ABSTRACT

THE EFFECT OF IMPLEMENTING A FLOW COORDINATOR ON EMERGENCY DEPARTMENT THROUGHPUT

By

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Emergency department (ED) overcrowding is a widespread and multifaceted problem caused by many factors including overutilization of the ED by non-emergency patients and a decreasing number of available ED beds nationwide. The flow of patients through the ED is known as throughput process, and many interventions to improve the efficiency have been described in the literature including sorting patients by acuity or condition, placing providers in the triage area, using a flow expeditor role and various technology applications.

This retrospective, comparative study assessed the implementation of an experienced registered nurse in the role of flow coordinator, with the focus solely on moving patients efficiently through their ED course. Three throughput metrics were used to measure ED efficiency before and after the role implementation: discharge length of stay (DCLOS), left without being seen (LWBS) and elopements. While no difference was seen in any of the three throughput metrics with regard to the sample as a whole, there were statistically significant differences between each of the throughput metrics

when the sample was separated by age and gender. Additionally, though not statistically significant at the $p < .05$ level, patient satisfaction improved after the flow coordinator was implemented. These findings add to what is known about the science of ED throughput processes as they suggest a flow coordinator may improve patient satisfaction, and interventions to improve flow should be individualized to patients based on their age and gender.

THE EFFECT OF IMPLEMENTING A FLOW COORDINATOR ON EMERGENCY DEPARTMENT THROUGHPUT

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ALOS	Admission Length of Stay
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
CMS	Centers for Medicare & Medicaid
D2P	Door to Provider
DCLOS	Discharge Length of Stay
ED	Emergency Department
LWBS	Left Without Being Seen
NP	Nurse Practitioner
PA	Physician Assistant
PIT	Provider in Triage
POC	Point of Care
PSF	Patient-Specific Flow
RTT	Rapid Triage & Treatment
VBP	Value-Based Purchasing

CHAPTER 1

INTRODUCTION

The problem of overcrowding in emergency departments (EDs) has grown significantly over the last two decades into a national crisis, with the number of patient visits increasing by 26% between 1993 and 2003, according to the Institute of Medicine's (IOM) 2006 report, *Hospital Based Emergency Care: At the Breaking Point.* Further fueling this crisis is the decrease of nearly 200,000 ED beds resulting from the closing of 425 emergency departments during the same time period (IOM, 2006). Additionally, an increased reliance on EDs for routine health care for uninsured patients, and the challenges of accessing health care quickly and efficiently by patients who do have insurance have contributed to higher volumes of patient visits (Asplin et al., 2003; IOM, 2006). The disparity between the increasing demand for ED resources and decreasing available capacity is at the heart of the crisis of overcrowding in EDs throughout the nation.

In an effort to address the challenges of overcrowding, various care delivery models have attempted to optimize the efficient flow of patients into, through and out of the ED, a concept referred to in the field of emergency medicine as the "throughput process." The models aimed at improving throughput have traditionally focused on three methods: (1) separating patients by acuity level into acute and non-acute treatment areas, and (3) using technological advances to expedite diagnostics and treatment results for ED patients (Storrow et al., 2009; Wiler et al., 2010). While these interventions have shown promise in improving efficiency of patient flow through the ED, researchers have cited the need for more study to determine the most effective models to improve ED throughput (Oredsson et al., 2011; Wiler et al., 2010).

Background

The problem of ED overcrowding is the result of nationwide trends in the health care environment including hospitals choosing to close EDs due to poor profitability, and an unmanageable surge in volume due to limited access for patients in the primary care environment that end up seeking care in EDs. In their study aimed at determining the causes of ED closures in the United States, Hsai, Kellerman and Shen (2011) investigated all of the EDs that closed their doors from 1990 to 2009. During the study period, 1,041 EDs shut down and only 374 new EDs opened, for a net loss of 27% of ED bed capacity nationwide. The most significant contribution of their study was the identification of the factors most highly associated with ED closure, including for-profit ownership status, location in a competitive market, safety net status, and a low profit margin (Hsai et al., 2011). As previously mentioned, while the number of available EDs has decreased, volume of patients seeking care has increased significantly. Of that larger volume of patients seeking care in the ED, a disproportionately higher number of those people were either publically insured or uninsured, creating even more of a financial burden on EDs already struggling to keep their doors open (Hsai et al., 2011).

Adding to the strain created by fewer EDs, a rising number of ED patients, and a poor payer mix, is the trend toward non-emergent patients seeking care in the ED (Pitts, Carrier, Rich & Kellerman, 2010). From 2001 to 2004, Americans made 1.09 billion visits to outpatient services to seek medical care. Of those visits, 28% were to hospital EDs, with many of the complaints classified as "non-emergent." The main reason for the trend toward ED utilization for primary care issues was the lack of timely access to care, especially after business hours and on the weekends (Pitts et al., 2010). The data paints a bleak picture for EDs that remain open for business: a surging volume due to neighboring EDs closing, a deteriorating payer mix and an increase in patients that should be receiving services in primary care settings but lack timely access, and so utilize the ED for basic health care needs (Asplin et al., 2003; Pitts et al., 2010).

Problem

The consequences of overcrowding and prolonged wait times in the ED are well established in the research literature and affect not only the quality of the care patients receive, but also satisfaction level and the overall length of stay in the hospital (Miro et al., 1999; Richardson, 2006; Sprivulis, Da Silva, Jacobs, Frazer & Jelinek, 2006). Effects of crowding in the ED include poorer clinical outcomes, including a correlation between high ED volumes and higher patient mortality rate and delays in receiving time-sensitive interventions for critical conditions like stroke, heart attack, pneumonia and prompt pain management (Fee, 2007; Hwang et al., 2008; Kulstad & Kelley, 2009; Schull, Vermeulen, Slaughter, Morrison & Daly, 2004). Further, the patient's length of stay in the ED has been shown to affect his or her entire hospital stay, as longer hospitalizations typically occur when time in the ED exceeds 24 hours (Bernstein et. al, 2008). Not only are patient clinical outcomes directly affected by ED overcrowding, but prolonged wait times have also been shown to be the driving reason for dissatisfaction in patients who access emergency care (Beaudroux & O'Hea, 2004; Pines, Decker & Hu, 2012; Vieth & Rhodes, 2008).

Aside from the impact on quality, timely care and patient satisfaction, ED overcrowding has a distressing impact on ED staff morale. The "work environment" has been cited as a leading cause of stress among ED employees, with workload and overcrowding topping the list of contributing factors (Healy & Tyrrell, 2011). Additionally, the presence of "burnout," a widely used concept in organizational psychology defined as emotional exhaustion, depersonalization and a reduced sense of personal accomplishment, is widespread among nurses in EDs, with the highest contributing factor being a work environment characterized by overcrowding, high demands and lack of adequate resources (O'Mahoney, 2011). While the effect of overcrowding on ED staff may seem to be a separate issue from the patient's experience, burnout among nurses has been shown to impact the likelihood of their retention and subsequent impact of patient care quality and satisfaction, suggesting a positive feedback loop between the reaction of nurses to the level of stress in the work environment and the patients' satisfaction with their hospital experience (Aiken, Clark, Sloane, Sochalski & Silber, 2002). Each of these negative outcomes of ED overcrowding, poorer quality of care, reduced patient satisfaction, and staff burnout, compound the already challenging situation that EDs face in the United States. This reality has led the federal government and accrediting agencies to put the burden on hospitals to address the problem (Balik, 2011; Raso, 2013).

Significance

Reducing ED overcrowding and creating efficiencies in the throughput process have a direct impact on the public image and financial performance of hospitals (Bayley et al., 2005; Handel & McConnell, 2008; Tekwani, Keerem, Mistry, Sayger & Kulstad, 2012). Recent regulations from accrediting agencies such as The Joint Commission and the federal agency the Centers for Medicare and Medicaid Services (CMS) have focused on hospital responses to ED overcrowding. The regulations from these two agencies have raised the standard of performance to maintain accreditation, and have tied financial performance to the patient's perception of their care (cms.gov, 2012).

As of January 1, 2014, The Joint Commission revised the "patient flow standards" (Leadership standard 04.03.11 and Patient Care standard 01.01.01) to include additional requirements for hospital EDs. In addition to the existing elements related to goal setting and data tracking of patient flow, EDs are now expected to meet the goal of holding admitted patients in the ED for no more than 4 hours, a concept referred to in the field of emergency medicine as "boarding" ("Approved Standards," 2012). Additionally, EDs must have a written plan for the boarding of psychiatric patients requiring services not offered at the facility. As the expectations to achieve accreditation from the Joint Commission become more stringent, EDs are forced to confront the problems of overcrowding and pursue any available intervention to improve throughput ("Approved Standards," 2012).

In addition to the stringent requirements for throughput performance to maintain accreditation, recent studies have shown that ED crowding leads to significant revenue loss for hospitals (Bayley et al., 2005; Falvo, Grove, Stachura & Zirkin, 2007; Handel &

McConnell, 2008). Overcrowding leads to reduced capacity to treat patients, causes diversion of ambulances and increases patient elopements based on prolonged ED wait times. Lastly, ED overcrowding contributes to revenue loss for hospitals that range from more than $200 per patient based on a study that measured the impact of wait times greater than 3 hours (Handel & McConnell, 2008), and up to $119,000 weekly, from another study assessing the connection between frequency of ambulance diversion and loss of revenue opportunity (Falvo et al., 2007).

Adding to the challenges of maintaining accreditation and limiting revenue loss is the increased focus by the federal government on the patient's experience during their hospital stay. A 2 year study of patients directly discharged from the ED, found that ED overcrowding, as measured by volume above the average for time of day and day of the week, was inversely correlated with patient satisfaction scores (odds ratio [*OR*] 0.32, 95% confidence interval, [*CI*] 0.17 to 0.59, $p < 0.001$), suggesting that overcrowding is associated with the patient's satisfaction with their care experience in the ED (Tekwani et al., 2012). Further, changes to hospital reimbursement established by the value-based purchasing (VBP) model currently tie 30% of potential funds from CMS to patient satisfaction scores, which reflect the quality of the patient experience (Raso, 2013). With the financial bottom line now impacted by health care consumers' perception of their care, patient satisfaction has moved from one of many priorities to a top concern for hospital executives (Balik, 2011).

Beyond the financial incentives that the federal government has provided for hospitals to improve patient satisfaction, the health care environment has increasingly taken on a consumer-mentality where patients have access to quality measures and patient satisfaction scores empowering them to make choices about their care based on these publically-accessible measures (Christianson, Ginsburg & Draper, 2008). These patient choices will be influenced by the experience in the ED offering an opportunity for the ED to establish a positive experience for the patient throughout his or her hospital admission. In light of the significant financial risks facing hospitals and the impact of public reporting of satisfaction measures, every aspect of care that influences the patient's satisfaction must be thoroughly examined. As such, common predictors of patient satisfaction in the ED, including quality of interpersonal interaction with providers, perception of provider skill level, and wait times, require focused attention to assure a positive experience for patients (McCarthy et al., 2011). One specific intervention that could impact the wait time indicator is process flow redesign and improving efficiencies in throughput which may, in turn, improve patient satisfaction (Boudreaux & O'Hea, 2004).

The implementation of a flow coordinator is a flow redesign intervention that could potentially impact ED throughput and improve both patient satisfaction and financial performance (Bayley et al., 2005; Falvo et al., 2007; Handel & McConnell, 2008). The significance of this intervention lies in the potential of this role to impact operational efficiency, financial viability and patient satisfaction. Progress in any of the aforementioned areas would effectively position the ED as a more economical and sustainable health care service, which could help alleviate the overcrowding burden and place EDs in an improved position to compete in the current healthcare environment. Hsai et al., 2011).

Purpose

The purpose of this study is to measure the effect of implementing a flow coordinator on the following ED throughput metrics: (1) discharge length of stay (DCLOS), (2) percentage of patients who left without being seen (LWBS), and (3) percentage of patients who elope from the ED, before care and discharge are complete. These three metrics were chosen for study because of their connection to efficiency, patient satisfaction, financial sustainability and elopements (Polevoi, Quinn & Kramer, 2005; Rowe et al., 2006). The identified metrics are the three main challenges in the ED that are directly impacted by prolonged wait times and overcrowding. The flow coordinator is an experienced registered nurse who does not have specific patient care duties, but is responsible for facilitating the course of patients through the ED based on acuity or phase of treatment from arrival, during the diagnostic and treatment phases, and through discharge, admission or transfer (Appendix A). Development of the flow coordinator's role was based on current literature identifying various care delivery models that target throughput metrics, which include funneling flow by patient type, expediting the triage process, and staffing specialty roles focused on throughput (Feehan & Smolin, 2006; Handel, Workman & Fu, 2011).

CHAPTER 2

LITERATURE REVIEW

This chapter will provide a discussion of the input-throughput-output conceptual model of emergency department (ED) crowding (Asplin et al., 2003) with the discussion focused on how the flow coordinator role integrates into the conceptual model to improve throughput efficiency. Further, a comprehensive review of the literature related to ED workflow issues will be presented including the following: (1) The patient-specific flow (PSF) model, which separates patients by either acuity or geographical location, will be explained, along with its effect on ED throughput. (2) The rapid triage (RT) model, focused on combining separate provider tasks into a simultaneous triage process, will be outlined. (3) The provider in triage (PIT) method, which places either a physician or mid-level provider, such as a nurse practitioner (NP) or a physician's assistant (PA) at the initial triage point of the ED, will be discussed. (4) An intervention centered on the use of a clinical role to improve efficiency will be described. (5) Technological impact, in the form of point of care (POC) testing, bedside imaging and mapping software, will be summarized as it relates to improvements in ED efficiency. The chapter will conclude with a discussion of the identified gaps in the literature, along with the integration of the input-throughput-output conceptual model of ED crowding, which provide the underpinnings for the proposed study.

Conceptual Model of ED Overcrowding

The problem of ED overcrowding and the resulting challenges to throughput are best understood using the conceptual model of ED crowding developed by Asplin et al. (2003). Asplin et al.'s model takes a systems approach to the throughput process, and has gained traction in the literature as an effective tool to understand the elements that enter the ED system, how those factors are managed through the patient flow process, and how the elements leave the system. This model is divided into three phases describing the flow of patients into and out of the ED: the input phase (divided into the three patient types who utilize the ED), the throughput phase (the stages of care that occur when the patient is physically in the ED) and the output phase (the destination of patients from the ED once their treatment is complete).

