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Implementation and Sustainability of Emergency Department Wait Time Management Strategies

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Walden University

College of Health Sciences

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Arnold Resto Del Valle

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Walden University

2020

Abstract

Implementation and Sustainability of Emergency Department Wait Time Management

Strategies

by

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Project Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Nursing Practice

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Abstract

The problem of excessive wait time in the Emergency Department (ED) is a barrier to receiving access to assessment and treatment for patients seeking care in the United States. This project sought to understand the success factors that help implement and sustain wait time management strategies (WTMS) and ensure reduction of wait times in hospital Emergency Departments. This study addresses the gap in practice of few documented success factors that are proven methods in clinical practice for reducing patient wait time or sustainability. Retrospective studies, randomized controlled trials, and prospective observational studies were included in this project. An exhaustive comprehensive search of Walden University databases was conducted. Analysis was performed and included a critical review of study methods, outcomes, and applicability to clinical practice. The PRISMA checklist was the model used to guide the systematic review protocol. Twelve research articles included factors or models influencing successful strategies, initiatives at the organizational level, and national or provincial level strategies or policies addressing WTMS. Results of this study showed that the most effective and feasible intervention for implementation and sustainability of WTMS are SMS text messaging, direct consultation to senior physicians, and standardization of the admission process. Findings will help hospital managers and decision makers better manage wait times in the ED by presenting strategies for effective wait-time management and sustainability for timely and adequate ED services. This project supports positive social change through recommendations to reduce mortality rates, lower healthcare expenditures and improve overall patient outcomes in the ED setting.

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Dedication

This project is dedicated to my wife Minerva who was by my side throughout my study years, my mother Norma and father Felix for their sacrifices, unconditional love and upbringing, my sisters Solymar and Lisa for always being there for me. To my entire family and above all my Lord and Savior Jesus Christ for giving me the most precious gift of eternal life.

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Section 1: Nature of the Project

Introduction

Wait time due to overcrowding in the emergency departments (ED) is a global problem that has earned the distinction of being labeled as a national crisis in some countries (Eitel et al. 2010). Hosseinichimeh (2012) described overcrowding as a disruptive force that adversely affects adequate performance and fluid workflow. When performance is affected, the care of patients who are seriously ill is compromised by the lack of timely and adequate services in the face of high volume. The Centers for Disease Control and Prevention (CDC), (2014) provided evidence that the rise in patients seeking care in an ED setting has outpaced the growth of the general population, straining a system already overburdened due to the closing of EDs and the consolidation of hospital services. Congestion of ED is a spreading worldwide general problem primarily due to numerous hospital internal and external factors such as hospital bed scarcity, ED deficiencies, and insufficient nurses and physicians (Somma et al. 2015). Long wait times are also a contributing factor to not only ED overcrowding, but also the rise of mortality and morbidity rates (Doupe et al. 2018). ED overcrowding causing wait times for healthcare services highlights the need for organizational structure change for improvement of healthcare delivery. The CDC, (2018) published mean wait times for ED treatment in 2016 as having increased as the annual volume of visits increased. Mean time was 24.1 minutes with less than 20,000 annual visits, compared with 48.7 minutes with 50,000 or more annual visits.

Long wait times in the ED contribute to the problem of overcrowding and is

associated with a greater risk increase of patient morbidity and mortality (Guttman, Schull, Vermeulen, & Stukel, T.A. (2011). The mean total cost for an index hospitalization for ED patients hospitalized as inpatients increased from \$16,621 to \$22,865 and for patients with an initial observation stay from the ED from \$6,129 to \$8,162 (Sabbatini et al., 2018). According to Sahota and Bennett (2019), review of ED invoices revealed that a total of 41 visits had been made by 28 patients making the total cost of \$308,466.67 of which \$258,668.15 consisted of treatment for preventable side effect syndromes.

Many studies suggest an existing gap of insufficient information regarding successful implementation of management strategies by hospitals for the reduction of wait time and successful sustainability in the ED. In this study, I conducted a systematic review of literature to explore success factors that help implement and sustain ED wait time management strategies (WTMS) and ensure reduction of wait times. Findings will help hospital managers and /or decision makers to better manage wait times in the ED.

Problem Statement

Excessive wait time caused by overcrowding creates a snowball of negative effects including poor patient outcomes, prolonged pain and suffering, patient dissatisfaction and decreased physician productivity and overall frustration by the healthcare staff (Derlet & Richards, 2000). The CDC (2014) estimated 23.4% of patients experienced a total ED length of stay greater than 4 hours. In terms of financial consequences of boarding in the United States, the approximate cost to build a hospital bed is roughly around \$1,000,000 and to staff that same bed will cost between \$600,000

and \$800,000 which many argue is the explanation for hospitals having little regard for addressing this problem (Salway et al. 2017). Wait time due to overcrowding is due to healthcare system failure on multiple levels, with the inability to ensure adequate inpatient capacity that compromises patient safety and endangers the reliability of the U.S. emergency healthcare system.

