EMERGENCY DEPARTMENT WAIT TIME COMMUNICATION STRATEGIES AND PATIENT THROUGHPUT EFFICIENCY

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A DISSERTATION

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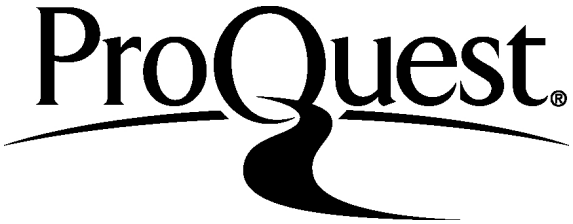

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EXECUTIVE DOCTORAL PROGRAM – SCHOOL OF HEALTH RELATED PROFESSIONS

ABSTRACT

This study investigates hospital strategies used to inform patients of anticipated wait times in the Emergency Department (ED) and the association of such strategies with patient throughput efficiency. When hospitals are inefficient in ED patient throughput, conditions of overcrowding often occur. Overcrowding of the ED is a problem for many hospitals. When such conditions exist, there is evidence in the literature that it leads to lower patient satisfaction, care quality, and financial position of the hospital. Therefore, improving patient throughput efficiency is a priority for hospitals.

To improve patient throughput efficiency, hospitals use a variety of strategies. This study focuses on two wait time communication strategies of posting ED wait times on the hospital website and the use of ED reservation systems. Through application of Rational Choice Theory, it is expected that patients who are informed of anticipated wait times will make rational decisions related to visiting a potentially overcrowded ED. Thus, engaged patients make decisions that can contribute to improved ED efficiency.

The question of this research study is "Do ED wait time communication strategies improve patient throughput efficiency?" This study sample includes acute care hospitals in Florida and the ED throughput efficiency metrics from the Center for Medicare and Medicaid Services (CMS) Hospital Compare data sets to contrast the performance of hospitals that use the study strategies.

The results of the study indicate that posting ED wait times on the hospital website has a statistically significant association with ED efficiency. However, the use of reservation systems does not have a statistically significant association with ED efficiency. Further, the control variables of hospital licensed bed size, metropolitan location, percent of population without health insurance, and percent of population Medicaid eligible have a statistically significant association with ED efficiency.

Consistent with expected behavior related to Rational Choice Theory, this study supports that informed patients will make logical decisions related to if and when to visit an ED for care and therefore contribute to improved throughput efficiency.

Key Terms: Emergency Department Efficiency, Emergency Department Overcrowding, Rational Choice Theory, Emergency Department Wait Times, Patient Decision Making

DEDICATION

This research study is dedicated to my family who has endured many interruptions in family life over the past three years in pursuit of this dream of a Doctoral degree. Further, this work is dedicated to all of those that worked alongside me for seventeen years as a hospital Chief Executive Officer, including those that believed in the importance of transparent sharing of information as a key element of Emergency Department operation and efficiency, and those that did not.

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LIST OF ABBREVIATIONS

ACA	Patient Protection and Affordable Care Act
ANOVA	Analysis of Variance
ARF	Area Resource File
CAH	Critical Access Hospital
CMS	Centers for Medicare and Medicaid Services
CON	Certificate of Need
DRG	Diagnosis Related Group
ED	Emergency Department
EMTALA	Emergency Medical Treatment and Active Labor Act
FHA	Florida Hospital Association
HCAHPS	Hospital Consumer Assessment of Healthcare Providers and Systems
HHI	Herfindahl-Hirschman Index
HPSA	Health Professional Shortage Area
HSA	Health Services Area
IRB	Independent Review Board
LWOT	Left without Treatment
RCT	Rational Choice Theory
VIF	Variance Inflation Factor
VA	Veterans Administration

CHAPTER 1

INTRODUCTION

The healthcare industry has experienced dynamic change over the past decades. Hospitals represent the largest cost centers (Iglehart, 1999) and influencers of quality outcomes for patients (Shover, 2008). Accordingly, hospitals have faced the greatest amount of market pressure for change as patients desire better access to care and transparency of outcomes (Kassirer, 2000). Response to these forces has reshaped the healthcare industry and required hospitals to not only respond but to innovate. One particular market force requiring innovation is the demand for access to Emergency Department (ED) care services (Derlet, 2002).

As demand has increased for ED care, hospitals have found it necessary to improve efficiency of services and availability of resources. When resources are stretched thin, ED efficiency decreases and a situation of patient volume, overcrowding occurs. The literature examining the result of overcrowding is substantial.

It is evident in the research literature that ED overcrowding has a negative impact on quality of care, patient satisfaction, and hospital financial health (Bernstein et al., 2009; Hwang & Concato, 2004; Ranney et al., 2012; Rice, 2011). Increasingly, hospitals are held accountable for quality performance in terms of public transparency and reimbursement (Wilper et al., 2008). In short, hospitals have many incentives to improve ED efficiency to reduce incidents of overcrowding and the subsequent negative impacts to both hospital and patient.

Accordingly, hospitals use many strategies to address and improve ED efficiency. Such strategies include internal efficiency improvement through process improvement, communication, and staffing effectiveness (Hwang & Concato, 2004). More common in recent years, hospitals have implemented external strategies of informing patients of anticipated ED wait times ("Heading to the ER? Some post wait times by text, billboard," 2010). By informing patients of anticipated wait times in the ED, hospitals aim to engage patients in a decision process consistent with RCT. The goal is to encourage patients to evaluate alternatives to ED care when the ED is crowded, as evidenced by posted long wait times. In other words, the hospital expects that informed patients will help improve ED efficiency. This study is designed to evaluate if such external strategies are effective in improving efficiency.

Significance of the Study

This research is essential to gaining a theoretical understanding of ED efficiency and the subsequent impacts of overcrowding on the hospital and the patient. To understand the impact and apply what is learned, it is important to understand the internal microenvironment of hospital operations and the external macro environment of the patient decision process and the effects of ED efficiency and overcrowding on the hospital and patient.

Present day market forces affecting hospitals have never been greater. One defining characteristic of the healthcare industry has been constant pressure of change. Such changes have been internally driven by organizations to adapt to a dynamic changing macro environment including pressures in the political, social, technological, and cultural environment elements that surround the healthcare industry.

While past challenges have included dramatic changes in reimbursement including Medicare Diagnosis Related Groupings (DRGs) in the 1980s, multiple reforms in the 1990s, and the Affordable Care Act of 2010, market forces have also created the necessity for dramatic change. Such forces have been largely competitive including mergers, acquisitions, physician employment, and the advent of large for profit and non-profit systems.

Accordingly, hospitals have implemented strategies for improved financial performance and in defense of market changes to adapt to dramatic changes in the macro environment. Research has indicated that while many strategies are related to improving the financial performance of the hospital, unless these strategies are aligned with the rapidly changing macro environment, leaders are not successful in improving hospital performance (Kumar, Subramanian, & Strandholm, 2002).

The challenges of emergency medicine care have increased the necessity for strategic response by hospitals. As a result, hospital ED efficiency has become a top priority for many hospitals. Accordingly, leaders of hospitals have implemented strategies in two main categories: market differentiation strategies, and efficiency strategies (Bruder, 1991; Kumar et al., 2002). Market strategies are externally focused on positioning the hospital or system for revenue growth. Efficiency strategies are internal to the organization and related to improving operational efficiency and therefore to improve outcomes of financial, quality and satisfaction metrics.

Selection of these strategies is often driven by the leader's understanding of the environment and their perceived locus of control. If the leader perceives the macro environment to be reasonably stable, the strategic focus of the organization is normally

efficiency based; however, a perceived instability of the macro environment typically leads to selection of market based strategies (Kumar et al., 2002). In fact, the environment dramatically impacts the organization's ability to control its own strategic direction (Bigelow & Mahon, 1989).

Additionally, research suggests that the strategy selection of a particular hospital is specific to their awareness of the macro environment and the level of challenges faced by the hospital (Bruder, 1991; Rouse, 2008). Hospitals in more harsh environments tend to emphasize cost containment strategies as the harshness of the environment limits the potential for revenue growth (Trinh & O'Connor, 2000).

To respond to dynamic macro environmental forces, leaders are wise to study and understand environmental and competition theory (Shortell, Morrison, & Friedman, 1990). Porter's Generic Strategies are a common beginning point to understand the factors that influence competitive environments and subsequent strategies for organizations. Executives of organizations can position within a market using one of two sustainable competitive advantages: low cost, or differentiation (Porter, 1980). By employing these strategies, the organization hopes to achieve a reasonable margin and gain a competitive advantage when compared to other organizations in the same market (Porter, 1985). However, there is risk in selecting these generic strategies as misunderstanding the market, or the position of the organization in the market, can lead to negative consequences (Porter & Teisberg, 2004). It is important that the organization effectively choose one strategy or they find themselves "stuck in the middle" whereby the organization may be unable to gain a competitive advantage and achieve a desirable margin (Porter, 1997).

Another theory worth consideration is related to the Miles and Snow Typology of organizations in terms of how they identify and respond to macro environmental change (Shortell et al., 1990). Using this theory, organizations are grouped into four categories including Prospectors, Defenders, Reactors, and Analyzers (Miles, Snow, Meyer, & Coleman, 1978). Prospectors are those organizations that are strong in diversification as they can quickly adjust services and products in the market. Conversely, Defenders are typically traditionalists that rarely deviate from established products or services in defined markets. Analyzers are a hybrid of both Prospectors and Defenders whereby they tend to focus on established products or services but they are regularly evaluating new products and services to bring to the market. Finally, Reactors are the least predictable as they lack strongly defined strategies and are likely to be more flexible in the market in terms of services and products (Miles et al., 1978; Shortell et al., 1990).

It is critical that organizations not only have an understanding of their micro and macro environments but also understand the type of organization they represent. It can be argued that any of the four types of organizations can be successful so long as they understand the environment and continuously adjust their strategies as the market experiences dynamic change (Miles, 2012).

As an organization adapts to the micro and macro environmental forces surrounding ED efficiency, hospitals will choose a low cost or differentiation strategy related to throughput, which is defined as moving a patient through the ED efficiently. Using a low cost approach, the hospital will reduce resources dedicated to the care of the patient and limit to only those services and costs necessary. Conversely, another hospital may use throughput strategies to differentiate the organization compared to the

competitors in the market. Either strategy can be an effective approach to create a competitive advantage.

This research is focused on ED patient throughput efficiency as a response to macro environmental forces. Specifically, this research will study ED efficiency and the causes of overcrowding, the common strategic responses of hospitals, and the impact on the organization.

Research Question

The literature supports that there is a great deal of knowledge related to ED efficiency. Commonly, the literature addresses poor ED efficiency and refers to this as a condition of overcrowding (Nugus & Braithwaite, 2010). Accordingly, this study will extensively review the condition of overcrowding and the impact of overcrowding on the hospital.

Overcrowding has a negative impact on the quality of care in the ED, patient satisfaction, and the financial health of the hospital. Clearly, there is a need for healthcare leaders to understand these relationships appropriately to prioritize ED efficiency in terms of the hospital's macro environmental strategy.

In recent years, hospitals have increased sharing of their ED wait times with patients as a strategy to engage the decision process for patients when considering visiting the ED for care. However, little is known if these strategies actually improve ED efficiency. This study answers the research question: "Do ED wait time communication strategies improve patient throughput efficiency?" The study design is to compare hospitals that share ED wait times to those hospitals that do not share ED wait times and

evaluate if there is a difference in ED efficiency as evidenced by published ED efficiency metrics.

Plan of Work

In Chapter Two, this study reviews the literature regarding the challenges of ED efficiency and overcrowding. The review of the literature will include the known impacts of ED overcrowding on quality outcomes, patient satisfaction, and financial performance and frame the importance of improving efficiency to mitigate negative impacts to both the patient and the hospital.

Chapter Three outlines the conceptual framework of this study through an exploration of hospital strategies to improve ED efficiency and the application of the applicable management theory, RCT. Through connecting strategy to theory, the effectiveness of the strategy is better understood.

Chapter Four focuses on the research methodology of this study related to the conceptual framework. From the research question, two related hypotheses are developed to test associations of the study variables. The study design is further defined including data sources, statistical analysis design selected, and the plan for hypothesis testing.

Chapters Five includes a presentation of the study findings. Thereafter, Chapter Six discusses the findings and the implications for management practice related to effective management decision making. Finally, this study discusses how RCT informs the findings for additional management application.

CHAPTER 2

LITERATURE REVIEW

A review of the current research literature frames the existing knowledge and gaps in the literature. As ED efficiency is a macro environment issue that affects most hospitals and their patients across the country, this phenomenon needs to be thoroughly understood.

In response to the necessity to improve ED efficiency, hospitals employ a variety of strategies to improve patient efficiency throughput and to relieve overcrowding. Further, the research discusses the extent of impact of overcrowding on hospitals and their patients leading to an understanding of prioritization of ED efficiency strategies to improve outcomes.

Emergency Department Efficiency and Overcrowding

Hospitals across the country struggle to manage the pressures associated with ED efficiency and the impact of overcrowding on the organization ("Press Ganey ED Pulse Report 2010," 2010). In fact, a study of California hospital leaders reported that 96% of respondents believed their hospital experienced overcrowding on a regular basis (J. R. Richards, Navarro, & Derlet, 2000). Such struggles are related to situations where the volume in the ED outstrips the resource capacity to provide timely appropriate care.

Overcrowding is generally defined as “to crowd to an uncomfortable or undesired excess” (Dictionary.com, 2014). Related to hospital ED operations, there is not a clear

and consistent definition of ED overcrowding as a resulting condition of poor ED efficiency in the literature. A literature review study of 230 medical articles between 1966 and 2002 found that a majority of ways overcrowding was defined were not explicit measurable definitions and that no clear consensus definition existed (Hwang & Concato, 2004). While studies have defined overcrowding based on bed availability, volume per ED bed, and other methods, the best method is to use time studies for actual ED performance in seeing patients timely upon arrival and discharging timely to the correct disposition (D. Richards, 2000). Unfortunately, such an approach is not evident in the literature and a commonly acceptable explicit definition does not exist.