Asplin et al.'s model breaks the input phase into three main patient types: (1) emergency care, including the ill and injured from the community, and the seriously ill referred from primary care sources, (2) unscheduled urgent care, created by a lack of capacity in the ambulatory care system and patients using the ED for care that is considered more immediate and convenient, and (3) safety net care, consisting of vulnerable populations such as the uninsured and those with barriers to accessing care such as transportation or financial need. The second and third groups, unscheduled urgent care and safety net care, have contributed disproportionately to the rise in ED visits over the last two decades, and are largely responsible for the high demand funneling into the input phase of the system (Hsai et al., 2011; Pitts et al., 2010).

Theoretical Framework

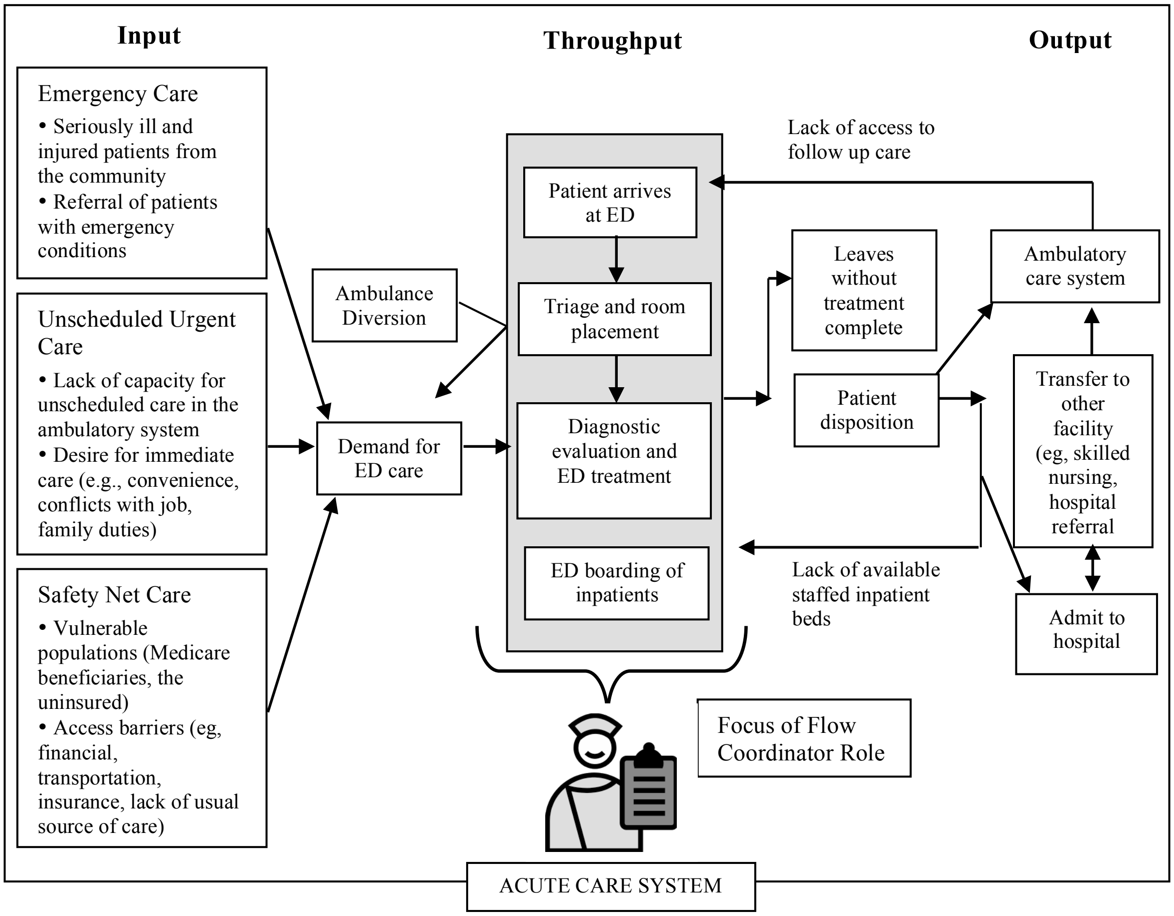


FIGURE 1. The input-throughput-output conceptual model for ED crowding adapted from Asplin et al. (2003).

The throughput phase of the model is divided into four segments: arrival at the ED, triage and room placement, diagnostic evaluation and ED treatment, and patient disposition (Asplin et al., 2003). The throughput phase is the point in the process where ED care is rendered, including the initial triage process, provider assessment, treatment and diagnostic testing. All of the five interventions, aimed at decreasing the overcrowding burden, included in the ensuing literature review occur in the throughput phase of Asplin et al.'s model. Further, the flow coordinator role is active in this phase of the model, beginning with the patient's arrival, facilitating triage and room placement, and ensuring diagnostics and treatment are initiated efficiently and resulted timely. The flow coordinator's role in this particular study is focused on preventing fallout in the throughput phase resulting from crowding and prolonged wait times, including patients that leave before they are seeing by a provider (LWBS), patients that leave prior to discharge (elopements) and extended length of stay in the ED for patients who are eventually discharged (DCLOS).

The output phase of Asplin et al.'s (2003) model begins when the provider makes the decision regarding the patient's disposition to follow up care, whether it is a referral to the ambulatory care system, transfer to another facility, or admission to the hospital. The point at which the patient leaves the ED ends the throughput phase and initiates the output phase. While many initiatives at the community level have focused on the output phase of the acute care system, specifically, where patients go after treatment, the focus of this study is on the throughput phase of the process, when the patient has arrived at the ED and is triaged, placed into a room, evaluated, treated and eventually discharged from the ED for appropriate follow up. Any surge of volume in the input phase results in overcrowding very quickly if patients are not moving through the throughput phase efficiently. The limited influence over the input and output phases of the system has led ED management and hospital administrators to focus heavily on the throughput phase of ED care, the point over which they have the most control (Oredsson et al., 2011). The flow coordinator role was designed as a clinical leader whose main duty was to keep patients moving through each phase of this process as efficiently as possible. The success of the flow coordinator can be measured in Asplin et al.'s model by a decrease in the number of patients who fall into the "Leaves Without Treatment Complete" (the equivalent of "elopement" in this study) category and an overall decrease in the length of stay in the ED, considered to be the throughput phase of the model. Similarly, in this study, parallel outcomes will be measured that reflect improved efficiency: a decrease in the LWBS, which is typically driven by overcrowding and long wait times, a decrease in overall length of stay for discharged patients (DCLOS), and a decrease in elopements.

Background Literature

A literature review was conducted to assess the current state of the science related to throughput issues in the ED and to identify any gaps in the evidence. The review was conducted for the period between 1999 and 2013 using the online databases, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed and MEDLINE, using the search terms emergency department, throughput, elopement, left without being seen, efficiency, fast track, rapid triage, length of stay, provider in triage, overcrowding, patient flow and patient satisfaction. In the literature, the most commonly applied strategies to manage ED overcrowding and improve throughput center around five different initiatives: patient-specific flow (PSF) models, rapid triage (RT), provider in triage (PIT), the flow expeditor model, and the use of technology (Wiler et al., 2010). While each of these models and the use of technology are applied uniquely to their settings, the general concepts are universally shared throughout the United States and in many other countries in an attempt to address the challenges common to EDs (Oredsson et al., 2011; Wiler et al., 2010).

Patient-Specific Flow

For ED managers, one of the primary strategies to increase throughput times is to design the layout of the ED to function most efficiently for different types of patients. This is usually achieved by splitting high acuity versus low acuity patients, or by creating smaller geographical pods staffed by teams that care for either the high or low acuity patient groups (Baker, Shupe & Smith, 2013). The idea behind splitting patient types is to expedite treatment of lower acuity patients that require fewer resources to treat but may disproportionately occupy valuable ED treatment areas (Oreddson et al., 2011). Three applications of the PSF model include the zoning system, fast track and vertical flow.

Zoning system. At a well known university hospital in New Jersey, hospital administrators instituted a zoning system in achieve a "15/30" guarantee that they made to patients, that they would be seen by a practitioner within 15 minutes of arrival and would receive a medical examination within 30 minutes (Welch, Jones & Allen, 2007). Administrators created four zones, the first three of which were staffed by a physician, two nurses and a tech and the fourth zone staffed by a physician, two mid-level providers, two nurses and a tech. The idea behind the separate zones was to increase accountability for each care team. Rather than a single employee functioning independently within a large department, each zone's performance was tracked and tied to the clinical staff working in that area. Six months after implementation of the four-zone system, the ED's door-to-provider time fell from an average of 21 to 16 minutes, the LWBS rate fell from 3% to 1% and patient satisfaction scores in the ED rose from the 75^{th} to the 80^{th} percentile (Welch et al., 2007). The zoning model has become a best-practice for EDs based on several core concepts: smaller areas allow for more efficient work flow and communication, supplies are more accessible when readily available in the zone and zones specific to patient population assist in accurately tracking patient location (Welch et al., 2007).

An additional hospital-based implementation of the zoning model achieved an average door to provider (D2P) time of 20 minutes and an average LWBS of 0.7% using a similar model of four teams including a chest pain team, a fast track (low acuity) team, a critical care team and a medical-surgical team (Burchett, 2013). A physician, a unit clerk and varying numbers of nursing staff depending on the acuity of their patient mix staffed each area. In their ED that sees over 96,000 patients annually, the ED designated specific patient types to specific geographical areas and held each team accountable to the time constraints. An additional element to their success was the staffing of a 24/7 case manager to quickly facilitate the admission and transfer process for patients out of the ED (Burchett, 2013). While the two studies above present impressive gains using the PSF model, both were retrospective, comparison studies restricted to one facility, limiting their contribution to the PSF model as a compelling intervention to improve throughput.

Fast-track flow. Several additional studies present the fast-track translation of the PSF model, which is generally defined as a separate treatment area for lower acuity patients, often staffed by mid-level providers such as a nurse practitioner or a physician assistant (Nash, Zachariah & Nitschmann, 2007; Rodi, Grau & Orsini, 2006; Sanchez, Smally, Grant & Jacobs, 2006). Researchers at a public teaching hospital in Melbourne, Australia measured the effect of a fast-track model on ED length of stay (Considine, Kropman, Kelly & Winter, 2008). During the three-month post-implementation period, non-admitted patients spent 16 fewer minutes in the ED compared to the control group. Secondary results of the study also included a decrease of 55 minutes in length of stay for admitted patients, most of whom did not utilize the fast-track unit, suggesting that all patients in the ED benefit from the fast-track model (Considine et al., 2008).

White et al. (2010) performed a similar retrospective study comparing before and after implementation of a fast track unit in a large, urban ED. The impact of fast track resulted in a decrease of the average ED LOS of 29 minutes and a 1.7% decrease in LWBS, despite an increase in ED volume of 9% during the post-implementation period (White et al., 2010). Sanchez et al. (2005) found similar results in their study that measured one year before and one year after implementation of a fast track unit. Overall LOS and LWBS were both decreased by half, with perhaps the most important contribution being no change in quality of care, as measured by revisits to the ED and overall mortality rate (Sanchez et al., 2005). The final fast-track study is a randomized, controlled trial that measured the relationship between length of stay and patient satisfaction. McCarthy et al. (2011), during a 10 week study period at an urban emergency department, found that lower wait times in the fast-track unit correlated with higher patient satisfaction scores.

<u>Vertical flow</u>. Similar to the zoning model is a split-flow model that "keeps vertical patients vertical" after initial evaluation, meaning that patients who are able to walk are not placed in a bed at any point of their visit to the ED. This model is based on the concept of a "results pending" area, where ambulatory patients wait for test results in a common area and not in a treatment room (Baker et al., 2013). The vertical flow model aggressively separates patients needing urgent or emergent care and directs them to

treatment areas in the ED, while ambulatory patients are evaluated quickly, and wait for results outside of the main treatment areas. While no scientific studies have focused specifically on the vertical flow model, Liu, Hamedani, Brown, Asplin & Camargo, (2013) conducted a study facilitated by the American College of Emergency Physicians (ACEP) where 152 academic medical centers were surveyed to determine their emergency departments on the most successful ED crowding initiatives. The study found that the "vertical patient flow," keeping ambulatory patients out of the main ED treatment area was a common, effective and relatively inexpensive strategy to reduce overcrowding and improve efficiency (Lui, et al., 2013).

Patient specific flow models are emerging in the literature as promising interventions to alleviate overcrowding in EDs. However, of the three types of PSF models reported in the literature, the fast track application is the most widespread and scientifically vetted, consistently showing a positive impact on ED length of stay, LWBS and elopements (Considine et al., 2008; Nash et al., 2007; Rodi et al., 2006; Sanchez et al., 2006). Thus, focusing on the fast track application may yield the best outcome for throughput metrics.

<u>Rapid Triage</u>

Perhaps the most widely implemented of the throughput strategies is the RT model, which typically focuses on combining tasks that previously occurred sequentially, most often registration and nurse triage. Also, in the RT model, the provider sees the patient sooner in the process by doing a brief medical screening examination to assist in sorting high vs. low acuity patients (Oreddson et al., 2011). This separation of patients allows for lower acuity patients to be siphoned off to a common waiting area for expedited treatment and discharge.

Murrell, Offerman & Kauffman (2011) reported a decrease in the LWBS rate from 7.7% to 3% and the D2P time from 62 minutes to 41 minutes after the implementation of a Rapid Triage and Treatment (RTT) model consisting of simultaneous registration, nurse triage and designation of high acuity patients immediately to a treatment room to be seen by a provider and low acuity patients to an internal waiting area for quick treatment and discharge. A similar implementation of a RT model known as rapid entry and accelerated care at triage (REACT) was trialed at an urban academic medical center with much lower volume (37,000 vs. 67,000 annual visits) but struggling with a high LWBS rate. The REACT model combined a quick registration with triage and initiation of a wide range of testing based on the patient's chief complaint. The LWBS rate before the REACT implementation was 4.6% and 12 months after implementation had fallen to 1.9%. Although the study focused on the LWBS, other ED throughput metrics improved with the REACT model including and 24 minute decrease in the average ED wait time, an 11-minute decrease in wait time for admitted patients and 22% increase in the amount of patients seen within 5 minutes of ED arrival (Chan, Killeen, Kelly & Guss, 2005).

Another study focusing on arrival to triage time and LWBS used a RT model at a large children's hospital in Washington, D.C. that sees over 70,000 patients annually in their pediatric emergency department to improve their front-end operations and overall throughput metrics (Doyle et al., 2012). The facility's rapid triage implementation included truncating triage down to only the most pertinent elements of the history and physical and a nurse-assigned acuity score. A quick registration was completed immediately upon arrival and, after the rapid triage assessment by the nurse, high acuity patients were escorted to a bed immediately and low acuity patients were sent to the non-urgent, fast track pod. Ten months after implementation, the arrival to triage time fell from 40 minutes to less than 10 minutes. Interestingly, the overall LWBS rate was unchanged in the pre-implementation and post-implementation group. However, the LWBS among higher acuity patients fell dramatically, whereas the lower acuity patients saw an increase in LWBS rates, suggesting that triage process correctly identified and quickly treated the higher acuity patients, keeping them in the ED, while the lower acuity patients saw less benefit and were more prone to leave before treatment was completed (Doyle et al., 2012).

