnell, C. J. (2018). *Productivity and efficiency analysis*. Springer.

Oh, H. C., Phua, T. B., Tong, S. C., & Lim, J. F. Y. (2011). Assessing the performance of operating rooms: What to measure and why? *Proceedings of Singapore Healthcare*, *20*(2), 105-109. https://doi.org/10.1177/201010581102000206

Olson, S., Jaross, S., Rebischke-Smith, G. S., Chivers, F., Covel, S. K., & Millen, C. E.

(2018). Decreasing operating room turnover time: A resource neutral initiative. *Journal of Medical Systems*, *42*(5), 1-3. https://doi.org/10.1007/s10916-018-0950-5

Oestreicher, C. (2007). A history of chaos theory. *Dialogues in clinical neuroscience, 9*(3), 279-289. https://doi.org/10.31887/DCNS.2007.9.3/coestreicher

Papera, M., Richards, A., van Geert, P., & Valentini, C. (2019). Development of second-order theory of mind: Assessment of environmental influences using a dynamic system approach. *International Journal of Behavioral Development, 43*(3), 245-254. https://doi.org/10.1177/0165025418824052

Park, K. W., Smaltz, D., McFadden, D., & Souba, W. (2010). The operating room dashboard. *Journal of Surgical Research*, *164*(2), 294-300. https://doi.org/10.1016/j.jss.2009.09.011

Pashankar, D. S., Zhao, A. M., Bathrick, R., Taylor, C., Boules, H., Cowles, R. A., & Grossman, M. (2020). A quality improvement project to improve first case on-time starts in the pediatric operating room. *Pediatric Quality & Safety*, *5*(4), e305. https://doi.org/10.1097/pq9.0000000000000305

Pathak, K., Kadakia, K., & Offodile, A. C. (2022). Applying lessons from COVID-19 to cost centers across the phases of surgical care. *Plastic and Reconstructive Surgery Global Open, 10*(3). e4187. https://doi.org/10.1097/GOX.0000000000004187

Peled-Raz, M., Tzafrir, S. S., Enosh, G., Efron, Y., & Doron, I. (2021). Ethics review boards for research with human participants: Past, present, and future. *Qualitative*

Health Research, 31(3), 590-599. https://doi.org/10.1177/104973232097233

Ploder, C., & Kohlegger, M. (2018). A model for data analysis in SMEs based on process importance. *International Conference on Knowledge Management in Organizations*. Springer

Plonsky, L., & Ghanbar, H. (2018). Multiple regression in L2 research: A methodological synthesis and guide to interpreting R2 values. *The Modern Language Journal, 102*(4), 713-731. https://doi.org/10.1111/modl.12509

Polit, D. F., & Beck, C. T. (2017). *Nursing research: Generating and assessing evidence for nursing*. Lippincott Williams & Wilkins

Preiser, R., Biggs, R., De Vos, A., & Folke, C. (2018). Social-ecological systems as complex adaptive systems. *Ecology and Society, 23*(4), 46. https://doi.org/10.5751/es-10558-230446

Puspitawati, L. (2021). Strategic information moderated by effectiveness management accounting information systems: Business strategy approach. *Jurnal Akuntansi, 25*(1), 101–119. https://doi.org/10.24912/ja.v25i1.727

Punch, K. F. (1998). *Introduction to social research: qualitative and quantitative approaches*. Sage Publications.

Pyrczak, F., & Oh, D. M. (2018). *Making sense of statistics: A conceptual overview*. Routledge.

Qiu, D., Seguy, S., & Paredes, M. (2019). Design criteria for optimally tuned vibro-impact nonlinear energy sink. *Journal of Sound and Vibration, 442*, 497-513. https://doi.org/10.1016/j.jsv.2018.11.021

Quaty, J., & Berkenstock, M. K. (2020). Identifying operating room delays for the first case in an ophthalmic ambulatory surgery center. *Perioperative Care and Operating Room Management, 21*, 1-4. https://doi.org/10.1016/j.buildenv.2021.107747

Rebekah, G., & Ravindran, V. (2018). Statistical analysis in nursing research. *Indian Journal of Continuing Nursing Education, 19*(1), 62-70.