Fortunately, recent years have created the opportunity for utilizing newly reported time performance data to define ED overcrowding. Prior to 2010, hospitals were not required to report ED efficiency throughput metrics. However, beginning with the first calendar quarter of 2012, the Centers for Medicare and Medicaid Services (CMS) Hospital Compare data, hospital ED efficiency metrics are now available to the public for research and hospital comparison. Such data metrics includes Median Time from ED Arrival to Provider Contact for ED Patients, Median Time from ED Arrival to ED Departure for Discharged ED Patients, Median Time from ED Arrival to ED Departure for Admitted ED Patients, and Admit Decision Time to ED Departure Time (CMS, 2014). Upon review of the literature, there is no evidence that these variables have previously been used to define ED efficiency and the condition of overcrowding. However, these variables serve as a consistent measurement of ED efficiency and overcrowding for this study.

The impact of overcrowding affects multiple areas of hospital performance including financial, patient satisfaction, and quality outcomes (Sun et al., 2012). A review of the literature suggests that there has been substantial research on the problem of ED efficiency and the impact on the financial performance of the hospital. Further, there is evidence of research related to patient satisfaction (Ranney et al., 2012).

Additional literature has suggested that delays in care due to overcrowding in the ED have a negative impact on the quality outcomes for those ED patients (Bernstein et al., 2009; Guttmann, Schull, Vermeulen, & Stukel, 2011; Sun et al., 2012). Further, other limited research has shown a negative impact of overcrowding on inpatient quality outcomes (Bernstein et al., 2009).

Depending on the Miles and Snow type of the organization (Miles et al., 1978) and the role of the organization in the competitive environment (Porter, 1979), the selection of one of Porter's Generic Strategies is expected to shape the response by a particular hospital to the problem of ED overcrowding. The literature clearly documents the existence of a highly dynamic competitive environment and the challenges of ED overcrowding. Therefore, the literature supports the necessity for a strategic response by hospitals to improve ED efficiency.

A primary cause of overcrowding is growing demand for patient access to care. The impending full implementation of the Patient Protection and Affordable Care Act (ACA) is a primary force that is affecting planning for healthcare organizations. At the heart of the ACA legislation is an expansion of access to care for those uninsured or with Medicaid coverage. In 2011, 48.6 million Americans were uninsured (Fox, 2012) representing a large population that potentially experiences access issues.

One of the greatest challenges for healthcare organizations has been a declining participation of primary care physicians in Medicaid programs (Fossett & Peterson, 1989). Therefore, these patients must rely on other resources, such as EDs, to receive primary care services. Additionally, hospitals provide a substantial amount of care to uninsured non-emergent patients through the ED (Derlet, 2002). Studies have found that 60-80% of emergency room populations at some hospitals have only minor injuries or illnesses that could be cared for in a primary care setting (Sun et al., 2012).

Due to access issues for primary care, much of the care provided to Medicaid and uninsured patients in the ED is non-emergent care (Derlet, 2002). An emergency condition is defined as a condition requiring care to patients that may be at risk of death or permanent injury without such care being provided within the near term, generally defined as the next 24 hours (West, 2012). As a result, hospitals and their physicians provide extensive non-emergent care in the ED.

The Emergency Medical Treatment and Active Labor Act (EMTALA) has a wide ranging effect on the operations of EDs (Trzeciak & Rivers, 2003). EMTALA is a federal law enacted in 1986 that requires hospitals to provide a medical screening examination and emergency care by a physician, or a physician extender supervised by a physician, regardless of the patient's ability to pay (West, 2012). Further, EMTALA only applies to hospitals and not to other healthcare providers. Therefore, hospitals must carry a majority of the legal burden of uncompensated non-emergent care as other providers, such as primary care physicians, urgent care providers, and other physician based resources, do not have the resources and are not legally obligated to care for these patients.

Accordingly, the EDs of hospitals are providing very expensive and resource intensive care to numerous patients that could be cared for in other settings, such as an urgent care center or a primary care physician office (Rice, 2011). As a result, ED patient volumes increase and a situation of overcrowding occurs as a result of poor ED efficiency (Sun et al., 2012). With overcrowding, longer wait times for patient care occur and the resulting concern is a negative association of ED efficiency and poor patient quality outcomes.

Additionally, there are micro forces at the organizational level that affect ED efficiency. Inefficiency in staffing and processes are often contributors. Hospitals that experience communication issues between departments, slow triage and admission processes, staff shortages, and delays in disposition discharge are likely to have efficiency issues and therefore overcrowding (Hwang & Concato, 2004). Further, hospitals that have insufficient physical resources in terms of space and equipment in both the ED and other departments also can experience overcrowding (J. R. Richards et al., 2000). However, most factors that are considered the primary causes of overcrowding are external macro environment forces related to the community (Hwang & Concato, 2004).

Based on the above research, overcrowding and subsequent long wait times in the EDs of hospitals are well documented as a growing problem without substantial resolution. The issue for healthcare leaders is how these factors affect hospital performance and specifically the impact on patient quality outcomes.

Improved Throughput and Patient Outcomes

While throughput strategies are essential to efficiency, the resulting value is improved patient outcomes. While many patients are already noted to present to the ED for non-emergent care, the challenge remains for those hospitals to provide the best possible care while reducing liability and cost of care. Patients arrive at the hospital ED with expectations. They expect to have their condition cared for in a timely manner and they expect to be treated as an "emergency condition" patient even if the hospital professionals do not perceive the same level of condition.

The literature supports that not only is overcrowding having a negative impact on hospital financial performance, but also, outcomes for patients. There is evidence that wait times are increasing substantially for patients that have minor illnesses or conditions and for those patients that may have a severe illness (Wilper et al., 2008). Further, there is evidence that wait delays are impacting critical condition patients, such as heart attack victims, who in 2004 waited twenty minutes compared to only eight minutes in 1997 (Shover, 2008). Of similar concern, wait times to receive care in the ED for chest pain have doubled from 1988 to 2008 (Shover, 2008).

The problem of patient demand for care in the ED is only getting worse. From 2001 to 2006, ED visits increased by 11% while the number of EDs only increased by 4% (Sun et al., 2012). Additionally, there is sufficient evidence in the literature to suggest overcrowding is a growing problem for most hospitals across the country (D. Richards, 2000).

Emergency care is designed to have a beginning and an end that results in a disposition of the patient. The most common dispositions are discharge home, admission

to the hospital, and discharge for follow up care outside the hospital. Each of these dispositions should be studied related to how ED inefficiency, overcrowding, and the related longer wait times or delays in care affect quality outcomes.

First, one disposition of patients is referred to as boarding. When a patient needs to be admitted to the hospital and a bed is not available, the patient is then boarded, or held, in the ED until the inpatient bed is available. This increases the number of patients in the ED and consumes limited resources needed for emergency care. Subsequently, boarding patients causes an increase in wait times for all patients presenting to the ED for care (Fottler & Ford, 2002).

Further, the issue of patients that Leave without Treatment (LWOT) must be considered. Long wait times commonly lead to higher LWOTs whereby the patient leaves the hospital ED without receiving needed care (Yin, 2010). The patient experiences increased risk due to not receiving the patient care. The hospital also experiences increased risk as the patient leaving without care increases the hospital liability. One study found an expected correlation where as more patients are boarded, organizations experienced a higher risk for LWOTs due to delays in care for waiting patients (Cheung-Laviree, 2011).

The second disposition relates to those patients discharged to their home after care in the ED and represents the largest population of patients. While these patients are typically less ill, they also represent the population that potentially has the most liability risk to the hospital as care is discontinued after the visit. A study in Ontario, Canada between 2003 and 2007 found that patients discharged home were actually more at risk than the patients that left without treatment. This study of more than fourteen million

patients found that for those patients that presented to an ED during periods of longer wait times had a longer length of stay and a corresponding greater chance of death and admission to the hospital (Guttmann et al., 2011).

The third disposition is those patients that are admitted to the host hospital or another hospital that accepts the transferred patient for admission. A study published in the Journal of Emergency Medicine found that of 995,379 ED visits from 187 hospitals, patients admitted on days with overcrowding conditions had a 5% greater chance of inpatient death, equating to 300 more deaths for the study sample alone. The study concluded that this increased risk also carried financial and satisfaction implications including an additional 6,200 inpatient days and $17 million in additional costs (Sun et al., 2012). Conversely, some hospitals that implemented policies to improve patient throughput efficiency resulted in decreasing the time to bed assignment for admitted patients from 421 minutes to 374 minutes (Yin, 2010).

Literature Review Summary

In summary of this section of literature review, the literature is clear that overcrowding is a problem that affects many hospitals across the country. As a result, there is extensive research in the literature designed to understand the causes and impact of overcrowding as a result of inefficiency in patient throughput to return home or receive care in another setting. When resources are stretched and capacity for timely care exceeded, the literature supports that there are negative impacts to the hospital related to operational efficiency and financial performance. Additionally, patients that experience delays in care often also experienced negative impacts in satisfaction and quality of care outcomes both in the ED and in inpatient units once admitted.

Accordingly, hospitals have placing increasing emphasis on improving ED efficiency in an attempt to reduce overcrowding. This study will explore further the forces affecting ED efficiency and the strategies hospitals employ to reduce the risk and impact of overcrowding.

CHAPTER 3

CONCEPTUAL FRAMEWORK

As evidenced in a review of the current literature, hospital leaders find it necessary to implement strategies to improve efficiency due to the risks to both patient and hospital related to ED inefficiency defined as overcrowding. This study reviews the strategies hospitals implement to improve efficiency and then applies management theory to understand the outcomes from these strategies. By so doing, a conceptual framework is developed for study of the research question, "Do ED wait time communication strategies improve patient throughput efficiency?"

Emergency Department Efficiency Strategies

A review of the literature frames not only the importance of improving ED efficiency but also the effectiveness of various strategies employed by hospitals to reduce overcrowding impacts to patients. To this point, the literature is well documented related to issues and problems associated with overcrowding. Hospitals commonly look internally first to improve efficiency in operations, communications, and patient throughput. One strategy on the rise for hospitals is looking externally to engage patients in making informed decisions to visit the ED when those patients have a choice of providers for care.

Perhaps the greatest challenges of hospital ED efficiency are uncontrollable. External macro environmental forces related to community demographics,

reimbursement, patient access to care, or lack thereof, and the unique requirements of hospitals drive the necessity for efficiency. While many of these factors cannot be controlled or avoided, the hospital can implement strategies to try to mitigate the impact.

One micro strategic response of hospitals to the pressures of improving efficiency and reduce overcrowding is to build additional EDs or expand capacity in existing EDs. Unfortunately, the financial pressure on hospitals over the past decades has limited funds available for capital projects (Dess & Davis, 1984). Further, regulatory approval requirements, such as Certificate of Need (CON) restrictions, have limited the opportunity for expansion (Salkever & Bice, 1976). Hospitals have therefore attempted to improve efficiency in existing beds rather than adding beds (Galewitz, 2013). By so doing, more patients can be cared for using the same resources.

Hospitals also have used efficiency strategies including resource allocation of staff and technology. Such strategies have proven effective in improving throughput. Generally, these strategies combine staffing and technology to create improved efficiency in operations and organizational structure. By combining these elements, the best strategies for efficiency are likely achieved.

The most popular efficiency strategy is to improve patient flow through the ED (Hwang & Concato, 2004). This is commonly referred to as "throughput" as the goal is to move the patient through the ED as quickly and efficiently as possible to their eventual disposition, thereby efficiently concluding their emergency care. By using discrete event simulation models, hospitals have had success in determining appropriate allocation of resources to meet patient demand (Ceglowski, Churilov, & Wasserthiel, 2007; Hamrock, Paige, Parks, Scheulen, & Levin, 2012; Stone-Griffith, Englebright, Cheung, Korwek, &

Perlin, 2011).The objective is always to provide the appropriate care given the emergency needs of the patient and then to move the patient to an appropriate resource intensive environment outside the ED. Such strategies are consistent with an efficiency low cost strategy of Porter (Porter, 1979).

Regarding macro environmental theory, when evaluating hospital position within the Miles and Snow Typology, the organizations that implement throughput efficiency strategies are expected to act as Analyzers, whereby they remain focused on existing services but evaluate how to differentiate the service in the market (Miles, 2012). Further, when considering Porter's generic strategies, these organizations are employing both low cost and differentiation strategies (Porter, 1985) as the ED wait time posting strategy is a differentiator to competitors but also helps to improve cost of the organization through spreading volume which improves cost efficiency. However, the organizations are avoiding being "stuck in the middle" by using an overall strategy that balances both strategies of Porter.

The possible association of sharing anticipated ED wait times with patients and the impact on efficiency improvement is a curious and unexplored relationship. The two primary strategies are to share current ED wait times or to use an ED reservation system. Both strategies are designed with a singular purpose of encouraging the patient to choose the ED wisely for care when they are informed in advance of anticipated time to receive care. Consistent with RCT, it is expected that when anticipated ED wait time information is shared with patients, they will engage in a decision process. This decision is if anticipated wait times are expected to be long, the patient is expected to consider other alternatives to ED care. As a result, the patient is engaged in helping to reduce

patient volumes during periods of overcrowding and thus contribute to increase efficiency.