Two final examples of the rapid triage model use a "quick look" nurse to start the triage process (Coccaro, 2010). At a New Jersey medical center, a unit clerk "greeter" completes a quick registration process and an RN simultaneously completes a "quick look" assessment to check the patient's vital signs and assign an acuity score. From there, the high acuity patient is directed to a bed where the remainder of triage is completed and orders are initiated by the RN based on department protocols. The lower acuity patients are escorted to the rapid evaluation unit of the ED, where quick treatment and discharge can occur. These changes in the triage process decreased the D2P time from an average of four hours to nine minutes (Coccaro, 2010). A similar "quick look" nurse role was implemented in the ED at a hospital in Houston, with an annual volume of 60,000 to 70,000 visits, which saw its D2P time fall from 93 minutes to 20 minutes (Shovelin, 2009). Researchers noted the doubling of intake rooms and use of this additional nurse to quickly assess and determine acuity scores allowed rapid sorting of patients out of the acute care area of the ED. As a result, LWBS rate fell from 9% to less than 2% due to their "quick look" process and aggressive sorting of patients by acuity (Shovelin, 2009).

A final study by Tsai, Sharieff, Kanegaye, Carlson and Harley (2012) investigated the relationship between a rapid triage assessment and door to provider, length of stay and left without being seen in a pediatric emergency department. In their retrospective, comparison study before and after the implementation of a rapid triage assessment, researchers found a decrease in door to provider time of 27 minutes, a decrease in overall length of stay from 239 minutes to 181 minutes and a reduction in LWBS from 9.7% to 3% (Tsai et al., 2012). In each of these studies, tasks that are typically done in sequential steps (such as registration, triage and provider assessment) were combined into a simultaneous team intervention, and rapidly discharging lower acuity patients had a positive impact on the respective throughput metrics that were measured, affecting the length of stay, especially for lower acuity patients (Baker et al., 2013).

Provider in Triage

A third approach to reduce overcrowding and improve throughput that has been broadly applied throughout the United States is the model of stationing a provider in triage (PIT) (Bahena & Andreoni, 2013). This model uses either a physician or a mid-level provider in triage with the aim of combining the triage process with provider assessment and eventual discharge, especially for low acuity patients. In a 23-bed ED in Massachusetts, the emergency department management team studied the effect of placing a physician in triage on D2P time, median length of stay in the ED and LWBS. In the

PIT model, patients saw a provider immediately after the quick registration process, allowing laboratory, radiology and other interventions to be initiated immediately. Patients who required no interventions were assessed and discharged within one interaction. Six months after implementation, the ED experienced a decrease in their D2P time of 36 minutes; a decrease in their median LOS of 12 minutes and their LWBS fell from 1.5% to 1.3% (Imperato et al., 2012).

Similar implementation of the PIT model at a large academic medical center was the focus of a study that investigated the impact of early initiation of physician orders in triage on overall length of stay in the ED (Russ, et al., 2010). A nearly two year study period revealed that patients who had orders initiated by a physician in triage saw their length of stay in the ED decrease by 37 minutes. The researchers discussed the findings of this study to be beneficial for EDs with or without a PIT model, emphasizing the early initiation of orders as the key contributing factor to their improved throughput times (Russ, Jones, Aronsky, Dittus & Slovis, 2010).

While placing a physician in triage provides the largest scope of practice to the front-end of the throughput process, it is also an expensive model (Bahena & Andreoni, 2013). Many EDs have instituted mid-level providers in triage that include nurse practitioners and physician assistants who will assess, order testing, discharge lower acuity patients, and refer the higher acuity patients to a primary ED physician. A review of the literature on nurse practitioners staffing the PIT model demonstrates that the model is effective when experienced NPs evaluate patients quickly upon arrival and refer only more acute patients for interventions or physician consult (Bahena & Andreoni, 2013). The key for nurse practitioners (NPs) functioning in triage is to provide a rapid medical screening exam, and not necessarily to treat and discharge patients. Bahena & Andreoni (2013), in their review of the current literature conclude that NPs in triage function in a niche role, ensuring rapid evaluation of patients and not necessarily the same level of care a physician in triage would provide. The throughput metric most affected by NPs in triage, then, is the D2P time, and, by extension, the LWBS typically falls, since patients are seen quickly by a provider and less likely to leave due to prolonged wait times (Bahena & Andreoni, 2013).

Using a physician assistant (PA) as the PIT provides a similar function as the NP in triage. At a large and busy ED in Minnesota, researchers used a PA during peak hours to provide a rapid medical screening exam to patients and initiation of testing quickly upon arrival (Nestler, et al., 2012). Treatment and discharge of patients was left to physicians later in the process. The use of PAs during high volume times decreased the median length of stay in the ED by 41 minutes and the LWBS fell from 9.7% to 1.4% compared to days without a PA in triage (Nestler, et al., 2012).

As each of these studies show, placing a physician in triage provides the broadest range of care options at the front-end of the throughput process because of their ability to assess, diagnose, treat and discharge a comprehensive range of patient acuities and conditions, but this model can prove to be expensive to sustain. A modification of this concept is the use of mid-level providers to provide rapid assessment and initiation of orders, leaving the remaining care and discharge of patients to other providers later in the patient's course of stay in the ED.

Flow Expeditor

The fourth model employed by emergency departments aiming to tackle the challenges of overcrowding is the flow expeditor role, typically staffed by a nurse, paramedic or technician (Feehan & Smolin, 2006). This role is modeled after the maître d' in a restaurant, and is responsible for attending to patients quickly upon arrival, keeping the flow of patients moving forward, alleviating bottlenecks and ensuring that patient care tasks do not fall through the cracks. A variety of flow expeditor models that have been measured for effectiveness in improving throughput include paramedic, technician, registered nurse, nurse practitioner and physician roles (Wiler et al., 2010).

At a university medical center in Oregon, Handel et al. (2011) studied the effect of using a paramedic as a flow expeditor on the ED length of stay (LOS) and ambulance diversion hours. Study investigators modified the duties of paramedics to focus on updating patients on the status of their care, rooming patients, prepping patients for evaluation and assisting with ambulance arrivals. Other ED staff members absorbed the previous duties of the paramedic expeditor, so no additional staffing hours were added during the study period. Post-implementation, the average LOS fell from 5.4 hours to 5.0 hours, despite a significant increase in their daily census during the testing period (Handel et al., 2011). Furthermore, elopements fell from 6.6% to 5.7% after implementation of the paramedic expeditor. The shift in focus of one particular role on the throughput process, not the addition of resources was identified as the key to maintaining the improvements while remaining financially sustainable (Handel et al., 2011).

In a slightly modified application of the flow expeditor role, emergency department leadership at a large hospital in Los Angeles County created a "lobby coordinator" role during peak volume hours (Rubino & Chan, 2007). The lobby coordinator was a registered nurse dedicated to updating patients on wait times, reassessing patient status, acting as a liaison between waiting patients and ED staff and enhancing customer service. Four months after implementation of the lobby coordinator, patient satisfaction increased by 24 % and the LWBS rate fell by 23% (Rubino & Chan, 2007).

A technician was used to staff the flow expeditor role at a New York hospital for the peak hours of 11 a.m. to 11 p.m. (Feehan & Smolin, 2006). The objectives of the flow technician included enhancing patient flow, decreasing delays in treatment and results, decreasing stress for physicians and nurses and facilitating communication between staff. While specific impact on throughput metrics are still being measured, study investigators noted that both patient and staff satisfaction have increased due to the dedicated flow technician's attention on communication and keeping the process moving smoothly (Feehan & Smolin, 2006).

Another translation of the flow expeditor role is the Clinical Initiatives Nurse (CIN), a nurse practitioner dedicated to overseeing the triage process, implementing clinical care in triage when necessary, assessing patients with prolonged wait times, acting as a liaison between the charge nurse and physicians and facilitating patient's movement through the ED (Wiler et al., 2010). The advantage of the CIN role is their ability to order interventions and perform advanced assessment, providing a higher level of care to the expeditor role. Essentially, the CIN role combines the provider in triage with the flow expeditor role, using the mid-level provider's ability to initiate orders and treatment with the flow expeditor's focus on facilitating patient movement (Wiler et al., 2010).

An expensive and less feasible version of the expeditor role is the triage liaison physician (TLP) Holroyd et al. (2007). Similar to the mid-level nurse practitioner's ability to function more broadly in assessment, intervention and discharge of patients soon after triage, is the TLP's ability to not only coordinate patient flow, act as a liaison between the triage and treatment areas in the ED, but also diagnose and discharge patients throughout the process. Holroyd et al. (2007) found that the implementation of a TLP over a six-week period of time in an academic, tertiary ED reduced the overall LOS by 36 minutes on the days it was used. The TLP assessed, treated and decided the disposition of an average of 15 patients during their shift and took an average of 15 phone calls and handled whatever "administrative" issues arose during their shift. Additionally, the LWBS rate fell from 7.9% to 6.3% on the days the TLP was used. Beyond the patient throughput improvements was the response of the ED staff: over 90% of nurses and 80% of physicians agreed that patient care and throughput were improved, revealing an impact not only on patient flow, but on staff perception of ED operations (Holroyd et al., 2007).

While the flow expeditor role can be found in the literature in several different forms, its impact on throughput is yet to be firmly established. The studies focusing on the flow expeditor are, at times, anecdotal, inconsistent and lack scientific rigor (Handel et al., 2011). This gap in the literature created the impetus for this study to focus on a clearly-defined registered nurse flow expeditor, tied to three specific throughput metrics to determine whether the role successfully improved the throughput process.

Technology

The final category of throughput interventions employed in EDs is the use of technology. The most common technological applications aimed at reducing overcrowding and improving throughput are point-of-care (POC) testing (Halverson & Milner, 2011), bedside ED imaging capabilities (Halm, 2013) and electronic mapping of ED utilization (Welch et al., 2007). The first two of these interventions focus on the diagnostic element of the throughput process, with intent to expedite results to providers. The third strategy of ED mapping, is concentrated on identifying patterns of ED usage and appropriately directing resources to best meet needs while minimizing waste.

Point of care testing. Point of Care (POC) testing is the measurement of various laboratory values at the point of patient care, or at the patient's bedside (Oredsson et al., 2011). POC testing allows caregivers access to laboratory results much more quickly than using the traditional method of sending blood samples to the central hospital laboratory to be placed in a queue and resulted along with many other patients' laboratory tests. Many EDs have used POC testing for many years, but the effect on the throughput process has only been widely studied in the last decade (Oredsson et al., 2011).

Jang et al. (2013), in a randomized, controlled trial, found that POC testing of complete metabolic panels on over 10,000 patients in a large, urban, academic medical center shaved off an average of 22 minutes on the length of stay for patients who had their laboratory values tested using the POC technology. Further, patients who required a computerized tomography (CT) scan, the length of time from the order being entered to test completion fell by an average of 11 minutes, suggesting that delays are compounded when additional tests are ordering. Investigators indicated that POC testing may not only improve LOS for patients with simple laboratory testing, but also for those with additional tests, reducing time intervals between the time when tests are resulted and further testing is ordered and completed (Jang et al., 2013). In their study at two EDs of Children's Hospital and Clinics in Minnesota, Halverson & Milner (2011) measured the effect of POC testing for Group A Strep for patients with pharyngitis on their overall ED LOS. During a three-year period after implementation of the POC testing, Halverson & Milner (2011) found that patients who received POC testing for Group A Strep were discharged an average of 25-30 minutes sooner than the average of all other discharged patients.

A systematic review by Sorrow et al. (2009) of 167 studies aimed at measuring the effect of cardiac marker POC testing on ED throughput concluded that improvement in turnaround time (TAT) of laboratory testing was universal and positively impacted ED LOS. Although specific results varied widely by institution and the type of POC technology used, researchers concluded POC testing for cardiac patients an important facet of any ED throughput improvement program (Sorrow et al., 2009). Whereas POC testing is anecdotally accepted as an effective tool for improving ED throughput, more research is needed to establish it as a best practice model for managing ED throughput (Oredsson et al., 2011).

Bedside ED imaging. Similar to the POC concept is the trend of making bedside ultrasound available for use in the emergency department. In a case study of a pediatric patient with a medical emergency, Halm (2013) found that length of stay in the emergency department was decreased by three hours and the patient's critical condition diagnosed within one hour of arrival to the ED. In a larger, retrospective study focused on the relationship between bedside pelvic ultrasound use and ED length of stay, Thamburaj & Sivitz (2013) compared patients who received pelvic ultrasounds at the bedside in the emergency against patients who went to central radiology for testing. Total sample size was small (*n*= 330) with 244 patients in the bedside ultrasound group. Time from arrival to ultrasound in the bedside group was 82 minutes, versus 149 minutes in the central radiology group. Additionally, the total LOS in the experimental group was 220 minutes, versus 357 minutes in the control group (Thamburaj & Sivitz, 2013).

Mapping ED utilization. Software programs exist that map ED utilization with the goal of directing resources most efficiently at the times and locations where they are most needed (Welch et al., 2007). This mapping includes varying staffing patterns, increasing certain roles based on patient-type specific volume, such as registration or triage personnel and adjusting supply levels based on time of day, day of the week and season of the year. Welch et al. (2007) studied the implementation of an integrated patient tracking system (PTS) at a large health care system, and evaluated its impact on ability to identify patters in patient volumes, acuity, radiology/laboratory utilization and length of stay. After using the PTS for one year, the PTS revealed consistent data that allowed emergency managers to better understand their needs with relation to patient volume, acuity, admission pattern, use of radiology/laboratory resources and ancillary support such as social workers (Welch et al., 2007).

A more facility-specific application that has shown promise applying the PTS concept is a patient flow simulation, which tracks the actual flow of patients from arrival to the various points of testing and treatment, and eventually to discharge or admission in a specific ED. At the a university medical center in Kentucky, emergency department administrators sketched out the process of a typical ED visit step by step from arrival through discharge. ED leadership at the facility mapped the volume, acuity and patient type through their ED by time of day, day of the week and month of the year. Resources used by each patient were logged and trended to identify patterns. Additionally, tracking the physical pathway that patients traveled allowed ED managers to reallocate resources to decrease backflow and maximize the most efficient ED design (Brenner et al., 2010). Technology may be one useful answer in contributing to solving throughput challenges, however, there is no conclusive evidence on the best applications to alleviate overcrowding burdens.