Reeves, J. J., Waterman, R. S., Spurr, K. R., & Gabriel, R. A. (2021). Efficiency metrics at an academic freestanding ambulatory surgery center: Analysis of the impact on scheduled end-times. *Anesthesia & Analgesia, 133*(6), 1406-1414. https://doi.org/10.1213/ane.0000000000005282

Reimann, M., & Jain, S. P. (2021). Maladaptive consumption: Definition, theoretical framework, and research propositions. *Journal of the Association for Consumer Research, 6*(3), 307-314. https://doi.org/10.1086/714822

Renshaw, I., Davids, K., Newcombe, D., & Roberts, W. (2019). *The constraints-led approach: Principles for sports coaching and practice design*. Routledge.

Rifai, F., Ridha, M. B., & Al-Maqousi, K. (2022). The impact of business entrepreneurship on organizational performance: An empirical study at Jordanian telecommunication companies. *Academy of Entrepreneurship Journal, 28*(1), 1-10. https://doi.org/10.1080/08276331.2022.2035171

Robertson, A., Kla, K., & Yaghmour, E. (2021). Efficiency in the operating room: optimizing patient throughput. *International anesthesiology clinics, 59*(4), 47-52. https://doi.org/10.1097/aia.0000000000000333

Rogers, J., & Revesz, A. (2020). *Experimental and quasi-experimental designs*. Routledge.

Rogers, M. J., Randall, D. J., Brennan, J. N., Zhang, C., Presson, A. P., & Kazmers, N. H. (2021). Evaluation of patient expectations before carpal tunnel release. *Plastic and Reconstructive Surgery Global Open, 9*(9). 1-7. https://doi.org/10.1097/gox.0000000000003823

Roh, Y., Heo, G., & Whang, S. E. (2021). A survey on data collection for machine learning: A big data - AI integration perspective, *IEEE Transactions on Knowledge and Data Engineering, 33*(4), 1328-1347. https://doi.org/10.1109/tkde.2019.2946162

Rothstein, D. H., & Raval, M. V. (2018). Operating room efficiency. *Seminars in Pediatric Surgery, 27*(2), 79-85. https://doi.org/10.1053/j.sempedsurg.2018.02.004

Roussel, R., Cani, M. P., Léon, J. C., & Mitra, N. J. (2019). Designing chain reaction contraptions from causal graphs. *Association of Computing Machinery Transactions on Graphics, 38*(4), 1-14. https://doi.org/10.1145/3306346.3322977

Ruggiano, N., & Perry, T. E. (2019). Conducting secondary analysis of qualitative data: Should we, can we, and how? *Qualitative Social Work, 18*(1), 81-97. https://doi.org/10.1177/1473325017700701

Rusu, V. D., & Roman, A. (2018). An empirical analysis of factors affecting competitiveness of CEE countries. *Economic Research-Ekonomska Istraživanja*, *31*(1), 2044-2059. https://doi.org/10.1080/1331677X.2018.1480969

Sadan, V. (2017). Data collection methods in quantitative research. *Indian Journal of Continuing Nursing Education, 18*(2), 58-63. https://www.ijcne.org/text.asp?2017/18/2/58/286271

Sarstedt, M., Bengart, P., Shaltoni, A. M., & Lehmann, S. (2018). The use of sampling methods in advertising research: A gap between theory and practice. *International Journal of Advertising, 37*(4), 650–663. https://doi.org/10.1080/02650487.2017.1348329

Saunders, M. N. K., Lewis, P., & Thornhill, A. (2019). *Research methods for business students* (8th ed.). Pearson Education Unlimited.

Sautchuk, E. A., & Fillus, M. A. (2020). Synchronicity: Relations between the Jungian work and new theoretical propositions. *Junguiana, 38*(2), 103-120.

Schock, G., & Blickensderfer, B. (2019). Operating room turnover time: Definitions and future research needs. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*. SAGE Publications.

Schmidt, L., Santurkar, S., Tsipras, D., Talwar, K., & Madry, A. (2018). Adversarially robust generalization requires more data. *Advances in Neural Information Processing Systems, 31*, 1-13.

Schneider, E. C., Shah, A., Doty, M. M., Tikkanen, R., Fields, K., & Williams, R. D. (2021). II. Mirror, mirror 2021: Reflecting poorly. *Health care in the U.S. compared to other high-income countries*. The Commonwealth Fund.