The first ED wait time strategy of this study is sharing real time anticipated ED wait times with patients. This strategy commonly utilizes four methods for communication including posting wait times on the hospital website, text messaging services, mobile applications, and billboards. Use of the hospital website is the most common of these four methods, whereby the ED wait times are posted in real time on the homepage of the hospital website. Another method is a text messaging service, the most common of which is ERtexting ("ERtexting," 2013). Patients send a text message using a hospital specific code or the mobile device uses the patient GPS location. Once the request text is sent, the system responds with a notification of the wait times for the requested or closest participating hospital. For mobile applications, hospitals use a proprietary or purchased service to share current ED wait times (Brentwood-Communications, 2014; Ochsner, 2014). Lastly, some hospitals will post their current wait times on billboards ("Heading to the ER? Some post wait times by text, billboard," 2010). Commonly, these billboards include information related to the sponsoring hospital and a periodically updated digital readout of current ED wait times for triage by a healthcare professional.

When researching these hospital strategies to share wait times with patients for this study, the most common and consistent method is using the hospital website to share this data. While some hospitals share ED wait times by texting methods, billboards, or mobile apps, this study found that typically these same hospitals will also post the ED

wait times on the hospital website. However, hospitals that posted wait times on the website did not typically use one of the other communication strategies.

A second ED wait time strategy is the use of an ED reservation system. Two common reservation system companies are InQuicker and ER Express ("ER Express," 2014; "InQuicker," 2013). In a reservation system, the patient can request a reservation time to visit the ED, typically for non-emergent conditions that do not require care in the next 120 minutes. Using this method, the external service provider manages the reservation system for the hospital for a fee. The patient is normally responsible for this fee although some hospitals offer the service for free to the patient ("No more waiting in the ED? Hospitals introduce online reservations," 2012). Once the patient requests an appointment time, they are generally provided a time in the next 90 to 120 minutes ("InQuicker," 2013).

This strategy has met resistance and harsh criticism. Some contend that this method discriminates against those that cannot afford to pay for a reservation and that this service should be reserved for a physician office setting (Armour, 2012). Despite the criticism, the reservation system meets the need of informing patients in a unique and innovative way. Having an appointment time is not only convenient for the patient but it benefits the hospital and all patients by spreading out patient arrival to the ED. The most prevalent proponent argument is that patient care improves from the availability of the service (Sadick, 2012). While a different approach than posting ED wait times, the intent is the same by providing information to patients so that they are better informed of the anticipated wait and are engaged in rational choice of alternative providers or settings.

Rational Choice Theory

RCT is rooted in both economics and sociology (Coleman & Fararo, 1992). The basis of RCT is that when an individual makes a decision, they will do so in a rational manner comparing value and cost of alternatives when such information is available (Tversky & Kahneman, 1986). When applying this theory, it is assumed that the individual is reasonably informed, capable of understanding the information, will act in self-interest, and will make a rational decision (Simon, 1955). Further, it is anticipated that when making decisions individuals will anticipate outcomes, weigh alternatives, and choose the alternative that is expected to give them the greatest satisfaction (Scott, 2000).

According to Gigerenzer and Selton (2002), a key consideration when evaluating this theory is the concept of bounded rationality, which assumes that the search for information is limited to what is already known. In contrast, unbounded rationality is when individuals continue to search for information, generally to identify alternatives or to gain cues on which alternative to choose (Gigerenzer & Selten, 2002).

The traditional consumer decision process involves five steps including recognition of the problem, information search, identification of alternatives, selection of an alternative, and purchase (Hawkins & Mothersbaugh, 2009). Information is a key to the decision process and individuals will choose an alternative even when such information to make a decision is incomplete (Tversky & Kahneman, 1986).

The internet age has modified the traditional decision process above to include additional steps. The Consumer Decision Journey, as described by Edelman (2010), incorporates the concept that individuals do not necessarily move in a straight line. Rather, an individual will continue the journey beyond purchase to include additional steps of enjoying, bonding, and advocating that will lead to not only impacting their

future purchase decisions, but also, the decision processes of others through social media and other interactions (Edelman, 2010).

Relating this theory to healthcare, it is assumed that patients will choose those healthcare providers that they expect to provide care at reasonable quality and cost points (Hibbard, Slovic, & Jewett, 1997). Further, research has shown that when individuals have information, they desire to be more active participants in the decision process for care (Arnold, 2007). In the case of choosing an ED versus an alternative setting for care, patients are expected to make reasonable decisions. In many instances, patients choose to visit an ED. As evidenced in the literature, a majority of care in the ED is non-emergent and could be received from other providers. Further, in most markets patients have a choice of visiting competing EDs for care. In situations of ambulance transport or patient direction, the patient's choice is limited; however, this is a minority of the time.

A Canadian study found that an overwhelming majority of patients want information and want to be involved in decision making related to care received (Deber, Kraetschmer, & Irvine, 1996). Further, a study in England of patient use of information related to the construct of quality outcomes scorecards, the researchers found that patients valued time data as it was an indicator that they could understand and such information factored into their decision making when choosing a hospital (Fasolo, Reutskaja, Dixon, & Boyce, 2010). Another study of patient choice related to ED care found that a major reason patients choose an emergency department versus going to a primary care physician office was that the perception of time required was less for ED care (Howard et al., 2005). Thus, it is clear that the perceived cost of time is a major factor in patient decision processes related to ED care.

At the heart of the strategy of posting ED wait times is the belief that informed patients will make decisions for their own self-interest. A patient will not choose a hospital that is expected to provide inferior care over a hospital that is expected to provide superior care. However, if the patient believes the quality of care will be the same, it is logical that patients will choose the ED based on anticipated cost. Due to health insurance, patients are less affected by the monetary cost of care. When insured, the patient does not pay the full cost of care and normally in network, similar providers have the same monetary cost to the patient. When monetary cost is not a factor in the patient decision-making, it is logical that the patient will choose ED care based on anticipated cost of their time compared to alternatives.

Healthcare decisions are complicated and it is not unusual for patients to lack complete information to make an informed decision (Hibbard et al., 1997). Such decisions are therefore bounded by the available information. Accordingly, it is expected that as information increases, patients will make more logical decisions related to alternatives of care providers.

By sharing anticipated ED wait times, it is expected that patients will use this information consistent with consumer decision theory and RCT in choosing that particular ED versus alternatives. Thus, RCT is an appropriate theoretical framework for consideration in this study to inform the research question and findings.

Theoretical Framework

The literature supports that improving ED efficiency is an important strategic goal as overcrowding is a growing problem that has wide-ranging effects on patients and hospitals. Additionally, the literature supports that most hospitals use internal

microenvironment efficiency strategies to improve ED performance and reduce the risk of overcrowding. The literature also supports that some hospitals use external macro environment strategies to improve efficiency. One challenge in the literature is an insufficient consistent definition of ED inefficiency known as overcrowding.

There is a gap in the literature related to the effectiveness of sharing expected wait times with patients to engage the patient in an informed decision of when and if to visit the ED for care. There is sufficient evidence in the literature that consumer decision models do apply and that patients desire to have more information and to participate in the decision process.

In summary, the literature supports it is in the best interest of hospital and patient to develop a theoretical model for improving ED efficiency. The literature supports the need for this study related to the research question, "Do ED wait time communication strategies improve patient throughput efficiency?"

Prioritizing strategy is of critical importance to hospitals as resources are increasingly limited (Bruder, 1991). This decision making is essential when market forces are promoting and even forcing change within organizations (Shortell et al., 1990). As the challenges of ED overcrowding and the necessity for improved efficiency increase in tandem, healthcare leaders need innovative evidence-supported solutions.

Due to the complexity of the environment, leaders are searching for theoretical approaches to resolve problems through innovation. By studying how a hospital's performance compares to the performance of other hospitals, the leaders of these hospitals can understand their position in the market. Once understood, application of the

appropriate strategy and management theory will lead to the desired outcome of an effective long-term solution.

As evidenced above, the literature does not include a consistent explicit definition of ED inefficiency and overcrowding. Therefore, this study will use a proxy to measure ED efficiency by way of an indexed mean of the four CMS ED time efficiency metrics. While it is logical that these metrics would serve as a reasonable proxy for ED efficiency, this proxy has limitations. Such limitations would include that an inefficient ED could be the result of poor management, limited space, or insufficient staff. Additionally, an inefficient ED could be the result of a spike in community illness or other external uncontrolled factors. Despite limitations, this proxy offers a potential new and explicit way to measure ED efficiency and should serve as a reasonable method for this study.

It is expected that this research will show, consistent with RCT, that patients will make rational decisions based on information available to contribute to improving efficiency and reduce the risk of overcrowding. Further, it is expected that hospitals that share their ED wait times with potential patients will have better ED efficiency. Within this conceptual and theoretical framework, this research study will provide a glimpse into the importance of sharing anticipated ED wait times and the association to ED throughput efficiency.

Research Question

The research question created the purpose and basis for this study: "Do ED wait time communication strategies improve patient throughput efficiency?" By understanding this relationship, hospitals can better prioritize the importance of sharing

anticipated ED wait times with patients to improve efficiency. Further, leaders have the opportunity to better understand the application of RCT in healthcare decision-making.

CHAPTER FOUR

RESEARCH METHODOLOGY

Following formation of the conceptual framework in Chapter Three, this chapter describes the design and methodology for this study to explore the research question, "Do ED wait time communication strategies improve patient throughput efficiency?" The hypotheses of this study are designed to explore the research question to connect what is known from the literature and to explore new knowledge of relationships. All variables of the study are explored in detail to inform the findings. Thereafter, this study establishes a framework of understanding for application of the findings to management theory and decision-making related to the study strategies.

Hypotheses

The literature supports the importance of ED efficiency on multiple levels and that delays in care due to long wait times for care have a negative impact on patient quality outcomes. Further, the literature supports that there are relationships between improved financial performance, patient satisfaction, and ED efficiency. However, there is a gap in the literature related to RCT associated patient decision behavior, and specifically, the effectiveness of sharing information related to anticipated ED wait times. It is assumed that this gap exists partially due to a previous lack of available data.

By application of RCT, this research hopes to identify a relationship that informing patients of ED wait times will contribute to better ED efficiency. This

research study is designed to determine relationships and then to discuss possible conclusions regarding the importance of posting ED wait times at a new level of strategic application. By using the study results, healthcare policy makers and hospital leaders will have a new opportunity to evaluate hospital strategy related to ED efficiency and to prioritize such strategy for their organizations.

The hypotheses of this study relate to the two ED wait time communication strategies and their association with ED efficiency. The results from analysis of the hypotheses will provide insight into the research question. These hypotheses include the following:

H_1: Hospitals that post ED wait times on the hospital website have better ED efficiency.

H_2: Hospitals that use ED reservation systems have better ED efficiency.

Data Collection

Data for this research partially originates from the CMS data collected from acute care hospitals. In partnership with the Hospital Quality Alliance, CMS formed the Hospital Compare initiative in 2002 designed to collect and report hospital performance data across multiple metrics (CMS, 2014). The Hospital Compare initiative has been expanded over the years since 2002. CMS added Inpatient Mortality in 2005, Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) satisfaction outcomes in 2008, ED efficiency metrics in 2009, and Readmission data in 2010 (CMS, 2014). It should be noted that while these metrics were added in the above years, actual reporting requirements and public availability of the data occurred in subsequent years. At the beginning of 2012, Hospital Compare data metrics for ED throughput efficiency

were first available for all hospitals nationwide to create the opportunity for comparison of performance.

Two Hospital Compare data sets, including Hospital Data and Emergency Department Throughput data sets, are merged into a single data set for hospital level comparison and statistical analysis (CMS, 2014). Further, this merged data set is augmented to add hospital licensed bed size data from the Florida Hospital Association (FHA) (FHA, 2014) and community demographic data from the Area Resource File (ARF) ("Area Resource File," 2014). Finally, hospital specific strategy data is added to the data set from the websites of the sample hospitals and the reservation system companies in the sample markets.

The 180 acute care hospitals in Florida with an ED are included in the study. The State of Florida is selected for two reasons. First, this study found that 60% of Florida hospitals used one of the two wait time communication strategies of this study. Second, one survey found that 92% of hospitals in Florida reported overcrowding (Derlet, 2002). Veterans Administration (VA) hospitals and hospitals without EDs are excluded from the study. Freestanding emergency departments are not included in this study as independent organizations as CMS reports this data in the host hospital consolidated data. Regarding children's hospitals, this study found that there are seven located in Florida but all report their data to CMS consolidated with their host acute care hospital.

Of note, seven of the acute care hospitals in Florida share a provider number with at least one other hospital in their hospital system. As they share a provider number, CMS data is reported consolidated. These systems consist of two two-hospital systems and one three-hospital system. For purposes of this study, these systems will be treated

as one hospital each. From this point forward, this study will include 176 hospitals in the sample.

One complete year of CMS data is available at the time of this research. The most recent complete year is the twelve months ending June 30, 2013. For control variables, the most recent available data is used from the ARF 2014 data set. While there are some variations in timing of available data in the study, it is not anticipated that any timing differences affect the results of the study.

Related to data for posting ED wait times, it was previously noted in this study that some hospitals use mobile apps, texting services, or billboards to post wait times. The study research found the hospitals using these methods also posted wait times on their websites. However, not all hospitals that posted wait times on their websites also used billboards, mobile apps, or texting services. Therefore, this study uses ED wait times posted on websites as the independent variable of interest to maintain consistency.

Hospital licensed bed size is not available from CMS but this information is available from the FHA website listing of all hospitals (FHA, 2014). Hospital licensed bed size is added to the consolidated data set from this source.

Regarding the hospital strategies for posting ED wait times on the website and the use of reservation systems, primary source research was conducted by the author in November 2014. Of the 176 sample hospitals, the author reviewed each hospital website for evidence of real time ED wait time posting and the availability of reservation systems. The data related to reservation systems was verified against publicly available information from the reservation system companies InQuicker ("InQuicker," 2013) and ER Express Reservations ("ER Express," 2014). This study found that of the sample 176

hospitals, 80 hospitals post ED wait times on the hospital website and 26 hospitals use a reservation system.