Conclusion

A flow expeditor role has been applied in various settings using different clinical roles and its use has inconsistently improved LWBS and elopements, but has not been shown to consistently decrease DCLOS (Handel et al., 2011; Holroyd, 2007; Rubino & Chan, 2007). Further, though it has shown promise as an effective tool, the flow expeditor role has not been as widely investigated as the other throughput interventions in the literature, making it an attractive option to study. The throughput phase of Asplin et al.'s model, focusing on triage, room placement, diagnostic testing and treatment, offers a systematic approach to studying the effect of a flow expeditor role on specific throughput indicators such as; LWBS, DCLOS, and elopement.

The literature revealed the most commonly applied strategies to manage ED overcrowding and improve throughput, centering around five different initiatives: patient-specific flow (PSF) models, rapid triage (RT), provider in triage (PIT), the flow expeditor model, and the use of technology (Wiler et al., 2009). Of these strategies, the flow coordinator appears to be a feasible yet understudied intervention. Thus, this gap in knowledge related to the impact of a flow coordinator on ED overcrowding supports further research on its implementation.

CHAPTER 3

METHODOLOGY

This chapter will discuss the methodology used to investigate the implementation of the flow coordinator role, including a description of the study design, explanation of the setting, sample, variables and the tools used to measure the relationship between the flow coordinator implementation and its impact on the three throughput metrics: left without being seen (LWBS), discharge length of stay (DCLOS) and elopements. In addition, the procedure for collecting the data of each of those throughput metrics will be discussed, along with mention of subject protection and permissions. The chapter will conclude with a section describing the analysis of the throughput metric data before and after the implementation of the flow coordinator role, and will include limitations and assumptions that underlie this study's methodology.

Study Design

The design selected for this study was a retrospective, comparison design using a historical control. A retrospective design was chosen because recent and comprehensive data was readily available for all three of the dependent variables, making analysis of a relationship between the implementation of the flow coordinator role and the impact on throughput metrics relatively straightforward. A comparison design was used because the implementation of the flow coordinator role at a specific point in time made it possible to compare the patient groups utilizing the ED pre and post-implementation.

Setting

The ED in an urban community hospital was the setting for this study. The medical center is a teaching hospital affiliated with a large, university medical school in Southern California. The emergency department, which consists of 21 acute care and 5 Fast Track (FT) urgent care beds, is split into two areas: the acute care side and the urgent care side, which operates with a Rapid Triage model. The flow coordinator role was stationed in the Rapid Triage area, which extends from the entrance of the ED to the end of the hallway where the patient registration process is completed.

The ED where this study was conducted sees a daily average of 145 patients and an average of 55,000 patients annually. During the seasonal peak from December-March, highest volumes typically reach 220 patients per day, whereas the lower seasonal months of April-November may see a daily census dip to 120 patients per day. The city in which the study's ED was set is one of the most diverse large cities in the United States with a population 46% white, 13% black, 13% Asian and nearly 40% of Hispanic descent (US Census, 2010). Among the Asian populations in the city are large Filipino, Cambodian, Samoan and Vietnamese communities, with 45% of households speaking a language other than English in their homes. The median household income in the city feeding the hospital is $48,000; almost 15% below the average income of the county and 19% of the city's residents are below the poverty level (US Census, 2010). Additionally, 72% of patients that are seen in the ED are covered by MediCal or have no insurance at all (SMCNA, 2012).

The staffing matrix in this ED consists of six core registered nurses (RNs) with three additional RNs staggered throughout the day to cover peak volume in a crescendodecrescendo staffing pattern. Core staffing of one ED technician is supplemented by three additional techs during peak volume hours. Administrative associates range from one to three, depending on peak hours throughout the day, with the highest number of administrative associates on shift from 2:00 p.m.-10:30 p.m. One to three emergency department physicians staff the acute side and one to two mid-level providers staff the FT side, from the hours of 8:00 a.m. to 12:00 midnight.

All nursing staff in this study's setting have completed specialty training in the following areas: Emergency Department Approved for Pediatrics certification (EDAP), Advanced Cardiac Life Support (ACLS), Pediatric Advanced Life Support (PALS) and Basic Life Support (BLS), Emergency Severity Index (ESI) acuity assessment, and the National Institutes of Health Stroke Scale (NIHSS) certification. Additionally, 68% of the nursing staff was certified in the Trauma Nursing Core Course (TNCC) during the study period. Thirty five percent of the nurses in the emergency department had a bachelor's degree in nursing while the remaining 65% were trained at the associate's degree level.

Sample Selection

The sample used for this study was the entire volume of emergency department patients that completed the registration process upon arrival and remained in the ED long enough to be evaluated by a practitioner. For the pre-implementation control group, the sample size included all ED visits during the prior 6-month period, beginning in June 2013 and ending in November 2013. The sample size for the control group included all patient visits for 6 months to account for the seasonal variability in census, in an attempt to accurately represent ED volume. For the post-implementation experimental group, the sample size included all ED visits for a six-month period, beginning with the day the flow coordinator role was implemented on November 11, 2013 and ending on May 11, 2014.

Variables

The independent variable was the implementation of the flow coordinator role. The dependent variables chosen for this study were discharge length of stay (DCLOS), left without being seen (LWBS), and elopements. Efforts were made to limit extraneous variables by controlling other changes to ED flow during the study period and training all flow coordinators to a uniform job description. The major extraneous variables in this study were nurse experience level and competency in the flow coordinator role, and parallel implementation of an internal waiting room pilot in the ED, another throughput intervention spearheaded by the registration department with the aim of decreasing LWBS and elopements. Reports from internal department data showed that patients with lower acuity scores were typically more inclined to leave without being seen, and this generally occurs between 10:00 p.m. and 2:00 a.m. when staffing levels decrease. A significant situational variable was the implementation of an electronic medical record shortly before the implementation of the flow coordinator role, temporarily decreasing staff efficiency and lengthening overall throughput times due to the learning curve of a new system.

Research Hypotheses

The hypotheses for this study focus on improvements in each of the three throughput metrics after the intervention of the flow coordinator role. The first hypothesis proposes that the length of stay in minutes for patients discharged from the ED will be lower in the experimental group after the implementation of the flow coordinator role. Secondly, this study intends to show that the percentage of patients who left without being seen (LWBS) by a provider will be lower in the experimental group after the implementation of the flow coordinator role compared to the control group of patients seen in the ED prior to the implementation of the flow coordinator. Finally, the intervention of the flow coordinator will show that the percentage of patients who elope from the ED will be lower in the experimental group after the implementation of the flow coordinator role.

Operational Definitions

Patient

A patient was defined as any person seeking medical attention, at the site where the study is being conducted, who completes the registration process and then places the patient into the tracking system.

Throughput Process

The throughput process was defined as the systematic course taken by a patient from arrival, throughout the phases of triage, placement in a room, treatment and eventual disposition from the ED.

Flow Coordinator

The flow coordinator was a clinical role staffed by a registered nurse designed to focus on the patient flow process beginning at the patient's arrival, through diagnostic testing and discharge. The major areas of focus for the flow coordinator were updating patient location on the tracking board during the patient's movement through the ED process, ensuring orders were carried out and high acuity patients are safely handed off to caregivers on the acute treatment side, and acting as a communication liaison between staff and patients (Appendix A).

Rapid Triage

Rapid Triage was the treatment area in the emergency department that included two intake rooms where patients were assessed by a registered nurse and a mid-level provider simultaneously to complete the triage process. The treatment area also consisted of three procedure rooms, one large room with three gurneys and four hallway treatment chairs. The main hallway of rapid triage is where the flow coordinator was stationed.

Discharge Length of Stay

Discharge length of stay was the length of time, measured in minutes, from the time the patient arrives in the ED and initiates the registration process, to the time they were officially discharged from the patient tracking system.

Left Without Being Seen

Left without being seen was a category of patient disposition defined as any patient that completes the registration process but leaves prior to being evaluated by a medical provider.

Elopement

Elopement was a category of patient disposition defined as any ED patient that completed the registration process, was evaluated by a medical practitioner, but left prior to completion of care and official discharge.

Instruments

Data was collected using the registration system in the ED The registration system captured the patient's information and time of arrival and populated them into the patient tracking system (PTS). The nurse caring for the patient entered the patient's disposition status into the PTS as LWBS, elopement, discharge, transfer or admission. This nurse-inputted entry classified patients into their respective categories and the time of entry completion stopped the clock measuring the patient's length of stay. The PTS report bank was used to extract the monthly data for DCLOS, LWBS and elopement. Also included in the PFS were the patient's age, race and insurance status. The instrument used to collect the data was a simple spreadsheet with each day of the month, daily census and the daily totals for DCLOS, LWBS and elopements. The values for each day were inputted onto the data collection tool from the information entered upon the patient's arrival to the ED during the registration process.

Procedures

When a patient arrived at the ED, they were entered into the patient tracking system through the registration process. When the patient left the ED, by LWBS, elopement or an official discharge, their ED visit was completed when the nurse entered this information into the PTS and closed out the patient's ED account. This routine, established process was the source of the data that was pulled with an existing report function.

At the completion of the 6-month study period, data was collected for all three elements under review—discharge length of stay, LWBS and elopement. These data elements were obtained through an established "ED Activity Report" in the patient tracking system. The practitioner researcher entered dates for the pre-implementation period and the post-implementation period to obtain the number in minutes for DCLOS, LWBS and elopements. Any patients who left without being registered were automatically excluded from the report. No patient identifiers were included in the data that were generated in this report.

To develop the flow coordinator role, registered nurses with at least three years of experience were assigned to 12-hour shifts during the day shift and the night shift, 6:30 a.m. to 7:00 p.m. and 6:30 p.m. to 1:00 a.m. Each of the nurses assigned were given a job description and had a brief meeting with the department director to discuss the role and address any questions. For the first two weeks of the implementation, the department director and supervisor on shift rounded frequently to discuss the role and address any issues that arose. The flow coordinator role was discussed with management and staff at monthly staff meetings to address questions and elicit feedback. Four months into implementation, one senior registered nurse emerged as a very effective flow coordinator, based on feedback from staff and providers. Data analyzed in the regular course of hospital operations supported this observation in the form of a lower percentage of Left Without Being Registered (LWBR) patients and shorter lengths of stay for patients being admitted. While neither of these metrics was being measured in this study, the improvements made a compelling case for duplicating this top performing flow coordinator's methods. In response to the improvements under her leadership, that nurse became the prototype for the position and re-trained the other flow coordinators to establish a consistent approach to the role.

Protection of Human Subjects

The researcher, in accordance with the facility's requirements, completed and passed online course on the protection of human subjects prior to any data collection or analysis. A formal proposal of this research study was approved by the chief medical officer of the local hospital where the study occurred, and submitted to the corporate Institutional Review Board (IRB) office for consideration. An online application was submitted to the corporate IRB committee for review and approval. On March 3rd, 2014, the corporate IRB office waived the study for exemption from the IRB process. The application for IRB approval at California State University, Long Beach was also submitted for review and was approved. At no time during the study was patient information included in the data collection.

Data Collection

Two different patient tracking systems (PTSs) were used to collect the data for this study. Near the end of the 6-month control group period, a new PTS was installed in the ED, requiring the data for the study period to be pulled from two different sources. Each of the three metrics being measured, DCLOS, LWBS and elopements, were captured in both PTSs and were extracted monthly for the ED performance improvement report. For the DCLOS statistic, a report was run in both PTSs for the control and experimental groups, measuring the length of stay in minutes of all discharged patients. For the LWBS and elopement statistics, a percentage of each category was being calculated in relation to total ED visits.

Data Analysis

Values from the data collection tool were analyzed using the statistical package tool in the Microsoft Excel program to run several statistical analyses. First, a log distribution of the data from DCLOS was run to determine the range of times in minutes of patients who were discharged. The log distribution revealed a balanced and symmetrical arrangement of the data, which then allowed for the application of an analysis of variance (ANOVA). A one-way ANOVA test was used to determine the difference in DCLOS, LWBS and elopement in the pre and post groups. Further analysis on gender was calculated with the use of ANOVA to determine the difference in the male and female groups for DCLOS, LWBS and elopement across the Pre FC and Post FC groups. For age, an analysis of covariance (ANCOVA) was calculated to determine which age group showed the highest rate of DCLOS, LWBS and elopement. After ANCOVA was run for the age effect for each of the throughput metrics, a Tukey test was calculated to isolate which age group emerged with the greatest difference among the three. For the patient satisfaction scores, Chi square testing was used to isolate any change in the Pre FC and Post FC groups based on the scores of each question.

Limitations

Variability in practice between flow coordinators was one of the major limitations of this study. While experienced nurses who received similar training were usually staffed in the role, each flow coordinator practiced differently, creating some disparity in the focus of their duties. Additionally, on several shifts throughout the post-implementation period, the flow coordinator was pulled from their role focusing on the throughput process to assist in other areas of the ED when volume surges or multiple high acuity patients strained department resources.

Further, parallel throughput process implementations occurred during the study period, including the creating of an internal waiting room designed to assist in limiting the LWBS by providing a designated space for the complete registration process to occur. In addition, a staff-led working group addressed other aspects of the throughput process during the study period independent of the flow coordinator role. These separate efforts limited the ability of this study to identify the flow coordinator role as the sole catalyst for any improvements in the throughput process.

Finally, the post-implementation period started at the beginning of the influenza season, resulting in a six-month period that showed volumes higher than the average. These higher volumes strained ED capabilities and may limit the full effect that the flow coordinator may have in a more typical volume period. Each of these limitations was considered in the study results, and became important topics for the discussion of the study's significance and suggestions for further research.

Assumptions

The major assumption of this study was that computer entry of patient times was inputted correctly into the system. It was also assumed that the entry of arrival and discharge times were inputted into the system in real-time to ensure that the length of stay was recorded accurately. Additional assumptions included adequate department staffing and a similar patient acuity mix during the pre and post implementation periods.

Conclusion

A retrospective, comparative study design was used to determine the effectiveness of a flow coordinator role on three specific measures of the throughput process, including discharge length of stay, left without being seen rates and elopement rates. The three study hypotheses predicting that the post implementation group data would be lower in minutes for DCLOS, lower in percentage for LWBS and lower in total amount for elopements guided the collection and analysis of the data. All patients who registered into the PTS during the pre and post-implementation groups were included in the study. Although no patient-specific information was included in the data collection and analysis, the appropriate facility-level, corporate-level and CSULB IRB processes were followed prior to data collection. Reports were generated from the patient tracking system to measure the DCLOS, LWBS and elopement rates. Staff practice variations, unassociated but parallel throughput projects in the ED, patient acuity and volume surges that strained department resources and variations in the accuracy of computer entry were several assumptions and limitations of the study that were considered when the study results were interpreted.