Schutts, K. (2011). *Management science theory*. https://prezi.com/q4_oz-oqbgnk/management-science-theory/

Sen, A., Ryan, P. B., Goldstein, A., Chakrabarti, S., Wang, S., Koski, E., & Weng, C. (2017). Correlating eligibility criteria generalizability and adverse events using big data for patients and clinical trials. *Annals of the New York Academy of Sciences, 1387*(1), 34–43. https://doi.org/10.1111/nyas.13195

Sestino, A., Prete, M. I., Piper, L., & Guido, G. (2020). Internet of things and big data as enablers for business digitalization strategies. *Technovation, 98*, 102173. https://doi.org/10.1016/j.technovation.2020.102173

Shoja, M., Arynchyna, A., Loukas, M., D'Antoni, A. A., Buerger, S. M., Karl, M., & Tubbs, R. S. (2019). *A guide to the scientific career: Virtues, communication, research, and academic writing*. John Wiley & Sons, Inc. https://doi.org/10.1002/9781118907283.ch31

Shaukat, S., Arshid, A. L. I., Eleyan, A., Shah, S. A., & Ahmad, J. (2020). Chaos theory and its application: An essential framework for image encryption. *Chaos Theory and Applications, 2*(1), 17-22.

Sidel, J. L., Bleibaum, R. N., & Tao, K. C. (2018). *Quantitative descriptive analysis*. Wiley Blackwell.

Siedlecki, S. (2020). Understanding descriptive research designs and methods. *Clinical Nurse Specialist, 34*(1), 8-12. https://doi.org/10.1097/nur.0000000000000493

Simsit, Z. T., Günay, N. S., & Vayvay, Ö. (2014). Theory of constraints: A literature review. *Procedia-Social and Behavioral Sciences, 150*, 930-936. https://doi.org/10.1016/j.sbspro.2014.09.104

Sizemore, A. E., Phillips-Cremins, J. E., Ghrist, R., & Bassett, D. S. (2019). The

importance of the whole: Topological data analysis for the network neuroscientist. *Network Neuroscience, 3*(3), 656-673. https://doi.org/10.1162/netn_a_00073

Slavov, M. (2021). Hume's thoroughly relationist ontology of time. *Metaphysica, 22*(2), 173-188. https://doi.org/10.1515/mp-2021-0004

Smith, L. B., & Thelen, E. (2003). Development as a dynamic system. *Trends in cognitive sciences, 7*(8), 343-348. https://doi.org/10.1016/S1364-6613(03)00156-6

Soulaine, C., Maes, J., & Roman, S. (2021). Computational microfluidics for geosciences. *Frontiers in Water, 3*, 643-714. https://doi.org/10.3389/frwa.2021.643714

Sproull, B. (2019). What is this thing called the theory of constraints? *Theory of Constraints, Lean, and Six Sigma Improvement Methodology*. Productivity Press.

Stack, L. (2019, September 2). Productivity vs. efficiency: Four ways they differ, and what matters most. *The Productivity Pro*. https://theproductivitypro.com/blog/2019/09/productivity-vs-efficiency-four-ways-they-differ-and-what-matters-most/

Staron, M. (2020). Validity evaluation. *In Action Research in Software Engineering*. Springer.

Stehle, S., & Kitchin, R. (2020). Real-time and archival data visualisation techniques in city dashboards. *International Journal of Geographical Information Science, 34*(2), 344-366. https://doi.org/10.1080/13658816.2019.1594823

Stephan, U., Patterson, M., Kelly, C., & Mair, J. (2016). Organizations driving positive social change: A review and an integrative framework of change processes. *Journal of Management, 42*(5), 1250-1281. https://doi.org/10.1177/0149206316633268

Sureka, R., Kumar, S., Mangla, S. K., & Junior, F. H. (2020). Fifteen years of international journal of productivity and performance management (2004–2018). *International Journal of Productivity and Performance Management, 70*(5), 1092-1117. https://doi.org/10.1108/IJPPM-11-2019-0530

Sürücü, L., & Maslakçi, A. (2020). Validity and reliability in quantitative research. *Business & Management Studies: An International Journal, 8*(3), 2694-2726. https://doi.org/10.15295/bmij.v8i3.1540

Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education, 48*(6), 1273-1296. https://doi.org/10.1007/s11165-016-9602-2

Tainter, F., Gongalla, B., Fitzpatrick, C., & Knodler, M. Jr., (2019). Evaluating the effects of cross-sectional roadway design elements and the impact on driver performance using a driving simulator. *Advances in Transportation Studies, 49*, 106–116. https://doi.org/10.4399/97888255280918

Talib, F., Rahman, Z., & Qureshi, M. N. (2013). An empirical investigation of relationship between total quality management practices and quality performance in Indian service companies. *International Journal of Quality & Reliability Management, 30*(3), 280-318. https://doi.org/10.1108/02656711311299845