Community and hospital data is added to the data set from the ARF ("Area Resource File," 2014). Such data is on a county basis and matched to each hospital based on its county physical location of the hospital. For purposes of this study, the county location of the hospital is defined as the health services area (HSA) for each hospital. In this study, county location and HSA are synonymous.

Statistical Analysis

The study variables are referenced in Table 1. The study includes two independent variables of interest of ED wait times posted on the hospital website (Wait Times on Website) and Reservation Systems used by the respective hospitals. No hospitals in the sample use both strategies. Therefore, these two variables include three distinct groups of hospitals:

1. hospitals that do not post wait times on the hospital website nor use a reservation system,
2. hospitals that post wait times on the hospital website but do not use a reservation system, and
3. hospitals that use a reservation system but do not post wait times on the hospital website.

The study dependent variable is an index of four CMS measures of ED efficiency in operations for each hospital. These four variables of ED efficiency include Median Time from ED Arrival to Provider Contact for ED Patients, Median Time from ED Arrival to ED Departure for Discharged ED Patients, Median Time from ED Arrival to ED Departure for Admitted ED Patients, and Admit Decision Time to ED Departure

Time for Admitted patients. The four ED efficiency variables are averaged to create a single ED Efficiency Index variable for each hospital.

The control variables of this study are divided into hospital specific variables and community specific variables. The hospital specific variables include hospital licensed bed size, hospital ownership as investor owned or not investor owned, and an indicator of market competiveness for each hospital from a calculated Herfindahl-Hirschman Index. The community specific variables include the location of a hospital in a metropolitan or non-metropolitan market , Health Professional Shortage Area status, the percent of population less than 65 years of age uninsured, the percent of population Medicaid eligible, and the percent of population over 65 years of age.

Control Variable Characteristics

Control variables are in two categories, hospital characteristics, and community characteristics. For hospital characteristics, the first variable is hospital ownership type. For this study, ownership type is limited to two dichotomous categories of investor owned and not investor owned hospitals. Another hospital related characteristic is the hospital's competitive position in the market. The Herfindahl-Hirschman Index (HHI) is a commonly used indicator of market competitiveness (Garnick, Luft, Robinson, & Tetreault, 1987). The HHI for the hospital is an indicator of not only the competition in the market but the individual hospital's position in the market related to the number of competitors and the comparable size of the competitors related to the hospital (Garnick et al., 1987). For this research study, the HHI Hospital Index is calculated for each hospital to reflect the hospital market share and the hospital's position relative to the competitors in the HSA. To calculate the HHI for each hospital in this study, the hospital market

share for each hospital is the number of licensed beds for the hospital divided by the total licensed beds in the HSA for the hospitals included in this study. The market share is then squared to determine the hospital specific HHI. For the HHI, the Department of Justice defines a value of 1.0000 for a hospital represents a monopoly in the HSA and, conversely, a low HHI value less than 0.1800 indicates a highly competitive market (Investopedia, 2015).

Community Characteristics

The characteristics and demographics of a market are expected to have an impact on hospital performance related to this study. For example, a hospital located in a HPSA may have issues with access to care compared to a hospital not located in a HPSA. As another example, a hospital located in a market with high rates of uninsured population or high rates of Medicaid eligible population would have greater challenges compared to a hospital that did not have these high unfavorable insurance population rates. As hospitals are affected by their markets, the appropriate control variables are included in the study.

It is important to note that not all control variables are the same period as the study dependent variable and the independent variables of interest. The CMS data of this study is 2012-2013; however, control variables from ARF did not always include 2012 or 2013 data. As an example, the most recent ARF data for Medicaid eligibility is 2008 and the most recent data in ARF related to the uninsured population in 2012. When available, 2013 data is used but when 2013 data is not available, the most recent year available is used in this study.

Table 1

Variable Types and Definitions

Category	Variable	Definition
Dependent	ED Efficiency Index	Indexed averaged variable of 4 CMS metrics including Median Door to Diagnostic Evaluation Time, Median Time from Arrival to Departure for Admitted Patients, Median Time from Arrival to Departure for ED Discharged Patients, and Median Time from Admission Decision Until Departure to an Inpatient Unit, each measured in minutes.
Independent	Wait Times on Website	Presence of ED Wait Times on Hospital Website 0 = No wait time posted on website 1 = Wait time posted on website
Independent	Reservation System	Use of ED Reservation System by Hospital 0 = No use of ED Reservation System 1 = Use of ED Reservation System
Control	Licensed Beds	Hospital size as measured by licensed beds
Control	Metropolitan Location	Location of Hospital in a Metropolitan Area 0 = Not Metropolitan 1 = Metropolitan
Control	Ownership	Ownership Type of Hospital 0 = Not investor owned 1 = Investor owned
Control	% Population Uninsured	Percent of population under 65 years of age without health insurance
Control	% Population Medicaid Eligible	Percent of population that is Medicaid eligible
Control	% Population >65	Percent of population age 65 and older
Control	HPSA	Designation of County as a Health Professional Shortage Area 1 = HPSA 2 = Partial HPSA
Control	HHI Hospital Index	Herfindahl - Hirschman Index of market competitiveness

The status of a HSA as a HPSA is an important community characteristic for this research. A hospital located in a shortage area may shoulder more of the demand for care in the ED as patients would have less access to primary care services versus a hospital located in a community that was not a HPSA. ARF reports HPSA data based on three categories including primary care, dental, and mental health. For this study, the Primary Care HPSA designation is only relevant as the study includes acute care hospitals. The most recent ARF data is 2013. ARF data includes three categories for a market including a HPSA, a Partial HPSA, and not a HPSA. A Partial HPSA is when a portion of the HSA is designated as a HPSA ("Area Resource File," 2014). However, none of the hospitals in the sample is in a HSA that is not a HPSA. Therefore, this variable is dichotomous within this study with two categories of HPSA and partial HPSA.

Another important characteristic of hospitals for this study is the designation of the hospital as located in a metropolitan or non-metropolitan market. The ARF data includes a Rural-Urban Continuum Code that provides a more detailed description of the market as urban, rural or metropolitan and sub categories of population size (HHS, 2014). The most recent data available for this variable in ARF was 2013. For this study, the location of the hospital in a metropolitan area versus non-metropolitan area is included for the variable Metropolitan Location.

The percent of population under 65 years of age without health insurance is another community characteristic relevant to this study. Since the literature supports that the percent of the population less than age 65 that is uninsured increases demand for ED services (Derlet, 2002). The most recent data available for this variable in ARF is 2012.

The study includes a control variable of percent of Medicaid eligible population of the total population for the HSA in the variable % Population Medicaid Eligible. The literature supports that when Medicaid eligible persons have difficulty in accessing care, the ED is often used as a resource (Fossett & Peterson, 1989). For the percent of population Medicaid eligible, 2008 is the most recent year reported in the ARF.

The final community characteristic included in this study is the percent of population that is age 65 and older. The ARF data includes population data for those age 65 and older and the total population for each HSA. The most recent data for population 65 and older years of age is 2012 and appropriately, the same year of total population data is used to calculate this variable. The population 65 and over is divided by the total population for the HSA to determine the percent of population 65 and older.

Hypotheses Methodology

Regarding hypotheses testing, the following methodologies are employed.

H_1: Hospitals that post ED wait times on their websites have better ED efficiency.

For H_1, the study investigates the association between ED wait times posting and the ED Efficiency Index variable using an ordinary least squares multiple regression analysis. The hospitals in the study sample are compared for those that do post ED wait times versus those that do not.

H_2: Hospitals that use ED reservation systems have better ED efficiency.

For H_2, the second of two hypotheses in this study, the study investigates the association of using an ED reservation system and the ED Efficiency Index variable using an ordinary least squares multiple regression analysis. The hospitals in the study

sample are compared for those that use an ED reservation system versus those that do not.

Chapter 5 presents the findings of this study followed by a discussion of the findings in Chapter 6. A discussion of the findings will allow for application of the new knowledge through the conceptual framework. Application of the conceptual framework will increase knowledge within the industry and provide healthcare leaders with new understanding of the relationship between sharing ED wait times with patients and better ED efficiency.

CHAPTER FIVE

FINDINGS

The statistical analysis includes descriptive analysis of the characteristics of the hospitals and community related to the research question, "Do ED wait time communication strategies improve patient throughput efficiency?" Next, a bivariate analysis of the variables is performed. Finally, the ordinary least squares multiple regression analysis is performed of hospital strategies and the control variables to test the hypotheses. All testing was performed in SPSS software version 21.

Descriptive Analysis

The first step of the analysis is a descriptive analysis of the variables. Descriptive statistics are presented in Table 2.

ED Wait Time Strategies

For this research study, two wait time strategies are included: posting ED wait time data on the hospital website, and the use of reservation systems. Of the 176 hospitals in the sample, 80 (45.5%) hospitals post their ED wait times on the hospital website and 26 (14.8%) hospitals use a reservation system. Combined, 106 (60.2%) hospitals use one of the two study strategies. It is notable that no hospitals use both strategies of posting ED wait times on the website and use a reservation system.

Table 2

Hospital and Community Characteristics (N=176)

Variable	Statistic
ED Wait Time Strategies	
Wait Time Posted on Website	
Yes (N/%)	80(45.5%)
No (N/%)	96(54.5%)
Reservation System	
Yes (N/%)	26(14.8%)
No (N/%)	150(85.2%)
Hospital Characteristics	
Licensed Beds (Mean/SD)	285.6(239.6)
Low	19
High	1306
Ownership	
Investor Owned (N/%)	72(40.9%)
Not Investor Owned (N/%)	104(59.1%)
HHI Hospital Index (Mean/SD)	0.2309(0.3322)
Community Characteristics	
Metropolitan Location	
Metropolitan (N/%)	155(88.1%)
Non-Metropolitan (N/%)	21(11.9%)
HSPA	
HPSA (N/%)	14(8.0%)
Partial HPSA (N/%)	162(92.0%)
% Population Uninsured (Mean/SD)	23.5%(4.3%)
Low	14.60%
High	33.20%
% Population Medicaid Eligible (Mean/SD)	16.9%(4.5%)
Low	13.30%
High	31.10%
% Population >65 (Mean/SD)	20.1%(6.6%)
Low	10.80%
High	54.20%

Hospital Characteristics

Of the 176 hospitals, 13 (7.4%) are CAHs with the remaining 163 (92.6%) of hospitals licensed as acute care hospitals. The 176 hospitals have licensed beds ranging from 19 to 1,306 with a mean of 286 beds. In this study, 40.9% of the study hospitals are investor owned.

Among the sample hospitals, the HHI ranged from a low of 0.003 to a high of 1.000 with a mean of 0.2309. Of note, 22 (12.5%) hospitals have a HHI of 1.0000 indicating a monopoly in the HSA. Conversely, 129 (73.3%) hospitals are identified as located in a highly competitive market as defined as an HHI of less than 0.1800. The remaining hospitals are not considered to be in a highly competitive or a monopolistic market position.

Community Characteristics

For this research study, five control variables are used to define the community characteristics: Metropolitan Location, HPSA, % Population Uninsured, % Population Medicaid Eligible, and % Population >65.

For the sample of hospitals related to HPSA, 8% of hospitals are located in a HPSA and 92% of hospitals are in a Partial HPSA. In addition, 88.1% of hospitals are located in a metropolitan area and 11.9% are located in a non-metropolitan area. The % Population Uninsured ranges from a low of 14.6% to a high of 33.2% with a mean of 23.5%. The % Population Medicaid Eligible has a range from a low of 13.3% to a high of 31.1% and a mean of 16.9%. Finally, the % Population >65 has a range of a low of 10.8% to a high of 54.2% and a mean of 20.1%.

ED Throughput Time Variable Characteristics

The four time variables of this study that comprise the ED Efficiency Index include Median Time from ED Arrival to Provider Contact for ED Patients, Median Time from ED Arrival to ED Departure for Discharged ED Patients, Median Time from ED Arrival to ED Departure for Admitted ED Patients, and Admit Decision Time to ED Departure Time for Admitted, each measured in minutes.

For the sample hospitals, Median Time from ED Arrival to Provider Contact for ED Patients has a range of 4 to 103 minutes with a mean of 31 minutes. For Median Time from ED Arrival to ED Departure for Discharged ED Patients, the sample hospitals have a range of 77 to 298 minutes with a mean of 153 minutes. For Median Time from ED Arrival to ED Departure for Admitted ED Patients, the sample hospitals have a range of 171 minutes to 667 minutes with a mean of 304 minutes. Finally, for the variable Admit Decision Time to ED Departure Time for Admitted ED Patients, the sample hospitals have a range of 0 minutes to 361 minutes with a mean of 121. The range low of 0 minutes is concerning as the next lowest reported time for this variable within the study sample of hospitals is 28 minutes; however, upon further inspection this particular hospital reported all other variables within reasonable ranges compared to the other sample hospitals in the study. The value of 0 likely indicates that this hospital does not board patients in the ED. Therefore, this outlier case value for this hospital is not adjusted in this study.

All four time variables were missing data for thirteen cases. These missing cases are the same thirteen hospitals, all of which are CAH in the sample. Each CAH has missing data for the same four variables and no non-CAH hospital is missing data for the

CMS variables of this study. The missing case variables are likely related to the fact that CMS does not require CAHs to report Hospital Compare data (CMS, 2014). While the CAH may choose to report voluntarily one or all metrics, based on the CMS Hospital Compare ED Throughput data set used by this study, no CAH in the sample voluntarily reported this data.

Of the CAH hospitals, four of the thirteen hospitals used the strategy of posting wait times on the hospital website. None of the CAH hospitals used the strategy of the reservation system. From the effective exclusion of the CAH hospitals from the study due to data not reported to CMS for ED throughput, the sample size for select bivariate analyses and multiple regression analyses will include a sample of 163 hospitals, including 76 (46.6%) hospitals that post wait times on the hospital website and 26 (16.0%) hospitals that use a reservation system.