CHAPTER 4

RESULTS

This subject of this chapter is the statistical tests and corresponding results for each of the metrics being investigated in this study: discharge length of stay (DCLOS), left without being seen (LWBS) and Eloped. The hypotheses that this study proposed were an improvement in DCLOS, LWBS and elopement with the flow coordinator role. An analysis of variance (ANOVA), analysis of covariance (ANCOVA), and Chi square tests were chosen to best compare the data before and after implementation, referred to from here forward as "Pre FC" and "Post FC", respectively. For each test that was run, the two data sets represent the Pre FC and Post FC groups, with their respective sample sizes labeled accordingly. The results of each test are graphically represented to show whether the change in the Pre FC and Post FC groups was significant.

Discharge Length of Stay

The data for all patients in the Pre FC and Post FC groups was analyzed to determine the distribution of patient times in minutes for DCLOS. What resulted was a normal distribution pattern, with the frequency of occurrence plotted against the range of times, in minutes, spreading out over the x-axis. This normal distribution demonstrated that the majority of data points for DCLOS fell into a similar range, and that the highest volume of patients had the same discharge length of stay of 206 minutes (Figure 2). With a normal distribution of data, an analysis of variance (ANOVA) test was chosen, as it is useful in determining the difference between groups where a specific treatment or intervention has been applied, in this case the implementation of the flow coordinator.

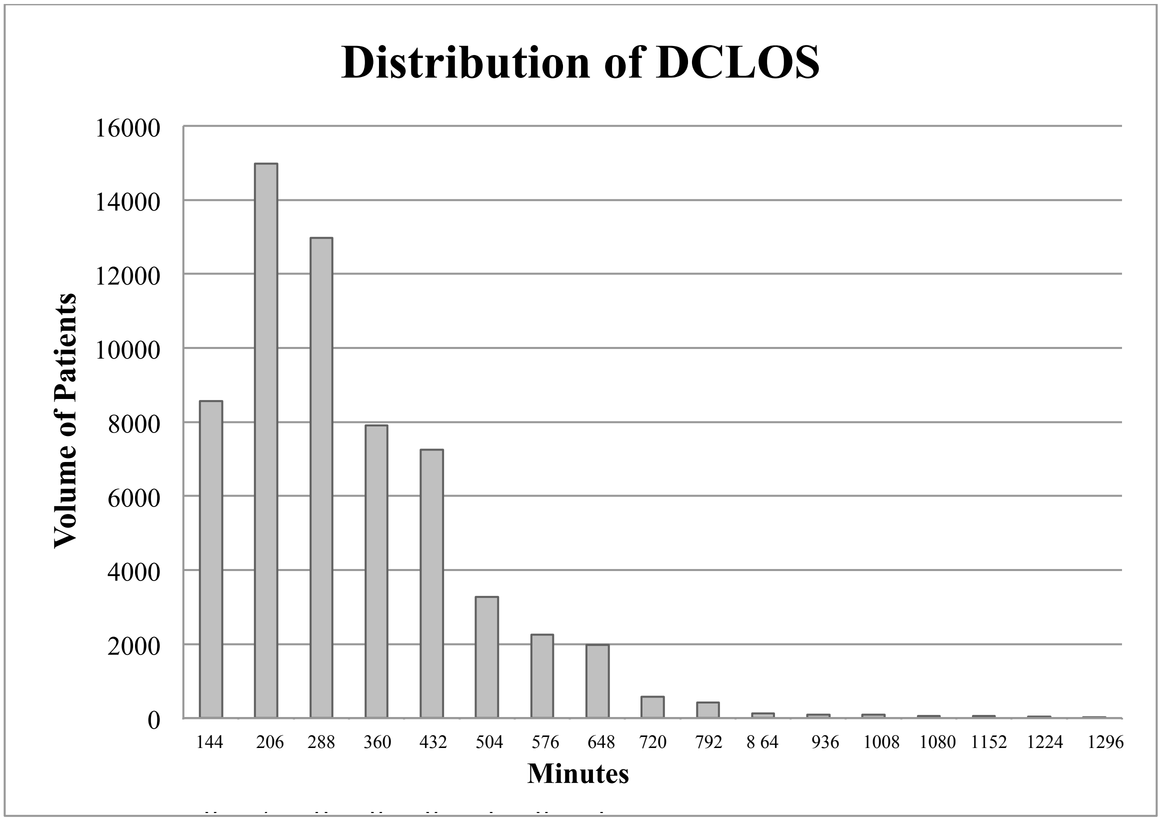


FIGURE 2. Distribution of discharge length of stay.

Using the data from the normal distribution, ANOVA was used on the Pre FC and Post FC groups to determine the difference in minutes of DCLOS after the flow coordinator role was implemented. Post FC, the post implementation group, exhibited a higher DCLOS on average of 216 minutes, than Pre FC group, which averaged 187 minutes [F (1, 53149) = 160.7, $p < 0.001$]. The flow coordinator role did not decrease the time from arrival to discharge in the Post FC group, as was anticipated based on the study hypothesis (Figure 3).

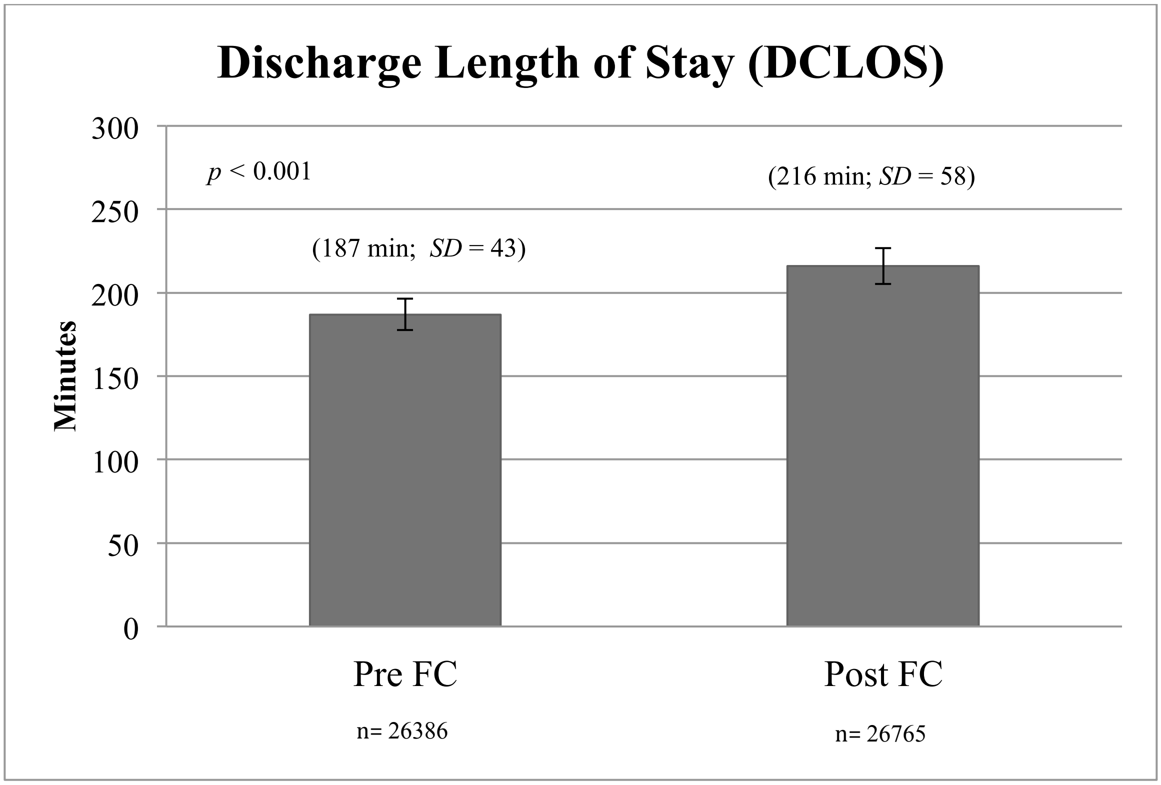


FIGURE 3. Effect of flow coordinator on discharge length of stay.

<u>Left Without Being Seen</u>

To determine the effect of the flow coordinator on LWBS, ANOVA was calculated for the Pre FC and Post FC groups. The Post FC group exhibited a significantly higher LWBS than the Pre FC group, with 1.94% of total ED patients leaving without being seen compared to 1.34% of patients prior to the flow coordinator role [F (1, 53149) = 29.78, $p < 0.001$]. Similar to the results of the DCLOS, the LWBS was not decreased by the flow coordinator, but Post FC showed a higher rate of leaving without seeing a provider than the Pre FC, disproving the hypothesis that the LWBS would decrease (Figure 4).

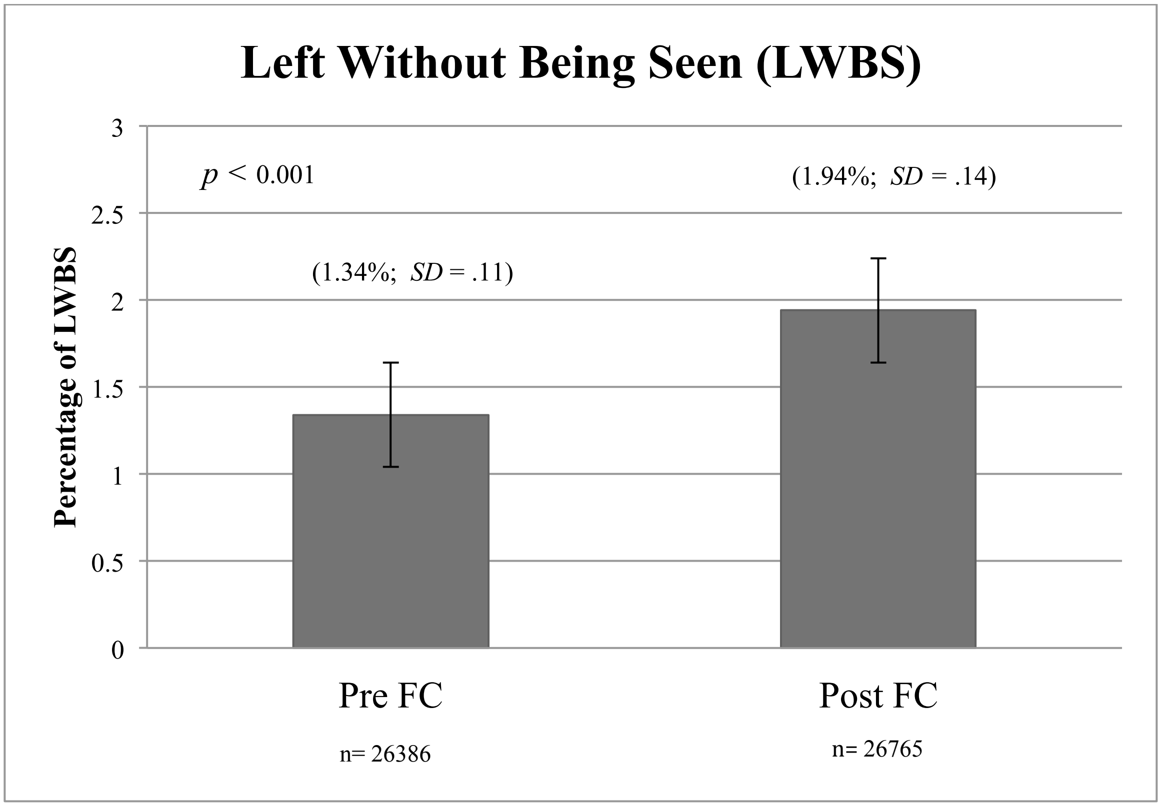


FIGURE 4. Effect of flow coordinator on left without being seen.

<u>Eloped</u>

To determine the effect of the flow coordinator on tendency for elopement, ANOVA was calculated for the Pre FC and Post FC groups. For this variable, Post FC had a rate of 3.95% of total ED patients eloping, versus the Pre FC group, where 3.75% of patients eloped (Figure 5). Although the Post FC had a higher rate of elopement, this increase was not statistically significant [F (1, 53149) = 1.395, p = 0.238]. For elopement, defined as a patient leaving prior to an official discharge from the ED, the flow coordinator had a neutral effect.

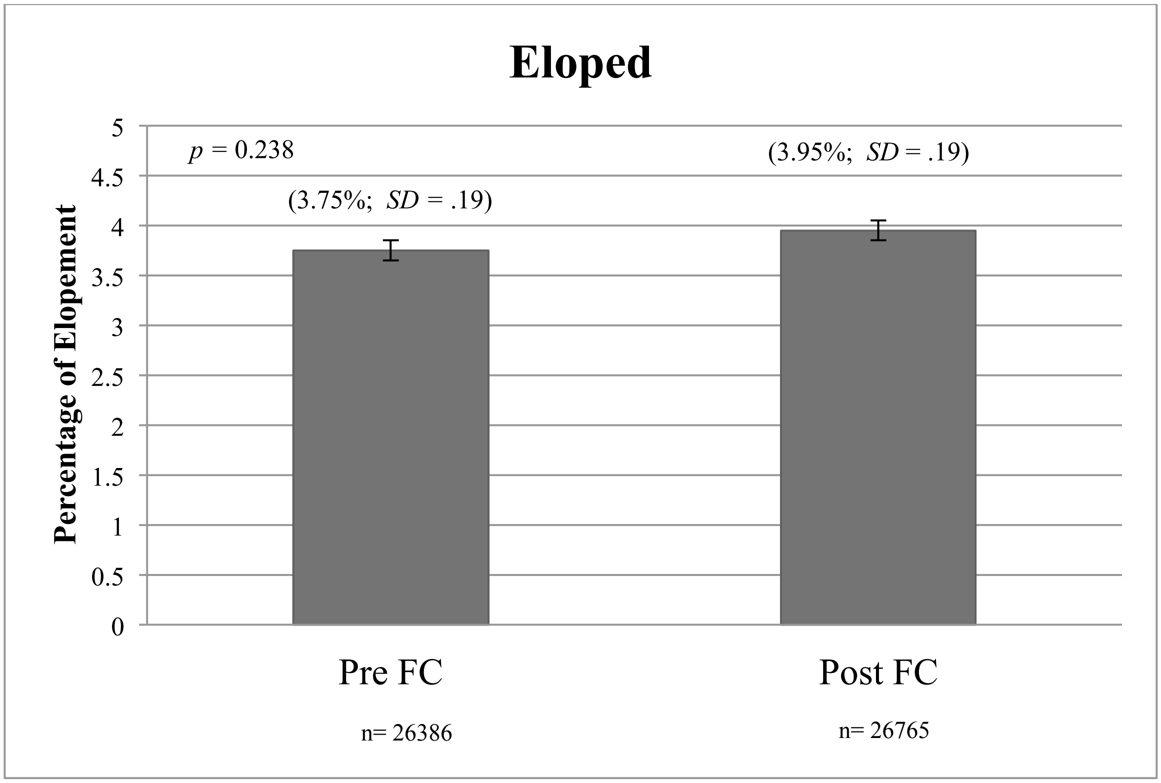


FIGURE 5. Effect of flow coordinator on elopement.