Tan, C. M., Bernstein, M., Raboud, J., Mannino, B., & Tinmouth, J. (2022). Efficiency in the endoscopy unit: Can we 'turn around'room turnover? an observational quality improvement study. *Journal of the Canadian Association of Gastroenterology*, 1-8. https://doi.org/10.1093/jcag/gwac005

Tangen, S. (2005). Demystifying productivity and performance. *International Journal of Productivity and Performance Management*, *54*(1), 34–46. https://doi.org/10.1108/17410400510571437

Tankard, K., Acciavatti, T., Vacanti, J., Heydarpour, M., Beutler, S., Flanagan, H., & Urman, R. (2018). Contributors to operating room underutilization and implications for hospital administrators. *The Health Care Manager*, *37*(2), 118-128. https://doi.org/10.1097/hcm.0000000000000214

Theofanidis, D., & Fountouki, A. (2018). Limitations and delimitations in the research process. *Perioperative Nursing-Quarterly Scientific, Online Official Journal of GORNA*, *7*(3), 155-163. http://doi.org/10.5281/zenodo.2552022

Thurner, S., Hanel, R., & Klimek, P. (2018). *Introduction to the theory of complex systems*. Oxford University Press.

Toldbod, T., & van der Kolk, B. (2020). Cascading control changes, incoherence, and dialogue: Insights from a longitudinal case study. *European Accounting Review* *31*(2), 1-31. https://doi.org/10.1080/09638180.2020.1813185

Torres, G. C. S., Relf, M. V., & Tuazon, J. A. (2020). The mediating role of preoperative patient readiness on surgical outcomes: A structural equation model analysis. *Journal of Advanced Nursing*, *76*(6), 1371-1383.

https://doi.org/10.1111/jan.14339

Turner, J. R., & Baker, R. M. (2019). Complexity theory: An overview with potential applications for the social sciences. *Systems, 7*(1), 4. https://doi.org/10.3390/systems7010004

Tutuba, N. B. (2021). Commercialization inabilities of rural value chain activities in emerging markets: The theory of constraints Approach. *Journal of Management Policy & Practice*, *22*(2), 72-82.

U.S. Department of Health and Human Services. (2022). *Health care access and quality*. https://health.gov/healthypeople/objectives-and-data/browse-objectives/health-care-access-and-quality

U.S. Department of Health and Human Services. (2021a). *The Belmont report: Ethical principles and guidelines for the protection of human subject of research*. https://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/read-the-belmont-report/index.html

U.S. Department of Health and Human Services. (2021b). *Complying with medical record documentation requirements.* https://www.hhs.gov/guidance/document/complying-medical-record-documentation-requirements-0

Uimonen, M., Kuitunen, I., Paloneva, J., Launonen, A. P., Ponkilainen, V., & Mattila, V. M. (2021). The impact of the COVID-19 pandemic on waiting times for elective surgery patients: A multicenter study. *PLoS One*, *16*(7), e0253875. https://doi.org/10.1371/journal.pone.0253875

Urban Institute, & Hatry, H. P. (1977). *How effective are your community services? Procedures for monitoring the effectiveness of municipal services*. Urban Institute. https://www.ojp.gov/ncjrs/virtual-library/abstracts/how-effective-are-your-community-services-procedures-monitoring

Uri, J. (2020, March 4). *Tackling first case on-time starts can be a quick win*. https://www.hospiq.com/blog/tackling-first-case-on-time-starts/

van Geert, P. L. (2019). Dynamic systems, process and development. *Human development*, *63*(3-4), 153-179. https://doi.org/10.1159/000503825

van Veen-Berkx, E., Elkhuizen, S. G., Kalkman, C. J., Buhre, W. F., & Kazemier, G. (2014). Successful interventions to reduce first-case tardiness in Dutch university medical centers: Results of a nationwide operating room benchmark study. *The American Journal of Surgery*, *207*(6), 949-959. https://doi.org/10.1016/j.amjsurg.2013.09.025

Varpio, L., Paradis, E., Uijtdehaage, S., & Young, M. (2020). The distinctions between theory, theoretical framework, and conceptual framework. *Academic Medicine*, *95*(7), 989-994. https://doi.org/10.1097/acm.0000000000003075

Velte, P. (2020). Determinants and consequences of corporate social responsibility assurance: A systematic review of archival research. *Society and Business Review 16*(1), 1-25. https://doi.org/10.1108/sbr-05-2020-0077

Verma, J. P., & Abdel-Salam, A. S. G. (2019). *Testing statistical assumptions in research*. John Wiley & Sons.