For the ED Efficiency Index, the range is from a low of 80 minutes to a high of 333 minutes with a mean of 152 minutes.

Bivariate Analysis

Differences in the variables are examined using bivariate statistics. For each variable, the study compares differences in characteristics between three groups: hospitals that do not use a strategy, hospitals that post wait times on the website, and hospitals that use a reservation system. Within each group for categorical variables, the hospitals that use the strategy indicated are compared to hospitals that do not use that strategy. For categorical variables, chi-squared (X^2) is used to compare differences between the groups. For continuous variables, analysis of variance (ANOVA) is used to compare means between the three groups. Table 3 includes a bivariate analysis of these

variables for the study sample of 176 hospitals. For each group, the bivariate analysis compares hospitals that are in that group versus hospitals that are not in that group.

Table 3

Bivariate Analysis of Variables by Strategy Type Use (N=176)

Variable	No Strategy (70)	Wait Time on Website (80)	Reservation System (26)
Ownership (n/% use)			
Not Investor Owned (104)	56.7%	27.9%	15.4%
Investor Owned (72)	15.7%	70.8%	13.9%
	x^2=30.520, p<0.001	x^2=31.653, p<0.001	x^2=0.076, p=0.783
Metropolitan Location (n/% use)			
Not Metropolitan (21)	61.9%	38.1%	0.0%
Metropolitan (155)	36.8%	46.5%	16.8%
	x^2=4.876, p=0.027	x^2=0.521, p=0.470	x^2=4.133, p=0.050
HPSA (n/% use)			
HPSA (14)	50.0%	28.6%	21.4%
Partial HPSA (162)	38.9%	46.9%	14.2%
	x^2=0.664 , p=0.415	x^2=1.749, p=0.186	x^2=0.535 , p=0.464
Licensed Beds (mean)	317	241	338
		F=2.659, p=0.073	
HHI Hospital Index (mean)	0.2692	0.1654	0.1465
		F=2.312,p=0.102	
% Population Uninsured (mean)	23.4%	23.6%	23.8%
		F=0.111, p=0.895	
% Population Medicaid Eligible (mean)	17.0%	17.0%	16.7%
		F=0.049, p=0.952	
% Population >65 (mean)	20.3%	20.3%	18.9%
		F=0.462, p=0.630	

Hospitals that use one of the strategies are more likely to be investor owned compared to hospitals that do not use a strategy (X^2=30.520, n=72, p<0.001). Furthermore, hospitals that post wait times on the hospital website are more likely to be investor owned when compared to hospitals that do not post the ED wait times (X^2=31.653, n=72, p<0.001). Regarding metropolitan location, hospitals that use a reservation system are more likely to be located in a metropolitan location (X^2=4.133, n=155, p<0.05).

The ED Efficiency Index is an indexed average of the four CMS throughput efficiency metrics for ED performance. A one-way between groups ANOVA is performed for these variables to compare the differences between the three groups of the sample of 163 non-CAH hospitals: hospitals that do not use a strategy, hospitals that post the ED wait times on the website, and hospitals that use a reservation system. The results of this bivariate analysis are found in Table 4.

Table 4

Bivariate Analysis Mean Time in Minutes for Strategies (N=163)

	Strategy Type (n)		
	No Strategy (61)	Wait Time on Website (76)	Reservation System (26)
ED Efficiency Index	167.94	134.62	168.47
		F=14.928, p<0.001	
Median Time from ED Arrival to Provider Contact	40.43	22.03	35.31
		F=21.774, p<0.001	
Median Time from ED Arrival to ED Departure for Discharged	162.90	141.39	165.85
		F=6.736, p<0.01	
Median Time from ED Arrival to ED Departure for Admitted	331.84	273.71	326.73
		F=11.745, p<0.001	
Median Time from Admit Decision Time to ED Departure Time for Admitted	136.59	100.96	146.00
		F=11.806, p<0.001	

For all four CMS variables and the ED Efficiency Index in this bivariate analysis, there is a statistically significant difference between groups for the ED Efficiency Index as determined by one-way ANOVA ($F(2,160)=14.928$, $p<0.001$). A Tukey post-hoc test revealed that the ED Efficiency Index is statistically significantly lower for hospitals that post wait times on the website ($134.52^{\pm}31.109$, $p<0.001$) compared to hospitals that use reservation systems ($168.47^{\pm}44.351$) and hospitals that do not use a strategy ($167.94^{\pm}45.337$). There is not a significant difference between hospitals that use a reservation system and hospitals that do not use a strategy. For ED Efficiency Index, hospitals that post wait times on the hospital website have statistically significantly lower (better) efficiency in this variable than hospitals that use a reservation system or do not use either strategy. Further, there is not a statistically significant difference in ED Efficiency Index between hospitals that use a reservation system and hospitals that do not use a strategy.

For Mean Time from Arrival to Provider Contact, there is a statistically significant difference between groups as determined by one-way ANOVA ($F(2,160)=21.774$, $p<0.001$). A Tukey post-hoc test reveals that the Mean Time from Arrival to Provider Contact is statistically significantly lower for hospitals that post wait times on the website ($22.03^{\pm}1.590$, $p<0.001$) compared to hospitals that use reservation systems ($35.31^{\pm}3.137$) and hospitals that do not use a strategy ($40.43^{\pm}2.527$). There is not a significant difference between hospitals that use a reservation system and hospitals that do not use a strategy. For Mean Time from Arrival to Provider Contact, hospitals that post wait times on the hospital website have statistically significant lower (better) efficiency in this variable than hospitals that use a reservation system or do not use either

strategy. Further, there is not a statistically significant difference in this variable between hospitals that use a reservation system and hospitals that do not use a strategy.

For Mean Time from Arrival to Departure for Discharged Patients, there is a statistically significant difference between groups as determined by one-way ANOVA ($F(2,160)=6.736$, $p=0.002$). A Tukey post-hoc test reveals that the Mean Time from Arrival to Departure for Discharged Patients is statistically significantly lower for hospitals that post wait times on the website ($141.39^{\pm}4.203$, $p=0.002$) compared to hospitals that use reservation systems ($165.85^{\pm}6.700$) and hospitals that do not use a strategy ($162.90^{\pm}5.568$). There is not a significant difference between hospitals that use a reservation system and hospitals that do not use a strategy. For Mean Time from Arrival to Departure for Discharged Patients, hospitals that post wait times on the hospital website have statistically significant lower (better) efficiency in this variable than hospitals that use a reservation system or do not use either strategy. Further, there is not a statistically significant difference in this variable between hospitals that use a reservation system and hospitals that do not use a strategy.

For Mean Time from Arrival to Departure for Admitted Patients, there is a statistically significant difference between groups as determined by one-way ANOVA ($F(2,160)=11.745$, $p<0.001$). A Tukey post-hoc test reveals that the Mean Time from Arrival to Departure for Admitted Patients is statistically significantly lower for hospitals that post wait times on the website ($273.71^{\pm}6.716$, $p<0.001$) compared to hospitals that use reservation systems ($326.73^{\pm}17.240$) and hospitals that do not use a strategy ($331.84^{\pm}10.940$). There was is a significant difference between hospitals that use a reservation system and hospitals that do not use a strategy. For Mean Time from Arrival

to Departure for Admitted Patients, hospitals that post wait times on the hospital website have statistically significant lower (better) efficiency in this variable than hospitals that use a reservation system or do not use either strategy. Further, there is not a statistically significant difference in this variable between hospitals that use a reservation system and hospitals that do not use a strategy.

For Median Time from Admit Decision Time to ED Departure Time for Admitted Patients, there is a statistically significant difference between groups as determined by one-way ANOVA ($F(2,160)=11.806$, $p<0.001$). A Tukey post-hoc test reveals that the Median Time from Admit Decision Time to ED Departure Time for Admitted Patients is statistically significantly lower for hospitals that post wait times on the website ($100.96^{\pm}4.263$, $p<0.001$) compared to hospitals that use reservation systems ($146.00^{\pm}13.713$) and hospitals that do not use a strategy ($136.59^{\pm}7.231$). There is not a significant difference between hospitals that use a reservation system and hospitals that did not use a strategy. For Median Time from Admit Decision Time to ED Departure Time for Admitted Patients, hospitals that post wait times on the hospital website have statistically significant lower (better) efficiency in this variable than hospitals that use a reservation system or do not use either strategy. Further, there is not a statistically significant difference in this variable between hospitals that use a reservation system and hospitals that do not use a strategy.

To summarize the above results of the bivariate analysis, there is a statistically significant difference for all time variables of this study for hospitals that post ED wait times on the hospital website compared to hospitals that use a reservation system or do not use a strategy. However, there is not a statistically significant difference for any of

the variables for hospitals that use a reservation system compared to hospitals that do not use a strategy.

Multiple Regression Analysis

To test the hypotheses of this research study, ordinary least squares multiple regression analysis is employed. Multicollinearity is tested using the Variance Inflation Factor (VIF). For the variables, the VIF values range from a low of 1.163 to a high of 1.777 supporting that the risk of multicollinearity between the variables is not found in the model.

Prior to testing, outliers are evaluated for all variables defined as more than two standard deviations from the mean. No variables of the study are identified as having outliers except for the dependent variable ED Efficiency Index. From descriptive analysis of the variables, four ED Efficiency Index values are more than two standard deviations from the mean. While outliers, these cases are plausible and therefore they are not removed.

From this summary, the study indicates that the model accounts for 41.1% of the variance observed in the dependent variable based on the R^2 of 0.441. Further, the Adjusted R^2 of 0.373 suggests that the cross validity of the model is very good with only a 0.068 difference between R^2 and the Adjusted R^2. The test of autocorrelation in the longitudinal data set does not indicate a concern of independent errors in this model.

The results of the multivariate regression are found in Table 5. Wait Times on Website (β=25.08, $p<0.001$) has a statistically significant association with the ED Efficiency Index. Posting wait times on the hospital website is associated with a 25.08

minute decrease in the ED Efficiency Index. Related to the use of Reservation Systems, there is not a statistically significant association with the ED Efficiency Index.

Table 5

Multiple Regression Analysis Coefficients (N=163)

	Unstandardized Coefficients		Standardized Coefficients		95.0% Confidence Interval for B	
	B	Std. Error	Beta	Sig.	Lower Bound	Upper Bound
(Constant)	30.54	37.693		0.419	-43.93	105.01
Wait Times on Website	-25.08	6.560	-0.296	0.000	-38.04	-12.12
Reservation System	-0.12	8.115	-0.001	0.988	-16.15	15.91
Licensed Beds	0.05	0.012	0.257	0.000	0.02	0.07
Ownership	-8.59	6.142	-0.101	0.164	-20.73	3.54
Metropolitan Location	32.30	14.098	0.175	0.023	4.44	60.15
HPSA	3.16	13.125	0.016	0.810	-22.77	29.09
HHI Hospital Index	11.16	11.681	0.073	0.341	-11.91	34.24
% <65 without Health Insurance	2.50	0.740	0.254	0.001	1.04	3.96
% Population Medicaid Eligible	1.76	0.853	0.171	0.041	0.07	3.44
% Population >65	-0.15	0.458	-0.024	0.741	-1.06	0.75
				R^2		0.411
				Adjusted R^2		0.373

Constant: ED Efficiency Index

Since a lower ED Efficiency Index is considered better ED efficiency, the lower the index the better the efficiency performance. For Licensed Beds (β=0.05, p<0.001), the larger the number of licensed beds for a hospital, the higher (worse) the ED Efficiency Index. Further, for every one unit increase in Licensed Beds (β=0.05, p<0.001), the ED Efficiency Index increases by 0.05 minutes.

Relative to non-metropolitan hospitals, metropolitan hospitals have higher (worse) ED Efficiency Index values (β=32.30, p=0.023). In practical terms, those

hospitals in a metropolitan location have a 32.30 minute higher ED Efficiency Index than hospitals not in a metropolitan area.

The higher the percent of the population uninsured, the higher (worse) the ED Efficiency Index (β=2.50, p=0.001). For every one percentage point increase in % Population Uninsured (β=2.50, p=0.001), the ED Efficiency Index increases by 2.5 minutes. Finally, the higher the percentage of Medicaid eligibles in a community, the higher (worse) the ED Efficiency Index (β=1.76, p=0.041). For every one percentage point increase in % Population Medicaid, the ED Efficiency Index increases by 1.76 minutes.

For the control variables that have a statistically significant association with the ED Efficiency Index, based on the standardized coefficients, the control variables from highest to lowest magnitude of impact include Licensed Beds (β=0.05, p<0.001), % Population Uninsured (β=2.50, p=0.001), Metropolitan Location (β=32.30, p=0.023), and % Population Medicaid Eligible (β=1.76, p=0.041).

Strengths of Associations

Following the multiple regression analysis results presented above, additional multiple regression analyses are performed to evaluate the strength of the associations of the independent variables of interest related to the dependent variable, ED Efficiency Index. Three additional regression analyses are performed including control variables only, control variables and only the independent variable of interest of Wait Times on Website, and control variables and only the independent variable of interest of Reservation Systems. Table 6 includes a comparison of the four comparable regression analyses.