Patient-Type Effect on Throughput

In addition to measuring the effect of the flow coordinator role on the throughput, the effect of gender and age were also analyzed for each of the three throughput metrics in this study. The aim of this testing was to determine if either gender or age influenced any of the throughput metrics with the hope of isolating a "type" of patient that may be more prone to a longer stay in the ED, leaving without being seen or eloping. Information gained through this testing has the potential to "positively profile" the type of patient that is likely to have a longer DCLOS, more inclined to LWBS or elope, and therefore could offer important information on how to specifically target interventions to improve the efficiency and experience of these particular patients.

Gender Effect on DCLOS

To measure the gender effect, the normal distribution of data was segregated into male verses female patients. An analysis for variance (ANOVA) was calculated to determine how the male and female groups differ with regard to DCLOS. Results of testing the gender effect on DCLOS showed that the female group exhibited a significantly higher DCLOS of 211 minutes compared to the male group at 198 minutes [F (1, 53148) = 132.7, p = 0.001]. As Figure 6 shows, female patients had a higher DCLOS than male patients, with longer times in the ED in both the Pre FC and Post groups.

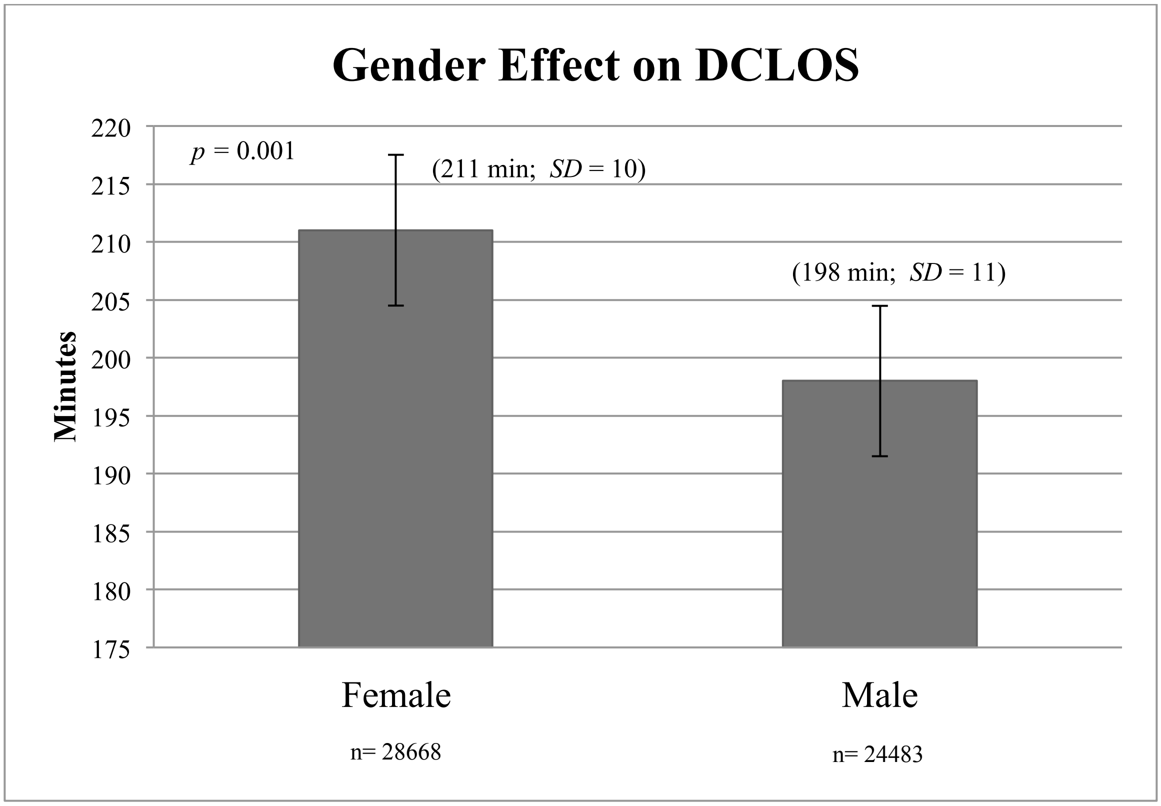


FIGURE 6. Gender effect on discharge length of stay.

Gender Effect on LWBS

The effect of gender on the LWBS metric was calculated using ANOVA. As Figure 7 reveals, the female group exhibited a lower LWBS of 1.43% of patients compared to the male group that had a 1.88% of elopement [F (1, 53148) = 16.53, p = 0.001]. Across both groups, female patients were less likely to leave the ED without being seen by a provider than male patients.

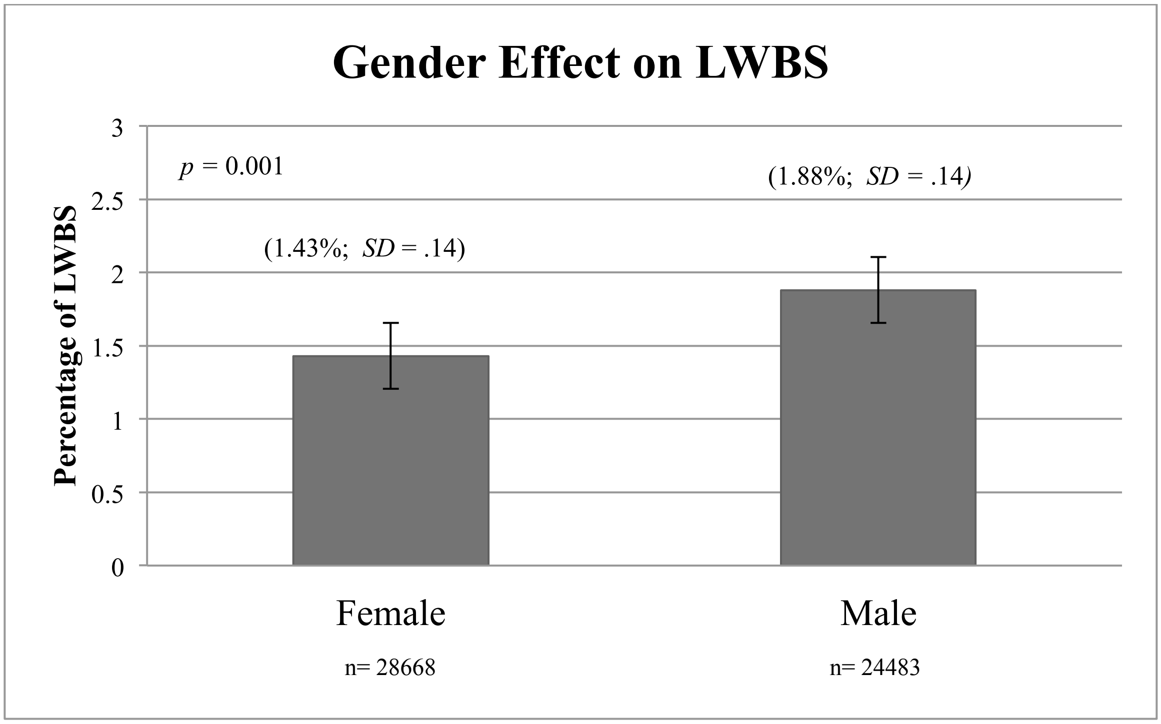


FIGURE 7. Gender effect on left without being seen.

<u>Gender Effect on eloped</u>

To determine the effect of gender on tendency to elope, data from the male and female groups was calculated with ANOVA. The female group exhibited a lower rate of Eloped patients at 3.63% compared to the male group, which had a rate of 4.12%. [F (1, 53148) = 8.665, $p = 0.01$]. Tendency to leave prior to an official discharge was lower in the female patient sample than in the male sample, across both throughout the Pre FC and Post FC phases (Figure 8).

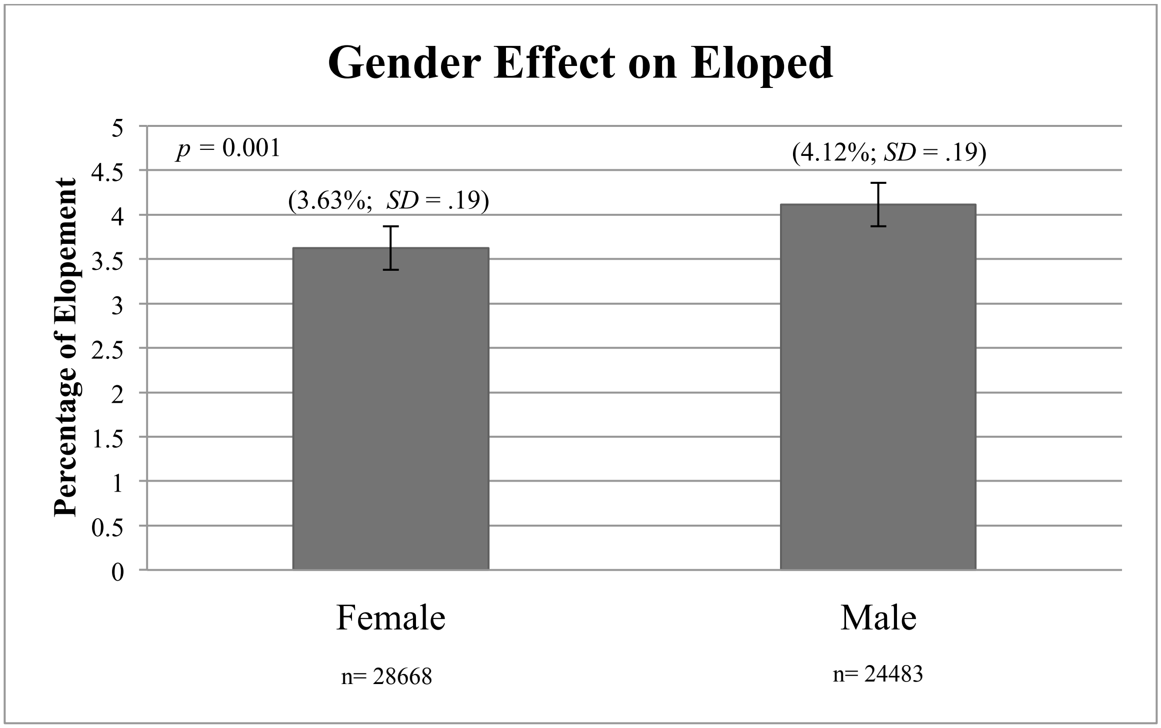


FIGURE 8. Gender effect on elopement.

Age Effect on DCLOS

The second patient-specific factor analyzed for impact on DCLOS, LWBS and Elopement was age. For this measure, patients were separated into three groups, 0 to 20 years old, 20-40 years old and greater than 40 years old. An analysis of covariance (ANCOVA) was applied to the normal distribution of DCLOS values for each of the three groups to show any difference by age for DCLOS, LWBS and Elopement. In addition to the ANCOVA test, a Tukey test was calculated to determine which particular group had the highest DCLOS. The three groups demonstrated a broad range of time in minutes for DCLOS [F (2, 53147) = 930.3, p = 0.001]. As it might be expected, length of stay in the emergency department from arrival to discharge increased with age, suggesting that older patients in both groups, who were likely to require more testing and care, stayed longer than their younger counterparts, as shown in Figure 9.

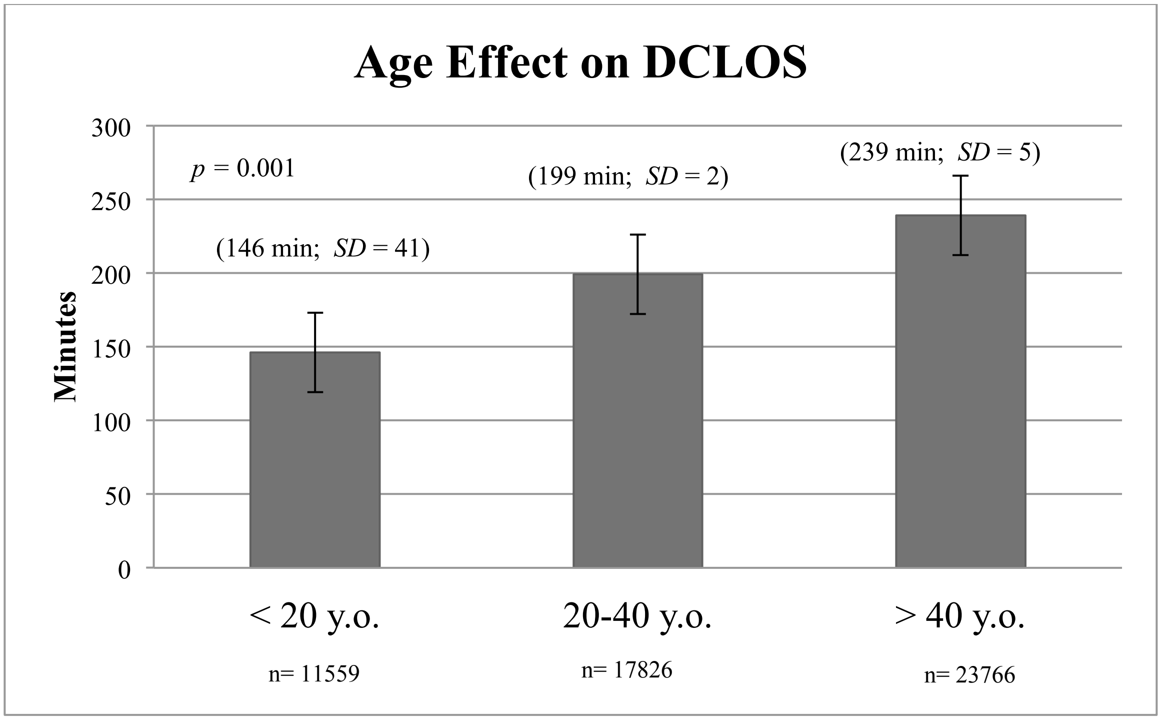


FIGURE 9. Age effect on discharge length of stay.