Wakeman, D., & Langham, M. R. (2018). Creating a safer operating room: Groups, team

dynamics and crew resource management principles. *Seminars in Pediatric Surgery, 27*(2), 107–113. https://doi.org/10.1053/j.sempedsurg.2018.02.008

Walsh, A. (2017, June 13). The data proves it: First case starts and turnover time are your best metrics. *Health I.T. Outcomes*. https://www.healthitoutcomes.com/doc/the-data-proves-first-case-starts-turnover-your-best-metrics-0001

Walden University. (2022). *Office of research and doctoral services: Research ethics review process by IRB*. https://academicguides.waldenu.edu/research-center/research-ethics/review-process

Wang, Y., Kung, L., & Byrd, T. A. (2018). Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations. *Technological Forecasting and Social Change, 126*, M3-13. https://doi.org/10.1016/j.techfore.2015.12.019

Weihrich, H. (2000). *Management: science, theory and practice* (pp. 4-13). IEEE Computer Society Press. http://precisionmi.org/Materials/ManagementMat/Mngt.ScienceTheoryPractice.pdf

Westreich, D., Edwards, J. K., Lesko, C. R., Cole, S. R., & Stuart, E. A. (2019). Target validity and the hierarchy of study designs. *American Journal of Epidemiology, 188*(2), 438-443. https://doi.org/10.1093/aje/kwy228

Williams, S. J., & Radnor, Z. J. (2021). Moving from service to sustainable services: A healthcare case study. *International Journal of Productivity and Performance Management, 71*(4), 1126-1148. https://doi.org/10.1108/ijppm-12-2019-0583

Wyssusek, K. H., Keys, M. T., & van Zundert, A. A. (2019). Operating room greening initiatives–the old, the new, and the way forward: A narrative review. *Waste Management & Research, 37*(1), 3-19. https://doi.org/10.1177/0734242x18793937

Yaqoob, I., Salah, K., Jayaraman, R., & Al-Hammadi, Y. (2021). Blockchain for healthcare data management: Opportunities, challenges, and future recommendations. *Neural Computing and Applications*, 1-16. https://doi.org/10.1007/s00521-020-05519-w

Younis, A. M., Ali, A. J., & Mohammed, M. H. (2021). Outcome of repair of inguinal hernia in adult: Comparison between general versus local anesthesia. *Scientific Journal of Medical Res*earch, 5(19), 46-49.

Yu, D., Chen, C. P., Ren, C. E., & Sui, S. (2019). Swarm control for self-organized system with fixed and switching topology. *IEEE Transactions on Cybernetics, 50*(10), 4481-4494. https://doi.org/10.1109/tcyb.2019.2952913

Yuan, B., Li, J., & Wu, P. (2021). The effectiveness of electronic health record promotion for healthcare providers in the United States since the Health Information Technology for Economic and Clinical Health Act: An empirical investigation. *The International Journal of Health Planning and Management, 36*(2), 334-352. https://doi.org/10.1002/hpm.3085

Zand, D. E., & Sorensen, R. E. (1975). Theory of change and the effective use of Management Science. *Administrative Science Quarterly 20*(4), 532- 545. https://doi.org/10.2307/2392021

Zantal-Wiener, A. (2021, June 10). *A brief history of productivity: How getting stuff done became an industry*. https://blog.hubspot.com/marketing/a-brief-history-of-productivity

Zhou, M., & Wang, C. (2020). A novel image encryption scheme based on conservative hyperchaotic system and closed-loop diffusion between blocks. *Signal Processing, 171*, 107484. https://doi.org/10.1016/j.sigpro.2020.107484

Žukauskas, P., Vveinhardt, J., & Andriukaitienė, R. (2018). Philosophy and paradigm of scientific research. In P. Zukauskas, J. Vveinhardt, & R. Andriukaitien (Eds.), *Management culture and corporate social responsibility*, Intech Open. https://doi.org/10.5772/intechopen.70628

Appendix: Data Use Agreement

DATA USE AGREEMENT

This Data Use Agreement ("Agreement"), effective as July 15, 2022. ("Effective Date"), is entered into by and between Rhafia Bucoy ("Data Recipient") and [redacted] ("Data Provider"). The purpose of this Agreement is to provide Data Recipient with access to a Limited Data Set ("LDS") for use in research in accord with the HIPAA and FERPA Regulations.