Table 8. Multiple Regression Analyses to Explore Strength of Relationships Associated with ED Efficiency Index (N=176)

Variable	Model 1 Original Full Regression Analysis (Beta, sig.)	Model 2 Control Variables Only (Beta, sig.)	Model 3 Control Variables and Wait Times on Website (Beta, sig.)	Model 4 Control Variables and Reservation System (Beta, sig.)
Constant	30.54(0.419)	25.972(0.510)	30.476(0.415)	19.834(0.614)
Wait Times on Website	-25.08(0.000)***		-25.035(0.000)***	
Reservation System	-0.12(0.988)			13.202(0.086)
Licensed Beds	0.05(0.000)***	0.051(0.000)***	0.046(0.000)***	0.052(0.000)***
Ownership	-8.59(0.164)	-18.700(0.002)**	-8.608(0.157)	-18.363(0.002)**
Metropolitan Location	32.3(0.023)*	33.942(0.023)*	32.279(0.022)*	31.556(0.034)*
HPSA	3.16(0.810)	-0.761(0.956)	3.182(0.807)	2.199(0.873)
HHI Hospital Index	11.16(0.341)	13.627(0.268)	11.167(0.339)	13.484(0.270)
% Population Uninsured	2.5(0.001)**	2.802(0.000)***	2.499(0.001)**	2.752(0.000)***
% Population Medicaid Eligible	1.76(0.041)*	1.423(0.112)	1.757(0.040)*	1.428(0.109)
% Population >65	-0.15(0.741)	-0.177(0.712)	-0.151(0.740)	-0.105(0.827)
r^2	0.411	0.342	0.411	0.355
Adjusted r^2	0.373	0.308	0.377	0.317

Constant: ED Efficienty Index

*p<0.05; **p<0.01; ***p<0.001

All Beta Coefficients are unstandardized.

The original full multiple regression analysis, Model 1, has a R^2 of 0.411 indicating that the model accounts for 41.1% of the variance in ED Efficiency Index. Model 2 includes only the control variables and not the independent variables of interest, Wait Times on Website and Reservation Systems. For this model, the R^2 is 0.342 indicating that the control variables without the independent variables of interest account for 34.2% of the variance in ED Efficiency Index. Compared to Model 1, R^2 decreases by 0.069 indicating a decline of 6.9% of predictability between the two models. Accordingly, the model suggests that the independent variables of interest contribute to

the predictability of the model related to understanding the ED Efficiency Index. To understand the strength of influence of the independent variables of interest, Models 3 and 4 evaluate the two independent variables of interest independently.

In Model 3, a multiple regression analysis is performed for all control variables and the independent variable of interest Wait Times on Website. By design, the Reservation Systems independent variable of interest is removed. This model includes a R^2 of 0.411, the same R^2 value of the full regression model performed in Model 1. This model accounts for 41.1% of the variability of ED Efficiency Index. As with Model 1, the independent variable of interest, Wait Times on Website (β=-0.296, $p<0.0001$) has a statistically significant association with the ED Efficiency Index variable. From these results, the addition of the Wait Times on Website variable increases the variation explained of the model by 6.9%.

Finally, in Model 4, a multiple regression analysis is performed for all control variables and the independent variable of interest Reservation Systems. By so doing, this model tests the Model 1 regression analysis without the Wait Times on Website variable. For this model, the R^2 has a value of 0.355 supporting that this model explains 35.5% of the variation in the ED Efficiency Index. However, as with Model 1, the association between Reservation Systems ($p=0.086$) and the ED Efficiency Index is not statistically significant. Also of note, for this regression analysis model, Ownership (β=-18.363, $p=0.002$), which does not have a statistically significant association with the ED Efficiency Index in Model 1, now has a statistically significant association. For a practical application, for Model 4 with Reservation System as the only independent variable of interest, Ownership (β=-18.363, $p=0.002$) indicates that hospitals that are not

investor owned have a lower (better) ED Efficiency Index. Additionally, in Model 1, % Medicaid Eligible has a statistically significant association with ED Efficiency Index but is not statistically significant in Model 4.

Based on the results from the comparison of the four models of multiple ordinary least squares regression, the original Model 1 including both independent variables of interest will remain the primary model for this study. However, this comparison of multiple regression models indicates that Wait Times on Website has a significantly stronger association with ED Efficiency Index than Reservation Systems.

Given the above, the results of these additional multiple regression models indicate a strong association of Wait Times on Website to ED Efficiency Index. Only the Licensed Bed control variable had a stronger association with ED Efficiency Index than Wait Times on Website.

CHAPTER SIX

DISCUSSION OF FINDINGS

This study addresses the research question, "Do ED wait time communication strategies improve patient throughput efficiency?" Other questions were raised as this research progressed including the following. Does RCT inform the findings of this study and help predict the behavior of patients when choosing to visit an ED for care? In other words, when a patient anticipates that wait times will be long, will the patient make a rational decision based on available information and weigh alternatives to visiting a potentially overcrowded ED? Will patients behave rationally and as expected in making this decision? Which hospitals should use the strategies of this study and which hospitals are most likely to benefit from using the strategies? Finally, why would hospitals use these strategies?

This chapter will include a discussion of the study findings, implications for management practice, limitations of this study, and recommendations for future research. Through this framework, this study discussion will answer the questions raised above.

Discussion of Findings

A summary of the findings of this study includes multiple points of interest. Related to the hypotheses of this study, Hypothesis 1 is supported and Hypothesis 2 is not supported. Hospitals that post wait times on the hospital website have a lower (better) ED Efficiency Index than hospitals that do not post wait times on the hospital website.

Further, hospitals that posted Wait Times on Website have an ED Efficiency Index 25.08 minutes lower than hospitals that do not post wait times on the hospital website. For hospitals that use a Reservation System compared to hospitals that do not use a Reservation System, there is not a statistically significant difference in the ED Efficiency Index.

Related to the control variables, there is a statistically significant association between the ED Efficiency Index and Licensed Beds, Metropolitan Location, % Population Uninsured, and % Population Medicaid Eligible. A discussion of these findings frames the application of the findings to management practice.

Wait Times Posted on Website

This study finds a statistically significant association of posting wait times on the hospital website with the ED Efficiency Index. Hospitals that use this strategy have better ED efficiency. As framed in the review of the literature, this benefits both the hospital and the patients of those hospitals. For all variables in the study, only the licensed bed size of the hospital is a more substantial predictor of ED efficiency but only slightly larger than the strategy of posting wait times on the website.

Further, hospitals that posted wait times on the hospitals website compared to hospitals that did post wait times not only had a better ED Efficiency Index but they also performed better in all four CMS throughput metrics that contributed to the index variable. In other words, these hospitals were more efficient not only in total but were more efficient in time to see a provider, length of stay, and time transferring an admitted patient to an inpatient unit. While this was expected based on the hypothesis for this

variable, it was unexpected how substantially better these hospitals performed in terms of ED efficiency.

As hospitals that post wait times on the website perform substantially better than hospitals that do not use this strategy, this study ponders causality of the relationship. It is curious if hospitals post wait times after they achieve ED efficiency or if ED efficiency is the result of posting wait times. As 45% of the study sample hospitals post wait times on the hospital website, it does not seem logical that only high performing hospitals would use this strategy.

This study contends that rather than posting wait times preceding ED efficiency or ED efficiency preceding wait times being posted, hospitals pursue both strategies of achieving efficiency and sharing the wait times efficiency. Hospitals that desire to have ED efficiency also want to share their efficiency by posting the wait times. Therefore, this study contends that hospitals using this strategy concurrently achieve ED efficiency and post wait times are positively associated. It is believed that hospitals which value patient engagement, evidenced by sharing ED wait times, also value ED efficiency. In other words, a hospital that values patients will provide information and efficient service.

Reservation Systems

Contrary to the findings related to posting wait times on the hospital website, the use of reservation systems does not have a statistically significant association with the ED Efficiency Index. In fact, the results of the multiple regression analysis and bivariate tests do not show a substantial difference in performance for hospitals that use a reservation system versus those that do not use a reservation system. This was unexpected and a substantial finding of the study as it was hypothesized that hospitals that use a reservation system would be more efficient.

When studying the CMS ED throughput metrics that contributed to the calculation of the ED Efficiency Index, the results are surprising. Regardless of the time metric investigated, the ED efficiency performance of hospitals that use a reservation system have similar performance to hospitals that do not use a reservation system for all metrics including time to provider, length of stay, and the time to transfer a patient from the ED to an inpatient unit. In other words, it would seem that a reservation system does not contribute to ED efficiency.

As the use of reservation systems was expected to lead to improved efficiency as evidenced by the hypothesis, it is important to explore why this study does not support that association. It would seem logical that if a hospital offers a reservation system they value patients and this dedication to patients would be reflected in ED efficiency. It is expected that informed patients will make logical decisions to visit an overcrowded ED when alternatives exist. It is possible the differences between the reservation system strategy and the posting wait times on the website strategy are the reason why one strategy is effective in improving ED efficiency and the other strategy is not effective.

It is possible that the use of a reservation system is an alternative strategy to posting wait times on the website when ED efficiency has not, or cannot, be achieved. In this scenario, if a competitor hospital posts wait times on the website and the performance is good, a hospital may choose not to post their inferior time performance data but offer a reservation system as an alternative.

Additionally, it is possible that the reservation system does not engage patients in the same manner as the strategy of posting wait times on the website. Alternatively, it is possible that patients do not perceive the two strategies in the same manner. This study

contends that the differences in the strategies lead to different ED efficiency performance; and, RCT informs both findings. These statements require further discussion later in this chapter.

Control Variables

Licensed Bed Size. Licensed bed size has a statistically significant association with the ED Efficiency Index. Larger hospitals have higher ED Efficiency Index values and therefore lower efficiency in the ED. While a hospital that has more licensed beds does not necessarily have a larger ED or higher ED volumes, it is logical that would be generally the case. It is possible that larger EDs are inherently more difficult to operate efficiently. It is also possible that an ED can be too big to be efficient. This study contends that larger hospitals are not as dependent on their EDs and therefore do not prioritize emergency department services as a strategy for growth and differentiation. Regardless of the reason, large hospitals with expected larger EDs, are not as efficient in the ED.

Metropolitan Location. The study indicates that hospitals in metropolitan areas have a higher (worse) ED Efficiency Index than those hospitals not located in metropolitan areas. Generally, larger hospitals are located in larger communities, which are commonly metropolitan areas, although this is not always the case. It follows logic that larger hospitals in larger communities with larger volumes would have lower (worse) ED efficiency and higher incidents of overcrowding. It is possible that larger communities have more demand for ED services. Metropolitan areas could be under-bedded in ED services to meet population needs compared to non-metropolitan areas. It is also possible that metropolitan communities have higher rates of uninsured or

Medicaid eligible populations; but the study did not find a collinear relationship between these variables. These are all possible reasons for the observed relationship among variables in the study. Regardless of the reason, hospitals in metropolitan areas tend to have less efficient ED operations compared to hospitals not located in metropolitan areas.

Uninsured Population. The study indicates that hospitals in communities with higher uninsured population as a percent of total population have lower (worse) ED efficiency. This is expected as the literature supports that when a patient does not have health insurance, they are limited on access to care (D. Richards, 2000). Due to poor access, uninsured patients typically seek out not only emergent care but also non-emergent care from hospital EDs. Therefore, it is expected and consistent with the findings of this study that when hospitals are located in communities with larger percentage wise populations of uninsured, higher patient volumes in the ED will stretch resources and decrease ED efficiency.

Medicaid Eligible Population. As with higher uninsured populations, there is a statistically significant association between Medicaid eligible population and the ED Efficiency Index. In communities with a higher percent of population Medicaid eligible, it is expected that the hospitals in those communities will have a higher (worse) ED Efficiency Index. This finding is also as expected as the literature supports that Medicaid insured populations do not have the same access to care as patients that have other insurances (Fossett & Peterson, 1989; D. Richards, 2000).

It is also expected, and this study supports, that a higher uninsured population has a greater negative impact on ED efficiency than a higher Medicaid eligible population.

This is because the Medicaid population has better access to care than the uninsured population; and therefore, they are less dependent on the ED for care.

Other Study Findings of Interest

Investor Owned Hospitals More Likely to Use Strategies. The study findings show that investor owned hospitals are more likely to use one of the wait time communication strategies of this study compared to the non-investor owned hospitals. It is assumed that investor owned hospitals are embracing the strategies to grow volumes as well as to achieve operational efficiency to increase margins. Investor owned hospitals are typically part of a larger system of hospitals and those systems are held accountable by shareholders. As such, the importance of implementing growth and efficiency strategies increases to achieve expected margins. As investor owned hospitals are embracing these strategies, it is recommended that other hospitals should consider the same.

Investor Owned Hospitals More Likely to Post Wait Times. The study findings indicate that hospitals that post wait times on the hospital website are more likely to be investor owned. As with the previous finding, this is expected as investor owned hospitals are more likely to use strategies to improve efficiency and to grow volumes to improve margins. Of the two strategies, the study found that this strategy was selected more often than the reservation system strategy. As such, all hospitals that do not post wait times on the hospital website should evaluate if this strategy is appropriate for their organization.

ED Efficiency Proxy Sufficient

Based on the above findings and the expected reasons for those findings, the use and reliability of the proxy ED Efficiency Index in this study to measure ED efficiency performance is supported. The findings of this study were consistent with the literature knowledge related to expected relationships. Additionally, the bivariate analysis findings and the multiple regression findings are consistent. For these reasons, this study finds the ED Efficiency Index to be a reliable measure of ED efficiency and a reasonable predictor of higher risk of incidents of overcrowding.

The literature supports that a consistent measure of ED efficiency performance and overcrowding is needed and recommended (ACEP, 2012; D. Richards, 2000). Accordingly, it is recommended that all hospitals and the hospital industry at large adopt the method of this study to measure ED efficiency. By so doing, the industry would have a consistent method for measurement, which would allow a hospital to compare performance related to market competitors and the industry.

Differences in the two Study Strategies

Prior to a discussion of application of RCT to inform the findings above, a discussion of the differences in the two strategies is important. While both strategies of posting wait times on the hospital website and reservation systems share the apparent intent to engage patients in a more informed decision process of when and if to visit an ED for care, the two strategies differ in structure and function.

There are four differences to explore including amount of patient activity required, push versus pull of information to action, cost to the patient, and the impact of bounded rationality of RCT. First, the reservation system requires more activity on the part of the patient. With posting the ED wait times on the website, all that is expected of

the patient is that they receive and act on the information. With reservation systems, the patient is expected to log into the reservation system and choose an appointment time provided. It is possible that these additional actions required of the patient leads to a decrease in effectiveness of the reservation system compared to posting wait times on the website.