Age Effect on LWBS

An analysis of covariance (ANCOVA) was applied to the three age groups across the Pre FC and Post FC phases to determine if a difference in LWBS existed based on age. Then a Tukey test was calculated to determine which age group had the highest LWBS. The different age groups exhibit no difference in LWBS between groups (Figure 10). None of the age groups demonstrated a difference in tendency to LWBS over the other, suggesting that in across the Pre FC and Post FC groups, age had a neutral effect on leaving the ED without seeing a provider [F (2, 53147) = 0.828, p = 0.001].

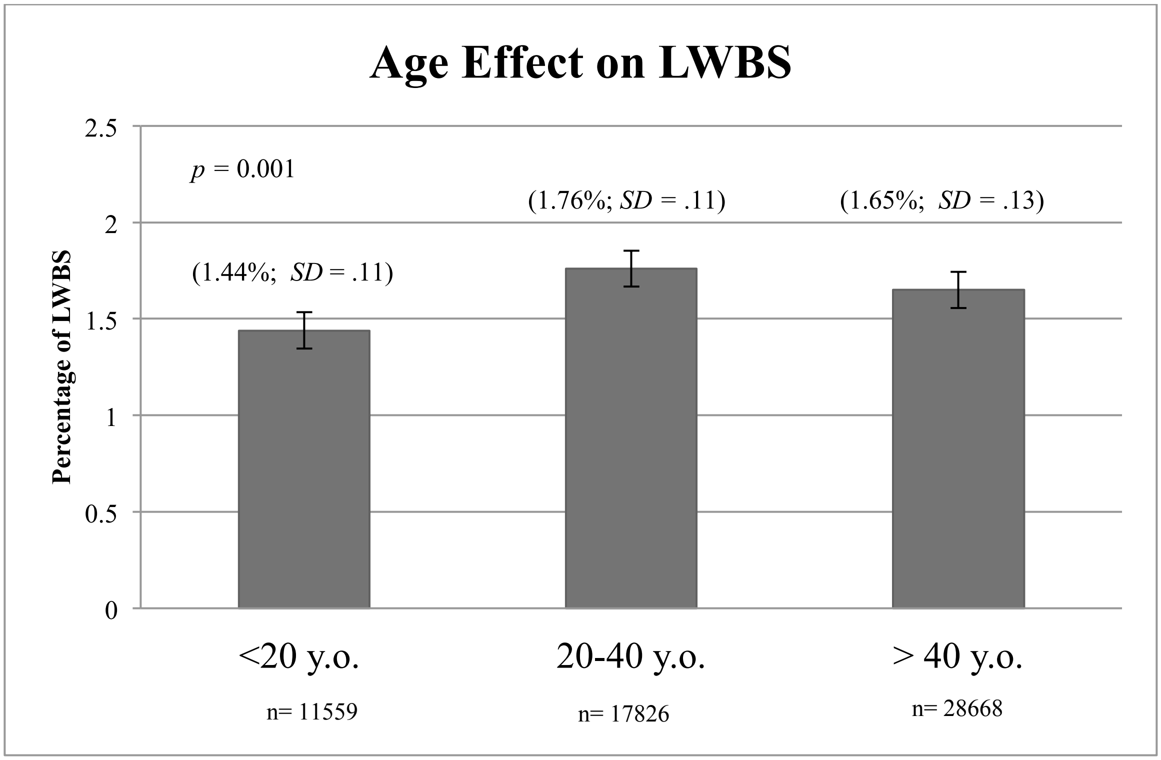


FIGURE 10. Age effect on left without being seen.

Age Effect on eloped

To test the effect of age on elopement, ANCOVA and Tukey testing were chosen to calculate each group's percentage of elopement throughout the Pre FC and Post FC periods [F (2, 53147) = 12.781, p = 0.001]. However, in addition to ANCOVA, a Tukey test was run to determine which groups in particular differed among the three. Results of the Tukey test suggested that the greatest difference between groups was in the 20 to 40 year old group at a rate of 4.52% compared to the Greater than 40 y.o. age groups at a rate of 3.07% (Figure 11). These results suggest that the 20-40 year old group is most likely to elope over their younger and older counterparts, yielding important information for clinicians in their efforts to identify those patients at highest risk for not receiving complete care.

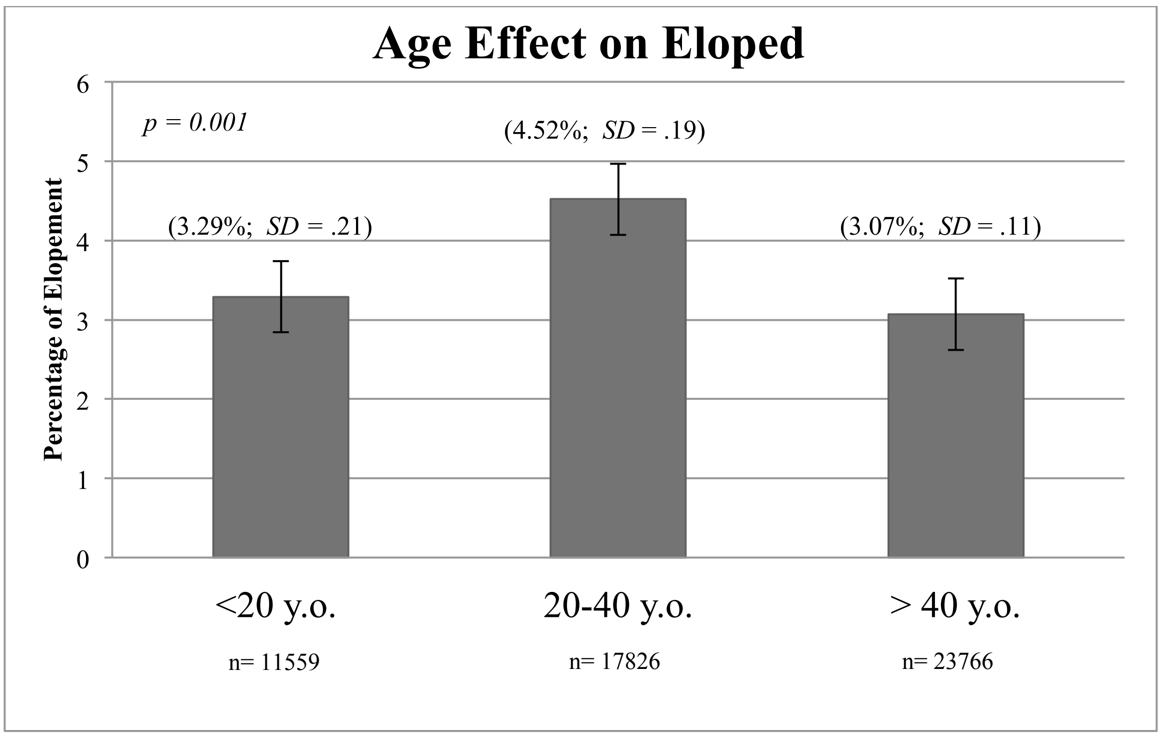


FIGURE 11. Age effect on elopement.

Effect of Flow Coordinator on Patient Satisfaction

In addition to measuring the effect the impact of gender and age on throughput, patient satisfaction scores were measured in the Pre FC and Post FC groups to determine if the presence of the flow coordinator role positively influenced the patient's experience in the ED. The tool used to measure patient satisfaction in the ED is the Avatar survey, which publically reports data on facilities that subscribe to its service. The Avatar service has designed a paper survey that is mailed to a pre-determined number of emergency department patients monthly, and scores are tabulated and reported to the facility 60 days after they are received. The four statements chosen on the survey to measure the impact of the flow coordinator role were based on the "Waiting for Care" category and included: 1) "Given my medical condition, I did not have to wait long," 2) "My health condition was checked immediately when I got to Emergency," 3) "The Emergency staff kept me comfortable while I waited to see a Physician," and 4) "The Emergency staff took my problem seriously and responded quickly to help me."

A Chi square test was calculated for each of the patient satisfaction questions comparing Pre FC and Post FC. Chi square testing was chosen because the data followed a normal distribution pattern, and this test allows for the possibility of a relationship in two directions. While the data improved for each question in the Post FC group, as shown in Table 1, the results were not shown to be statistically significant, and therefore, the flow coordinator could not be definitively proven to increase the patient satisfaction score for this particular question. Similarly, for each of the other three statements measuring aspects of waiting for care, although the Post FC scores were higher, they were not found to be statistically significant (Appendix B).

TABLE 1. Waiting For Care

"Given my medical condition, I did not have to wait long"				
	Group		x^2	df
Response	Pre FC	Post FC	0.0448	1
"Always"	354	409		
"Sometimes"	24	78		
Score	0.8325991	0.8398357		

Note: *p*= .08324, confidence interval 95%

Conclusion

For each of the three metrics that measured throughput, the Post FC group showed poorer results than Pre FC, despite the implementation of the flow coordinator role, which was intended to positively impact the efficiency of the throughput process. For DCLOS, the Post FC group, on average stayed in the ED 29 minutes longer when compared to the Pre FC group. For LWBS, the rate increased by nearly 50%, from 1.34% to 1.94% in the Pre FC and Post FC groups, respectively. Finally, elopement was shown to be unaffected by the flow coordinator role with the variance in percentage of leaving prior to official discharge was not statistically significant.

Results from the patient-type analysis, however, did yield significant results. The female group showed a higher DCLOS across the Pre FC and Post FC groups, but the male group was shown to have a higher tendency to LWBS and elope. This is an important finding, given the data that shows that the male group has a shorter DCLOS, meaning that males generally stay shorter lengths of time but are more prone to leave the ED prematurely. Additionally, with regard to the testing by age, the 20-40 year old group demonstrated a greater tendency to elope over their younger and older counterparts. With these results combined, clinicians may find a higher rate of males, aged 20-40 leaving prematurely from the ED and could feasibly target that group as "high risk" for elopement. Finally, although the patient satisfactions scores improved in the Post FC group for all the questions measured in the survey, they were not found to be statistically significant.

CHAPTER 5

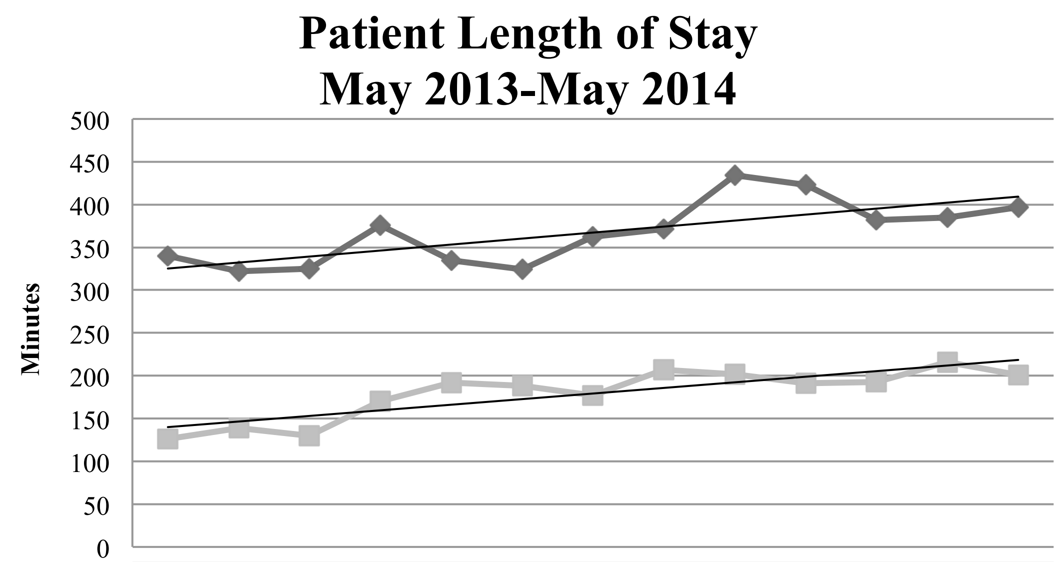
DISCUSSION

Throughput in the emergency department is a dynamic process with many factors affecting how efficiently patients move through the course of their care. This multi-factorial system is most commonly represented in the literature by Asplin et al.'s three-phase conceptual model of ED overcrowding (2003). The throughput phase of the model was the focus of the hypothesis testing in this study. Many efforts have been made to address the problem of overcrowding in the ED, with the most common interventions being PSF models, the RT model, the PIT model, the flow expeditor model, and the use of technology (Wiler et al., 2009). Of these common interventions, this study assessed the implementation of the flow expeditor model, placing an experienced registered nurse in the position of flow coordinator in an effort to address the common issues that lengthen patient stay in the ED. This chapter will discuss the results of implementing the flow coordinator role and the important implications of this research, which include a contribution to the literature surrounding ED throughput models, insight into patient-types that disproportionately affect DCLOS, LWBS and Eloped, and the impact of a flow coordinator-type role on patient satisfaction.

Explanation of Throughput Metric Results

In each of the three throughput metrics that this study set out to measure, the flow coordinator role did not show an improvement. Discharge Length of Stay (DCLOS), left without being seen (LWBS) and Elopement exhibited either poorer efficiency, as with DCLOS and LWBS, or had a neutral impact, as with Eloped. A plausible explanation for this is an unexpected delay in throughput times beginning in the second month of the testing period when a new electronic medical record (EMR) was employed in the emergency department. While the researcher knew of this implementation at the time and an initial impact study was performed, the negative effect on throughput vastly surpassed expectations, dramatically extending the throughput process for several months after the EMR go-live date.

The new electronic medical record was noted to add approximately 4-5 minutes onto each patient's initial registration and triage into the emergency department. In addition, every aspect of care in the emergency department was affected by this new system, even tasks outside of those being measured in this study, which slowed down global operations considerably for all patients. Figure 12, which displays the upward trend of length of stay for both admitted and discharged patients from the beginning of the Pre FC phase through the close of the Post FC phase. The EMR implementation is likely the major cause of poorer results in the Post FC versus Pre FC groups. Unfortunately, this parallel implementation made it very difficult to clearly measure the actual impact of the flow coordinator, given the broad impact of the EMR on every operational aspect of care in the ED.



	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14
ALOS	340	322	325	376	335	324	362	371	434	423	382	385	397
DCLOS	126	139	130	170	192	188	177	207	202	191	193	216	201

Data Source: ED Monthly Metrics- 5/2013 - 5/2014 ALOS- Admission Length of Stay DCLOS= Discharge Length of Stay

FIGURE 12. Length of stay for all patient types.