1. Definitions. Unless otherwise specified in this Agreement, all capitalized terms used in this Agreement not otherwise defined have the meaning established for purposes of the "HIPAA Regulations" codified at Title 45 parts 160 through 164 of the United States Code of Federal Regulations, as amended from time to time.

2. Preparation of the LDS. Data Provider shall prepare and furnish to Data Recipient a LDS in accord with any applicable HIPAA or FERPA Regulations.

3. Data to be included in the LDS. **No direct identifiers such as names may be included in the Limited Data Set (LDS).** The researcher will not name the Data Provider in the doctoral study that is published in Proquest unless the Data Provider makes a written request for the researcher to do so. In preparing the LDS, Data Provider or designee shall include the **data fields specified as follows**, which are the minimum necessary to accomplish the research:
Patient Data:
   - WHO: Random data samples of scheduled elective cases (surgical electronic records with date and time stamps of surgery with no PHI).
   - WHEN: Jan 1, 2018 – Jan 31, 2022 (Within 5 years)
   - HOW MANY: 68
   - WHERE: From two free-standing ambulatory surgical locations in [redacted] and [redacted] Data archive will be time stamped surgical records of random procedure logs of patients with no need of any PHI.
   - WHAT:
     a. Case tracking events of patient in room time and patient out time for that day of all first scheduled cases,
     b. Case tracking events of patient in room time and patient out time for that day of subsequent cases for the day,
     c. Date of surgery,
     d. Patient's age,
     e. Patient's gender,
     f. Types of surgery.

4. Responsibilities of Data Recipient. Data Recipient agrees to:

a. Use or disclose the LDS only as permitted by this Agreement or as required by law;

b. Use appropriate safeguards to prevent use or disclosure of the LDS other than as permitted by this Agreement or required by law;

c. Report to Data Provider any use or disclosure of the LDS of which it becomes aware that is not permitted by this Agreement or required by law;

d. Require any of its subcontractors or agents that receive or have access to the LDS to agree to the same restrictions and conditions on the use and/or disclosure of the LDS that apply to Data Recipient under this Agreement; and

e. Not use the information in the LDS to identify or contact the individuals who are data subjects.

5. Permitted Uses and Disclosures of the LDS. Data Recipient may use and/or disclose the LDS for its research activities only.

6. Term and Termination.

a. Term. The term of this Agreement shall commence as of the Effective Date and shall continue for so long as Data Recipient retains the LDS, unless sooner terminated as set forth in this Agreement.

b. Termination by Data Recipient. Data Recipient may terminate this agreement at any time by notifying the Data Provider and returning or destroying the LDS.

c. Termination by Data Provider. Data Provider may terminate this agreement at any time by providing thirty (30) days prior written notice to Data Recipient.

d. For Breach. Data Provider shall provide written notice to Data Recipient within ten (10) days of any determination that Data Recipient has breached a material term of this Agreement. Data Provider shall afford Data Recipient an opportunity to cure said alleged material breach upon mutually agreeable terms. Failure to agree on mutually agreeable terms for cure within thirty (30) days shall be grounds for the immediate termination of this Agreement by Data Provider.

e. Effect of Termination. Sections 1, 4, 5, 6(e) and 7 of this Agreement shall survive any termination of this Agreement under subsections c or d.

7. Miscellaneous.

a. Change in Law. The parties agree to negotiate in good faith to amend this Agreement to comport with changes in federal law that materially alter either or both parties' obligations under this Agreement. Provided however, that if the parties are unable to agree to mutually acceptable amendment(s) by the compliance date of the change in applicable law or regulations, either Party may terminate this Agreement as provided in section 6.

b. Construction of Terms. The terms of this Agreement shall be construed to give effect to applicable federal interpretative guidance regarding the HIPAA Regulations.

c. No Third Party Beneficiaries. Nothing in this Agreement shall confer upon any person

other than the parties and their respective successors or assigns, any rights, remedies, obligations, or liabilities whatsoever.

d. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.

e. Headings. The headings and other captions in this Agreement are for convenience and reference only and shall not be used in interpreting, construing or enforcing any of the provisions of this Agreement.

IN WITNESS WHEREOF, each of the undersigned has caused this Agreement to be duly executed in its name and on its behalf.

DATA PROVIDER	**DATA RECIPIENT**
Signed: [redacted]	Signed: 
Print Name: [redacted]	Print Name: Rhafia Bucoy
Print Title: Vice President, Regional Chief Nurse Executive & Clinical Integrations	Print Title: Doctoral Student of Walden University
[redacted]	