Second, the strategies differ related to push versus pull of information. Posting the ED wait times on the website pushes information to the patient so that the patient can make a decision of if and when to visit the ED. The reservation system requires a pull of information regarding the availability of the reservation times. The reservation time options are provided to the patient and then the patient chooses only from those times available. In other words, the patient arrival time to the ER is chosen largely by the hospital rather than chosen by the patient.

Third, there is the difference in cost. While both strategies are used to inform patients and to empower patients to make a rational decision regarding if and when to visit the ED, the two strategies have different costs to the patients. Related to posted ED wait times on the website, there is no cost to the patient except the time required to view the ED wait time posted. However, for the reservation system, the patient must register on the reservation system site and select a time provided to visit the ED.

Additionally, unlike the posting of the ED wait time strategy, many hospitals charge a fee for the patient to use the reservation system. This fee is approximately $15 to $30 per reservation appointment ("InQuicker," 2013). Therefore, there is a difference in cost of time and money between the two strategies. Consistent with RCT, it is

expected that the differences in cost for the two strategies will reduce the effectiveness of the reservation system compared to the ED wait times on website strategy.

Fourth and finally, it seems logical that from the perspective of RCT, bounded rationality is much more at play with the reservation system. The patient is required to be more active, invest time and money, and has less flexibility, as they must choose a time provided to visit the ED. With the reservation system, the patient must seek out more information and they may choose not to do so; and thus, their decision is more bounded.

The four differences between the two strategies clearly are differentiators. Accordingly, it is necessary to understand how RCT informs the study findings related to the two strategies and why one strategy is more effective in improving ED efficiency.

Rational Choice Theory

This study applies RCT to explore how patients are expected to respond to information related to anticipated ED wait times. The literature supports that patients do make decisions related to care and provider selection consistent with RCT (Deber et al., 1996; Howard et al., 2005). However, the literature does not address if this behavior applies specifically to selection of an ED for care. It is logical that this would occur, but such assumption requires discussion.

The study framework includes the use of RCT as a theoretical knowledge base that contributes to the findings. RCT is based on the concept that a consumer will make rational decisions based on the information available to make that decision (Coleman & Fararo, 1992). The literature supports that such application of RCT would be bounded by the information available and that patients will make a limited effort to seek out information to make a decision (Gigerenzer & Selten, 2002).

RCT Applies to Selecting an ED for Care. Patients largely choose if and when to visit an ED for care when alternatives to care exist. Such alternatives could include other EDs, urgent care centers, primary care offices, or other healthcare providers. This study contends that RCT does apply to patient selection of an ED for care. The literature is clear that patients will make rational decisions and the literature supports that RCT is applicable to healthcare decisions (Deber et al., 1996; Tversky & Kahneman, 1986). The literature supports that consistent with RCT patients will make a logical decisions related to when to receive care, selection of a provider, and assessment of alternatives. While the literature does not specifically address ED care, there is no evidence in this study that RCT does not apply to patient selection of an ED for care.

It is logical that a patient, when making a decision of if and when to visit an ED, will act on information available, conduct little research to gain more information, act bounded by the information known, and act rationally. Therefore, it follows that a patient will choose an ED based on wait time communication information available and will logically select alternatives when available and perceived as less costly than the ED. Such cost can be financial, but also, would be based on time cost associated with wait times.

Accordingly, this study supports and contends that RCT applies to if and when a patient will select an ED for care when alternatives exist. In other words, RCT contributes to this study that informed patients engaged in decision-making leads to an improvement in ED efficiency. Such patients therefore are contributing to the efforts of the hospital to improve ED efficiency by spreading volumes during times of high volume.

Such actions and participation is expected to improve efficiency and reduce overcrowding.

While the results of the study support two strategies with different statistically significant associations with the ED Efficiency Index, it is believed that RCT informs the findings of both strategies.

RCT and Wait Times Posted on Website. This study finds that the use of the strategy to post wait times on the website has a statistically significant association with the ED Efficiency Index. In other words, there is evidence in this study that informed patients engage in decision-making that contributes to improved ED efficiency. It is expected that when a patient is informed of anticipated long wait times to receive care in a particular ED, the patient will consider alternatives to care when available and make a rational decision of if and when to visit the ED. In other words, the patient is engaged in helping the hospital spread out arrival volumes and redirecting volumes to other alternative providers when the anticipated wait times are long. RCT seems to have logical application in this study to support that informed patients will engage in this activity. As a result of sharing information with the patient, the ED efficiency improves. Therefore, this study contends that RCT does inform the findings related to the strategy of posting ED wait times on the hospital website and the association with ED efficiency.

RCT and Reservation Systems. The study did not find this strategy to have a statistically significant association with the ED Efficiency Index. When considering RCT related to this finding, it would seem there is a conflict of application. However, the difference in the effectiveness of these two strategies to reduce overcrowding is likely due to differences in structure and function of the two strategies. Due to the differences,

patients use and perceive the information differently and bounded rationality is a contributing factor.

Reservation Systems require more action on behalf of the patient consistent with the concept of bounded rationality. The patient must invest more financial and time resources and accept a time option provided by the hospital to visit the ED. Further, the patient is only committed to arrive at the ED and be seen by a care provider within a short period of time from arrival. In other words, there is no commitment of the hospital to provide timely care after the first provider contact. While patients can anticipate being seen timely to initiate care there is no expectation that care will be time efficient.

Based on the study results, there is no evidence that hospitals that use a reservation system are more efficient than hospitals that do not use a reservation system. This is true for all four CMS time metrics and the ED Efficiency Index. The differences of the reservation system apparently create a difference in ED efficiency compared to posting wait times on the website. While the efficiency performance is different, RCT does inform the findings that the reservation system strategy does not apparently lead to improved ED efficiency.

Implications for Management Practice

Based on the findings of this research, there are multiple implications for management practice. The next section of this chapter will explore a number of these implications.

ED Efficiency is Important

The literature supports that overcrowding has major negative implications for the hospital and the patient. Therefore, all hospitals should dedicate resources to improve ED efficiency to reduce the occurrence of overcrowding. This study supports that by

providing more information to the patient of expected wait times in the ED, the patient will engage in rational decision making to participate in improving ED efficiency, which should lead to a reduction in overcrowding. ED efficiency is important to both hospital and patient. Thus, strategy use is correspondingly important to both parties.

Types of Hospitals Likely to Use a Strategy

Related to choosing an ED efficiency strategy, the types of hospitals that are likely to use a strategy is important to consider. The study findings support that smaller hospitals and investor owned hospitals are more likely to use one of the wait time communication strategies of this study. Further, the study supports that investor owned hospitals are more likely to post wait times on the hospital website and that metropolitan hospitals are more likely to use a reservation system. It is believed that such strategy selection decisions are consistent with the strategy theories of Porter, and Miles and Snow.

Porter's Generic Strategies includes the two strategies of efficiency and market share growth (Porter, 1985). Related to a hospital choosing an ED wait time strategy, both efficiency and market share growth strategies of Porter apply. A hospital desiring to improve efficiency would logically choose to share expected wait times with patients if that is expected to improve efficiency of operations. Related to market share growth, if a hospital believes it is more efficient in seeing patients in the ED and they have capacity to care for more patients, sharing wait times with patients would logically lead to increased volumes and market share. Therefore, a hospital that is adopting either of Porter's Generic Strategies would logically choose one of these ED wait time strategies.

Related to the Miles and Snow Typology, it is expected that hospitals that choose a role as an Analyzer are more likely to use an ED wait time communication strategy. As Analyzers, these organizations are hybrids of Prospectors and Defenders. By sharing wait times with patients in hopes of better patient engagement, these hospitals are defending their resources to achieve efficiency, and, it is likely that they are prospecting for market growth. It seems logical from the consideration of Porter's Generic Strategies and the Miles and Snow Typology that the posting of wait times is a shared strategy between efficiency and market growth when a hospital has capacity for additional ED volumes.

Strategy Selection by a Hospital

Given the above, this study explores why a particular hospital would choose a wait time strategy. A hospital could choose to use a strategy if they have too many patients for their resources. By sharing wait times, the hospital's objective is that patients would choose other alternatives for care when the hospital ED volumes are high. Conversely, if a hospital has capacity and wants to grow volumes, the hospital could share wait times, and if the wait times are attractive compared to alternatives, this would logically lead to an increase in volumes. From another perspective, a hospital that has capacity, but only at certain times, could share ED wait times to spread the arrival of patients to the ED for care. Therefore, all hospitals could share wait times in hopes of achieving a variety of patient volume objectives.

A hospital might also choose a strategy of posting ED wait times based on marketing objectives. Competition could lead to a hospital choosing a strategy whereby hospitals in a market could be reactively responding to the strategies of competitors. Alternatively, a hospital could choose a strategy to differentiate it from other hospitals in

the market. Both choices would take into consideration how the hospital compares in performance to competitors and how patients would perceive the hospital. Posting a consistently high wait time would not make sense to increase hospital volume. However, posting wait times during a time when the hospital ED is slower could lead to a near term increase in volume. Additionally, the same hospital posting wait times that are high may not have resources available for timely care of additional patients. Therefore, consistent posting of ED wait times could spread volumes through patient engaged decision-making. As a result, the wait time communication strategy could be an effective tool for increasing efficiency and market share.

Other Methods to Communicate ED Wait Times

Earlier in this study, other methods for sharing ED wait times with patients were explored. These included posting ED wait times on billboards, through mobile apps, and text messaging systems. This study focused only on ED wait times posted on hospital websites. It was noted that some hospitals use these other methods to share ED wait times. This study explores how these strategies differ. The use of billboards seems to be more of a marketing tool for top of mind awareness. It is not expected that a patient would drive to view a billboard in order to make a decision of if and when to visit an ED for care. It is logical that if ED wait time performance of a hospital was perceived as superior over a time compared to alternatives, then the patient may choose the hospital when a need for care arises. However, this decision would not necessarily be based on real time ED wait data.

Regarding mobile apps for sharing wait time data, this would seem to be designed for the patient that is more often using a smart phone for access to information rather than

using a computer with internet access. Therefore, this method is very similar to posting ED wait times on a hospital website and is likely easier to access when the patient is mobile and not at home or their place of work.

Third and finally, regarding the use of text messaging services, this requires the patient to send a text message and receive a text message of expected wait times at the ED. This is expected to function for the patient similar to the mobile app.

Regarding all four methods, the use of billboards is the only method that differs dramatically in how the patient receives and uses the information. Given the above, hospitals that post wait times on the hospital website should also consider doing the same on a mobile app and by text messaging. The important element of posting wait times is that the patient receives the information to make a decision. Therefore, hospitals should use multiple methods for sharing ED wait times. However, the use of billboards should only be used as a strategy for marketing top of mind awareness. This recommendation is supported by the study findings and the application of RCT.

Reasons to Choose to Offer a Reservation System

This research found that the use of reservation systems did not have a statistically significant association with the ED Efficiency Index; yet, hospitals choose to offer a reservation system for a variety of reasons. One report found that the primary objective was to increase patient satisfaction as CMS has initiated incentives for hospitals that achieve certain metrics ("No more waiting in the ED? Hospitals introduce online reservations," 2012). Achieving these incentives can improve the hospital bottom line. Further, hospitals can also use reservation systems to allow patients to wait at home rather than in the ED waiting room (iHealthBeat, 2011).

Another reason to offer a reservation system is for marketing purposes (Isger, 2011). From a competitive perspective, the reservation system could be an alternative to posting the actual wait times. If a hospital's actual efficiency was poor compared to competitors, it might not choose to share these times with patients. In this situation, a hospital could use a reservation system as a response to a competitor posting its ED wait times on the website.

Hospitals also could use a reservation system to compete with alternatives for care, including urgent care and primary care practices. The reservation system service InQuicker is used by a number of these alternative providers to an ED for care ("InQuicker," 2013). Finally, a reservation system could be used to improve efficiency of ED operations (Isger, 2011; "No more waiting in the ED? Hospitals introduce online reservations," 2012). The objective is to spread out arrival times for patients that can wait for care.

Hospitals do not Use Both Strategies

During data gathering, it was noted that of 176 sample hospitals in Florida, 80 hospitals posted wait times on the hospital website and 26 hospitals used a reservation system. Curiously, none of these hospitals used both strategies. This study contends that while both strategies are designed to engage patients in decision making to affect ED efficiency, selection of one strategy is based on the overall strategic objectives of the hospital. Thus, hospitals do not choose both strategies.

The differences in overall hospital strategy can be explained in four categories including efficiency priority, volume growth objective, competitive differentiation, and Porter's Generic Strategies selection. First, in terms of efficiency priority, hospitals that

choose either wait time communication strategy are interested in efficiency. Based on the study findings, it seems logical that hospitals that post wait times on the website prioritize efficiency more so than hospitals that use a reservation system. This is based on the finding that hospitals that post wait times on the website do in fact have better efficiency than hospitals that use a reservation system. Hospitals that choose the reservation system may desire improved efficiency but they do not believe strongly enough in efficiency performance to share their performance with the public. In other words, these hospitals are selecting other operational objectives to have priority over ED efficiency.

Second, related to volume growth objectives, hospitals that post ED wait times on the website are seemingly interested in broad growth in volumes that result from real and perceived beliefs of patients that the ED is an efficient alternative for care. This could be designed to compete with not only other hospitals but to compete with urgent care and primary care offices for non-emergent patients. Conversely, hospitals that use reservation systems desire to grow volumes but only from those patients that have the ability and willingness to pay for a reservation and pay for the care they receive. In other words, the posting wait times on website strategy is for broad growth while the use of the reservation system is a selective growth strategy for those likely insured.