Implications

Although the implication of the flow coordinator role did not have the intended effect on improving throughput efficiency, the results of this study have three important implications on the body of knowledge regarding ED throughput. The first implication both confirms and broadens the understanding of what interventions affect throughput in the ED. Secondly, the analysis of patient type including gender and age yield important insights for clinicians interested in targeting throughput interventions toward the populations that are most prone to a higher DCLOS or have a tendency to LWBS or elope. Finally, the impact of the flow coordinator on patient satisfaction represents the growing trend of using a clinical role not just to improve efficiency in patient flow, but also to improve the patient's experience in the ED.

Contribution to ED Throughput Models

The first implication of this study is its contribution to the body of literature focusing on the role of a clinician to expedite the throughput process. The research devoted to measuring the effectiveness of a clinician in the role of flow expeditor is growing, however, there is a broad range of methods for how role is implemented, based on type of clinician and the scope of their duties (Oredsson et al., 2011). Physician assistants, nurse practitioners, technicians, nurses, paramedics and physicians have all been studied in a role similar to the flow coordinator with positive results on throughput metrics such as LWBS, elopements and length of stay (Handel et al., 2008; Smolin, 2006). Additionally, the flow coordinator role has been shown to have positive effects on patient satisfaction and staff morale, although the data is limited to support this relationship (Nestler et al., 2012).

While the data for DCLOS, LWBS and Eloped did not show a significant impact on improving efficiencies in this study, it does raise the question of what benefit the flow coordinator role adds to the ED team. The initial hypothesis of this study suggested that efficiencies would be gained with the creation of the role, and while that hypothesis was not proven, the ED staff quickly perceived the role as indispensable to the team. Though anecdotal in nature, the feedback that came up repeatedly by ED staff was the benefit of an additional set of eyes on the process and on the patients, contributing to a safer environment and providing a central contact person through whom all information flowed. This raises the question of the broader effectiveness of this type of role: in what other areas outside the realm of this study does the flow coordinator add value? Does the role improve staff morale? Do they facilitate better communication between team members, and improve the safety of patient care? These questions are beginning to be addressed in the literature as ED managers look beyond efficiency alone include patient safety and satisfaction in their top priorities. One study specifically designed with a registered nurse as flow coordinator saw a drop in monthly ambulance diversion hours from 93 to 43, suggesting that the flow coordinator may affect patient safety indirectly by allowing for shorter paramedic rides and quicker access to definitive care (Murphy et al., 2014). While the literature supporting the flow coordinator role as a means of improving patient safety, staff morale and patient satisfaction is scarce, this is an important area for further research on the impact of the role beyond throughput efficiency.

Patient-Type Impact on Throughput

The second implication of this study relates to the results of the effect of gender and age testing on the three throughput metrics. The gender testing in this study revealed female patients to have a higher DCLOS and a lower LWBS and Eloped, with male patients had a lower DCLOS but a much higher tendency to LWBS or elope. The gender component of LWBS and Elopement has not been well established in the literature, with some studies showing a higher LWBS for male patients, while other investigations showed relationship to gender (Johnson, Meyers, Wineholt, Pollack & Kusmiesz, 2009). Additionally, the results from this study revealed that both female patients and patients greater than 40 y.o. had higher DCLOS times. A proposition from this data would be to consider how to speed up the diagnostic testing for these types of patients, perhaps working off protocols or patient pathways to streamline care.

Lastly, certain patient-types have shorter DCLOS times and are at lower risk for LWBS or Elopement. The results of this study verify what has been established in the literature that patients with the highest DCLOS and lowest LWBS and Elopement tend to be female with regard to gender, and over 40 years old with regard to age (Ay, Akkas & Sivri, 2010 & Pines et al., 2012). While these patients should not be disregarded in the conversation of how to improve the throughput process, they should be considered a "lower risk" group in terms of their tendency for LWBS or Elopement.

The literature does support a strong relationship between advanced age and a higher DCLOS, with the most common reasons being that older patients typically present to the ED with a higher acuity condition, and more diagnostic testing and treatment is required for the elderly (Ay et al., 2010; Knapman & Bonner, 2010; Pines et al., 2012). Existing research in this area is consistent with the findings in this study that show DCLOS to be the highest in the greater than 40 year old group, further establishing that patients with advanced age would be a worthwhile group to pursue interventions to make their ED stay as efficient as possible. Novel interventions for targeting this older group of patients are emerging in the literature, with one particular model referred to as "Senior Streaming Assessment" (Shetty, Gunja, Byth & Vukasovic, 2012). This model includes an assessment tool and specific care pathway that identifies senior patients quickly, moves them to a specific area of the ED and initiates diagnostic testing and treatment quickly. Targeted interventions for the senior population have shown both a quicker D2P time and a reduction in overall length of stay in the ED (Asha & Ajami, 2013; Shetty et al., 2012).

The literature also demonstrates a link between age and LWBS, with multiple studies showing younger age, no insurance or Medicaid coverage associated with higher LWBS (Ding et al., 2006, Johnson et al., 2009). The results of this study again confirm this phenomenon, contributing to the strong case in the literature that the younger population is most prone to LWBS. With this information, providers and staff may consider a simple intervention by the flow coordinator to increase communication or update the patient on wait times to decrease the incidence of younger patients leaving prior to being seen or prior to discharge. On such model described often in the recent literature is the "Quick Look" nurse who functions in a hybrid role of flow coordinator and triage nurse (Sharieff et al., 2013). The goal of this model is for the Quick Look RN to assess every patient within 5 minutes of arrival and triage them into either a low-acuity "Gold Zone" or a high-acuity "Blue Zone." The lower acuity patients were segregated geographically in the ED and interventions were started immediately for their minor complaints. This hybrid model using the flow coordinator to identify the lower acuity, higher risk for LWBS or Elopement has shown a significant decrease in both length of stay and LWBS (Sharieff et al., 2013).

Impact on Patient Satisfaction

While the flow coordinator did not show an improvement in DCLOS, LWBS or Elopement, it did show an improvement on Patient Satisfaction and approached statistical significance. Since each of the throughput metrics was negatively affected by the substantial delay created by the electronic medical record implementation, it would seem that patient satisfaction would also be negatively affected. In fact, the reverse was true, and although the increase in the patient satisfaction scores were not determined to be statistically significant, the flow coordinator might be considered a balancing agent that helped patients experience better communication or attentiveness, despite the slower times in the throughput process.

It is possible then, that the flow coordinator role could positively impact patient satisfaction, if all other variables were sufficiently controlled. This effect cannot be overstated in the current health care environment, as patient satisfaction is a driver for both volume and financial viability for hospitals (Bayley, et al 2005; Handel & McConnell, 2008; Tekwani et al., 2012). Perhaps the most important conclusion from the data is the stabilizing effect of the flow coordinator on the patient's experience in the ED in light of the significant increase to overall length of stay resulting from the EMR implementation. Focusing this role on making rounds, reassessing patient conditions and updating patients on their plan of care should be a high priority whenever a clinical role is used as a tool to improve ED throughput.

Limitations

The limitations of this study include: (1) confinement to one specific emergency department as the sample population, (2) two different systems used to collect data and (3) narrow measures chosen to define throughput efficiency. The first limitation was the limited setting of this study, an urban community hospital emergency department in Los Angeles County, makes it difficult to broadly generalize the results. The socioeconomic, ethnic background and payor mix demographics at this particular emergency department are unique to its geographic area and may not be applicable to other EDs with a different patient population. Additionally, this ED served as a specialty center for Trauma, Stroke, Pediatrics and STEMI (ST segment Elevation Myocardial Infarction) and the city's Base

Station for paramedic traffic, broadening the services offered, the higher acuity of patients and the advanced training of staff. Research has shown that EDs with higher specialty volume, overall volume, greater admission rates and paramedic traffic effect overcrowding and the throughput process as a whole and should be considered important when generalizing results of this study (Wilner et al., 2012).

Additionally, the implementation of the new electronic medical record created a challenge when pulling the data for the Post FC group. The definition for LWBS, for example, was split into two groups in the new system, and was merged for the sake of continuity. While the researcher practitioner spent extended time matching data to ensure a quality comparison, the two different systems do raise a question about the symmetry of the samples in the Pre FC and Post FC groups. Furthermore, the change in systems slowed the process of patient registration and triage, altering the researcher's ability to accurately measure the effect of the flow coordinator on the throughput process.

Finally, the three measures chosen for study, DCLOS, LWBS and Eloped, while they give a snapshot indication of how patients flow through the process, they do not fully represent the throughput process in the emergency department. As mentioned in the literature review, ED throughput is a complex and dynamic process and several important areas including Left Without Being Registered (LWBR), Admission Length of Stay (ALOS), paramedic diversion hours, total emergency department volume, acuity distribution and use of contract labor all affect the efficiency of patient flow (Wiler et al., 2010). The results of this study should not be considered a comprehensive representation of the "front end" efficiency of this particular ED, as it focused on patients who eventually discharged and those who LWBS and Eloped, which are somewhat limited indicators of front end efficiency.

Significance

This significance of this study can be explained in three ways. First, it investigates an important intervention to improve the ED throughput process in the implementation of the flow coordinator role staffed by a registered nurse. Emergency departments struggling with overcrowding and boarding of admitted patients are forced to pilot creative strategies to improve patient flow, and the flow coordinator model represents an important option for leaders to consider (Handel et al., 2011). Second, it raises the issue of the issue of the effect of technology on efficiency. The implementation of the electronic medical record created a delay in patient care that has persisted long beyond the study period. This raises important questions for leaders regarding the unintended consequences of technology on patient care. While the change in system made certain tasks easier, it lengthened both the registration and triage processes, and this had an overall effect on ED operations for all patients. The increase in overall length of stay and decreased efficiency for both nursing and physician staff is consistent with what has been proven in the literature regarding the impact of an electronic medical record on throughput times, often persisting for many months after the initial go-live date (Kennebeck, Timm, Farrell & Spooner, 2012; Poissant, Pereira, Tamblyn & Kawasumi, 2005).

Additionally, the gender and age relationship with DCLOS, LWBS and elopement provide important confirmatory data on what already established in the literature with regard to patient types that are more prone to either stay longer in the ED, or leave prior to completion of treatment (Ay et al., 2010 & Pines et al., 2012). Lastly, this project raises the issue of patient satisfaction in the ED as an important indicator of both performance and throughput. The efficiency of the flow coordinator was not supported by data, but staff feedback indicated that the flow coordinator played an important role in ensuring patient care is coordinated with adequate communication and follow up, despite the extended wait times in the Post FC group.

Recommendations

Further study on the ED throughput process should focus on staff training and the development of the flow coordinator role, an expanded group of global metrics measuring efficiency and trials of different types of clinicians in the role of flow coordinator. Staff training proved to be an important indicator in the quality and consistency of the flow coordinator role. While several staff members emerged as the top performers, the role could not be solely staff with those nurses. A more intensive training program, with perhaps an application process and financial incentive, could serve to formalize the role and incentivize staff to pursue it as a promotion. Next, including a broader range of the throughput measures would provide a more robust understanding of how the role affects patient flow. Impact on LWBR, diversion hours, acuity and admission rates would show whether other areas of efficiency were either positively or negatively impacted by the role. Finally, trialing different clinicians in the role would tease out effectiveness verses financial impact. For example, a technician would be significantly less expensive than a registered nurse is, and allow leadership to weigh the benefits and drawbacks of each type of clinician.

Conclusion

The ED conceptual model of overcrowding divides the patient's course into three phases including input, throughput and output, each with many factors affecting the patient's course of treatment (Asplin et al., 2003). This study focused on the throughput phase, beginning with the patient's registration and ending with their discharge from the ED. An extensive literature review identified the major interventions already in use to improve ED throughput, including dividing patients by condition or acuity, creating a rapid triage area of the ED, placing a provider in triage, using a clinician as a flow expeditor and various technological applications to improve efficiency. The flow expeditor role was chosen as the intervention for this study, with an experienced RN trained to focus solely on expediting the throughput process. To measure the effectiveness of this role, the three throughput measures chosen to represent efficiency were discharge length of stay, left without being seen and elopement. Each of these areas were measured before and after the flow coordinator implementation, to see determine if any efficiencies were gained.

While the results did not support any improvement in the three throughput metrics after the flow coordinator role was instituted. The researcher-practitioner believes that the data in the post FC group was considerably skewed by the implementation of an EMR during the testing period and important information was gained in the course of this study. These insights include the effect of age and gender on throughput, as well as the impact of the flow coordinator role on patient satisfaction, which is a growing area of concern for hospitals and EDs (Rowe et al., 2006; Polevoi, 2005). Further research into the complicated subject of ED throughput should focus on standardizing the flow coordinator role and delving into the impact on patient safety and patient satisfaction in the emergency department.

APPENDICES

APPENDIX A

Flow Coordinator Job Description

APPENDIX A

Flow Coordinator Job Description

Requirement: RN (at least three years experience)

Hours: 6:30am-7:00pm; 6:30pm-1:00am (until Rapid Triage side closes)

Basic Duties:

1. Facilitates the flow of patients from arrival, through registration, Rapid Triage, to internal waiting room and to main waiting room when needed.
2. Communicates collaboratively with ED charge nurse to progress patients through the process toward disposition with emphasis on Rapid Triage patients that need to be moved to the acute side for evaluation
3. Maintains updated location of all patients on the tracking board
4. Checks charts for order completion and assists with handoffs between providers
5. Works proactively to alleviate bottlenecks by moving patients, assisting staff with tasks and interventions and completes triage and discharge when available
6. Monitors laboratory and other diagnostic results and notifies providers
7. Updates patients on their plan of care by rounding frequently
8. Night shift Flow Coordinator ensures handoff of all patients to the acute site prior to Rapid Triage closing

APPENDIX B

Patient Satisfaction Scores

APPENDIX B

TABLE 2. Health Condition Checked Immediately

"My health condition was checked immediately when I got to Emergency"				
	Group		x^2	df
Response	Pre FC	Post FC	0.3894	1
"Always"	386	422		
"Sometimes"	68	65		
Score	0.8502203	0.8665298		

Note: $p=$ .5326, confidence interval 95%

TABLE 3. Staff Provided Comfort

"The Emergency staff kept me comfortable while I waited to see the physician"				
	Group		x^2	df
Response	Pre FC	Post FC	0.0406	1
"Always"	380	411		
"Sometimes"	74	76		
Score	0.8370044	0.8439425		

Note: $p=$ .8404, confidence interval 95%

TABLE 4. Problem Taken Seriously and Quick Response

"The Emergency staff took my problem seriously and responded quickly to help me"				
	Group		x^2	df
Response	Pre FC	Post FC	1.0005	1
"Always"	380	420		
"Sometimes"	74	67		
Score	0.8370044	0.8624230		

Note: $p=$ .3172, confidence interval 95%

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