Third, related to competitive differentiation, hospitals that post wait times on the website desire an aggressive competitive advantage over alternative providers. They want to increase volumes and are willing to compete on performance to achieve this goal. Conversely, hospitals that use reservation systems seemingly are not interested in competing or differentiating on performance but as an alternative to performance. Thus, they differentiate competitively by introducing a unique service of a reservation system to

selectively grow and compete. By offering this service, they offer patients and alternative to visit the ED with a scheduled time to arrive. This is designed not only to compete with other hospitals but to compete also with urgent care centers and primary care offices. By so doing, they create a differentiating advantage over hospitals that do not offer this service and a comparable competing advantage with providers that offer scheduled times for care. Therefore, it is possible that the reservation system is both an offensive growth strategy and a defensive strategy to compete with alternatives to ED care.

Fourth and finally, the selection is based on different objectives consistent with Porter's Generic Strategies of low cost and differentiation (Porter, 1997). At the heart of Porter's low cost strategy is efficiency. Hospitals that are using the wait times on the website strategy are carefully pursuing both strategies of low cost and differentiation while avoiding being "stuck in the middle" (Porter, 1979). Conversely, hospitals that are selecting the reservation system strategy are more interested in differentiation. Thus, the difference in strategy selection is a result of differences in prioritization of Porter's generic strategies.

The above differential categories comparing the two wait time communication strategies are consistent with the findings of this study and informed by RCT. Regardless of the strategy selected, the hospitals are interested in engaging patients to improve ED operations and efficiency albeit with different prioritization of the objectives for these improvements. In short, both strategies have a place in the market but the reasons for choosing one strategy over the other are due to the differences in the strategies and the objectives of the hospital.

Limitations of the Study

Seven limitations were identified as having a potential impact on the findings of the study. These limitations are summarized below in no particular order.

First, this study only applies to acute care hospitals located in Florida. While a larger study population of a region of the country or the entire country was considered, the necessity for study of individual hospital websites for strategies employed by those hospitals limited the opportunity to choose a larger sample size. However, it should be noted that with 60% of the hospitals in Florida using one of the two strategies, it is logical that Florida hospitals would be selected for the sample for this study.

Second, at the time of this study, there is only one complete year of CMS data available related to ED throughput metrics. As explained previously, this is due to new reporting requirements of CMS in the first publicly available data in 2012. Therefore, the dependent variable of ED Efficiency Index has a short period of available data and it is not possible to compare periods or study performance over more than a twelve-month period.

Third, as there is only one year of CMS ED throughput data, it is not possible to measure ED efficiency pre and post wait time communication strategy implementation by a hospital. While this is interesting potential research, such an opportunity is not currently an option.

Fourth, there is not a consistent and widely accepted definition of ED efficiency and overcrowding in the literature. As such, this study relies on a proxy for ED efficiency in the form of an indexed average of the four CMS ED throughput metrics into a new calculated variable of ED Efficiency Index. While it is believed and supported that

the proxy was sufficient for this study, the use of this particular proxy is not supported in the literature.

Fifth, the use of the proxy in any study is limiting. For this study, ED efficiency could be the result of many factors. As such, a situation of poor ED efficiency and resulting overcrowding could be the result of many micro and macro environmental factors other than those variables included in this study.

Sixth, there are differences in time periods for variables, which create a limitation. The data from CMS and ARF contributed multiple variables to this study. While the CMS and ARF data sets, were the most recent available, some variables within these data sets varied by year collected. This research included the most recently available data for each variable but some time periods differed within the CMS and ARF data sets. For example, ARF included the most recent data for Medicaid eligibility as 2008; but the most recent data related to uninsured population was 2012. Related to all variables, 2013 data was used if available. If 2013 data was not available for a variable, the most recent data available was used.

Seventh and finally, the data available and collected related to hospital strategy use had limitations. Such strategy research was conducted by the author of this study. The individual websites of hospitals were surveyed in November 2014 and it had to be assumed that hospitals were using the same strategies during the CMS ED throughput data period, which was from July 2012 through June 2013. It would have been ideal to collect the strategy data during the CMS data period but such opportunity was not possible for this study.

While this study has limitations, it is not believed that any of the limitations substantially discount or devalue the findings and conclusions.

Future Research Recommended

It is recommended that additional research build on this study's findings and expand opportunities for application. Such recommended research includes the following in no particular order.

First, it is recommended that as additional time periods of data for ED throughput performance is publicly available from CMS, that multi-year studies are conducted to note trends over time. This will allow for paired comparison of hospital performance in the same hospital in the same community.

Second, it is recommended that future studies compare ED Efficiency Index performance pre and post strategy implementation at multiple hospitals. Such study would identify more specifically the impact of the strategy on performance.

Third, it is recommended that future research define a common industry standard for measuring ED efficiency and overcrowding. By so doing, the industry would have the opportunity to embrace a common definition for more extended research into developing other theoretical frameworks for management strategy application. The ED Efficiency Index proved reliable for this study but further refinement of this measurement is recommended for broader application.

Fourth, it is recommended that future research study actual patient decision making prior to visiting an ED. By so doing, the application of RCT by patients can be further tested for application in ED selection based on the availability of information to

the patient. Further, patient decision making could be studied related to ED selection between hospitals that employ different strategies for patient decision engagement.

Fifth and finally, it is recommended that this study is updated at such time that the CMS ED throughput data is available for the period July 2014 through June 2015, the one-year period that would include the time that strategy use data was gathered. The author intends to perform this study in the future and update the findings.

Conclusion and Strategy Recommendations

This study affirmatively answers the question, "Do ED wait time communication strategies improve patient throughput efficiency?" Consistent with the findings of this study, RCT is a factor in patient selection of an ED for care. Further, this study supports that hospitals should post ED wait times on the hospital website and provide the same information through other methods designed to inform patients of anticipated wait times such as text messaging and mobile apps. With anticipated wait time information, the patient has the opportunity to engage in decision making that will positively affect ED efficiency and lead to a logical decrease in the risk of ED overcrowding. However, the use of reservation systems should not be viewed as a strategy to improve ED efficiency and reduce the risk of overcrowding. Rather, reservation systems should be used as a marketing differentiation strategy when ED efficiency has not been achieved or is not a priority.

Healthcare decision makers are encouraged to find and implement better ways to inform patients of hospital performance metrics to create the opportunity for greater patient decision engagement. While this study has been focused on one element of patient engagement, the industry leaders should explore how patient engagement,

consistent with RCT, would lead to better outcomes for hospitals and their patients. It is believed that engaged patients can and will contribute through effective decision making to help hospitals improve performance across many metrics.

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Appendix

Independent Review Board (IRB) Approval Form

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

Institutional Review Board for Human Use

DATE: 12/11/14

MEMORANDUM

TO: Tom McDougal
Principal Investigator

FROM: Cari Oliver
Assistant Director
Institutional Review Board for Human Use (IRB)

RE: Request for Determination—Human Subjects Research
IRB Protocol #N141125006 – Emergency Department Wait Time Strategies and Overcrowding

A member of the Office of the IRB has reviewed your Exempt application with the above title, and it was determined that the application **qualifies for the designation of Not Human Subjects Research**.

The reviewer has determined that this proposal is **not** subject to FDA regulations and is **not** Human Subjects Research. Note that any changes to the project should be resubmitted to the Office of the IRB for determination.

470 Administration Building
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205.934.3789
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irb@uab.edu

The University of
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Mailing Address:
AB 470
1720 2ND AVE S
BIRMINGHAM AL 35294-0104

Project Revision/Amendment Form

Form version: June 26, 2012

In MS Word, click in the white boxes and type your text; double-click checkboxes to check/uncheck.

- **Federal regulations require IRB approval before implementing proposed changes. See Section 14 of the IRB Guidebook for Investigators for additional information.**
- **Change means any change, in content or form, to the protocol, consent form, or any supportive materials (such as the Investigator's Brochure, questionnaires, surveys, advertisements, etc.). See Item 4 for more examples.**

1. Today's Date	02/18/2015	10986

2. Principal Investigator (PI)

Name (with degree)	Tom McDougal	Blazer ID	tommcd
Department	Health Services Administration	Division (if applicable)	
Office Address		Office Phone	205-434-0445
E-mail	tommcd@uab.edu	Fax Number	

Contact person who should receive copies of IRB correspondence (Optional)

Name	Elizabeth Hendrix	E-Mail	ehendrix@uab.edu
Phone		Fax Number	
Office Address (if different from PI)			

3. UAB IRB Protocol Identification

3.a. Protocol Number	N141125006
3.b. Protocol Title	Emergency Department Wait Time Strategies and Overcrowding

3.c. Current Status of Protocol—Check ONE box at left; provide numbers and dates where applicable

- ☐ **Study has not yet begun** — No participants, data, or specimens have been entered.
- X **In progress, open to accrual** — Number of participants, data, or specimens entered:
- ☐ **Enrollment temporarily suspended by sponsor**
- ☐ **Closed to accrual, but procedures continue as defined in the protocol (therapy, intervention, follow-up visits, etc.)**
  - Date closed:
  - Number of participants receiving interventions:
  - Number of participants in long-term follow-up only:
- ☐ **Closed to accrual, and only data analysis continues**
  - Date closed:
  - Total number of participants entered:

4. Types of Change

Check all types of change that apply, and describe the changes in Item 5.c. or 5.d. as applicable. To help avoid delay in IRB review, please ensure that you provide the required materials and/or information for each type of change checked.

- ☐ **Protocol revision (change in the IRB-approved protocol)**
  In Item 5.c., if applicable, provide sponsor's protocol version number, amendment number, update number, etc.
- ☐ **Protocol amendment (addition to the IRB-approved protocol)**
  In Item 5.c., if applicable, provide funding application document from sponsor, as well as sponsor's protocol version number, amendment number, update number, etc.
- ☐ **Add or remove personnel**
  In Item 5.c., include name, title/degree, department/division, institutional affiliation, and role(s) in research, and address whether new personnel have any conflict of interest. See "Change in Principal Investigator" in the IRB Guidebook if the principal investigator is being changed.
  - ☐ **Add graduate student(s) or postdoctoral fellow(s) working toward thesis, dissertation, or publication**
    In Item 5.c., (a) identify these individuals by name; (b) provide the working title of the thesis, dissertation, or publication; and (c) indicate whether or not the student's analysis differs in any way from the purpose of the research described in the IRB-approved HSP (e.g., a secondary analysis of data obtained under this HSP).
- ☐ **Change in source of funding; change or add funding**
  In Item 5.c., describe the change or addition in detail, include the applicable OSP proposal number(s), and provide a copy of the application as funded (or as submitted to the sponsor if pending). Note that some changes in funding may require a new IRB application.

☐	**Add or remove performance sites** In Item 5.c., identify the site and location, and describe the research-related procedures performed there. If adding site(s), attach notification of permission or IRB approval to perform research there. Also include copy of subcontract, if applicable. If this protocol includes acting as the Coordinating Center for a study, attach IRB approval from any non-UAB site added.
☐	**Add or change a genetic component or storage of samples and/or data component—this could include data submissions for Genome-Wide Association Studies (GWAS)** To assist you in revising or preparing your submission, please see the IRB Guidebook for Investigators or call the IRB office at 934-3789.
☐	**Suspend, re-open, or permanently close protocol to accrual of individuals, data, or samples (IRB approval to remain active)** In Item 5.c., indicate the action, provide applicable dates and reasons for action; attach supporting documentation.
☐	**Report being forwarded to IRB (e.g., DSMB, sponsor or other monitor)** In Item 5.c., include date and source of report, summarize findings, and indicate any recommendations.
☐	**Revise or amend consent, assent form(s)** Complete Item 5.d.
☐	**Addendum (new) consent form** Complete Item 5.d.
☐	**Add or revise recruitment materials** Complete Item 5.d.
x	**Other (e.g., investigator brochure)** Indicate the type of change in the space below, and provide details in Item 5.c. or 5.d. as applicable. Include a copy of all affected documents, with revisions highlighted as applicable.

▶ Change in Title to "Emergency Department Wait Time Communication Strategies and Patient Throughput Efficiency." Ad SIRB cur

5. Description and Rationale

In Item 5.a. and 5.b, check Yes **or** No **and see instructions for** Yes **responses.**
In Item 5.c. and 5.d, describe—and explain the reason for—the change(s) noted in Item 4.

☐Yes XNo	**5.a. Are any of the participants enrolled as normal, healthy controls?** If yes, describe in detail in Item 5.c. how this change will affect those participants.
☐Yes XNo	**5.b. Does the change affect subject participation, such as procedures, risks, costs, location of services, etc.?** If yes, FAP-designated units complete a FAP submission and send to fap@uab.edu. Identify the FAP-designated unit in Item 5.c. For more details on the UAB FAP, see www.uab.edu/cto.

5.c. Protocol Changes: In the space below, briefly describe—and explain the reason for—all change(s) to the protocol.

▶

5.d. Consent and Recruitment Changes: In the space below,
(a) describe all changes to IRB-approved forms or recruitment materials and the reasons for them;
(b) describe the reasons for the addition of any materials (e.g., addendum consent, recruitment); and
(c) indicate either how and when you will reconsent enrolled participants or why reconsenting is not necessary (not applicable for recruitment materials).

Also, indicate the number of forms changed or added. For new forms, provide 1 copy. For revised documents, provide 3 copies:
- **a copy of the currently approved document (showing the IRB approval stamp, if applicable)**
- **a revised copy highlighting all proposed changes with "tracked" changes**
- **a revised copy for the IRB approval stamp.**

▶

Signature of Principal Investigator TRM Date 02/18/2015

FOR IRB USE ONLY

☐ Received & Noted ☐ Approved ~~Expedited~~ NHSR* ☐ To Convened IRB

Signature (Chair, Vice-Chair, Designee) Date 3/4/15

DOLA NA

Change to Expedited Category Y / N / NA

*No change to IRB's previous determination of approval criteria at 45 CFR 46.111 or 21 CFR 56.111