In this doctoral project, I focused on the local nursing practice problem of overcrowding in Puerto Rico hospital Emergency Departments. According to Alvarez and Goodnough (2015), it is common to see beds in hospital emergency rooms line the hallways with so few nurses that people often hire their own private nurses during hospital stays.

The partner organization is a Level 2 trauma center located in Puerto Rico providing 24 hour ED services, resuscitation, minor surgery, and stabilization of injured patients that experiences a high volume of patient visits that can benefit from implementing sustained WTMS to reduce the wait time and overcrowding situation they face as do the majority if not all Puerto Rico hospitals. According to Shin et al. (2015), Puerto Rico's 20 federally funded network health facilities operating in 71 sites positioned in the commonwealth had served 330,736 clients, demonstrating that Puerto Rico displays a greater proportion of Medicaid clients served, equaling 69% compared to 46% outside Puerto Rico.

In this doctoral project, I provided strategies that may effectively reduce wait-time delays and patient overcrowding for improvement of performance in direct care of patients within the ED. The outcome of this doctoral project could be applied in ED

universally to improve overall mortality rates, lower healthcare expenditures, and improve overall patient outcomes in this setting.

Purpose

The purpose of this project was to conduct a systematic review to explore the success factors that help to implement and sustain WTMS and ensure reduction of wait times in hospital ED. In this project, I addressed the insufficient information regarding implementation strategies by hospitals for the reduction of wait time in the ED. The practice-focused question for this doctoral project was: What are the success factors that help implement and sustain WTMS and ensure reduction of wait times in hospital ED. This practice-focused question was relevant in identifying the gap in practice because an EDs main objective is to provide timely, efficient, and safe health care to all clients regardless of the circumstances. Patient wait for health services has been a long-standing concern and lacks a clear, evidence-based standard on appropriate patient wait time due to multiple factors and the primary reason why The Institute of Medicine, the Joint Commission, and the Institute for Healthcare Improvement have encouraged the adaptation of patient flow improvements for addressing the problem of overcrowding (McHugh, Van Dyke, McClelland, & Moss, 2011). Various conceptual frameworks have been proposed to describe and measure ED crowding and its causes (Moskop et al. 2009). There is no documented success factors deemed best practice for reducing patient wait time through WTMS implementation or its sustainability. In this project, I addressed the gap-in-practice by identifying success factors that help implement, sustain and ensure reduction of wait times by providing an unbiased and comprehensive summary of the

best available strategies for clinical decision making on health care delivery. Findings will help hospital managers and /or decision makers to better manage wait times in the ED.

Nature of the Doctoral Problem

The gap in practice that I addressed in this project was insufficient information regarding implementation strategies by hospitals for the reduction of wait time in the ED. Patient wait for health services has been a long-standing concern and lacks a clear, evidence-based standard on appropriate patient wait time. The focus of this project stems from a review of literature findings suggesting that the difficulty of implementing a sustainable and successful solution to overcrowding is due to the multiple causing factors that can occur during the patient journey from start to finish (Morley et al. 2018, p.2). The disproportion between ED capacity and ED demand affecting patient flow is a growing concern that needs to be addressed. According to Yarmohammadian et al. (2017), prolonged inpatient length of stay, treatment delays, adverse patient outcomes, and high mortality rates have been caused by high occupancy (above 90%) and access block. These factors, as well as the lack of clinical knowledge on how to improve the manifestations of multiple causal factors of ED overcrowding, provide meaningful and relevant supporting evidence that provides justification that this problem is meaningful and relevant to the local setting. In this systematic review, I focused on services provided within the ED setting through an extensive electronic database search of existing articles up to the year 2019. My end goal was to be able to present strategies that have effectively reduced wait time delays and patient overcrowding. Inclusion criteria

included search strategies to decrease patient length of stay, WTMS implementation strategies, and WTMS sustainability in the ED. These factors can then be developed into best practices for patient-centered care to create a reliable tool for managers and decision makers that have a responsibility for wait time management, leadership, and healthcare provision. The main exclusion criteria were assessment of patient flow outside of the hospital ED and assessment of direct real patient flow intervention or with students or faculty. The highly complex environment of the ED is the intended setting that will benefit from this doctoral project. I conducted a systematic review to explore the success factors that help to implement and sustain WTMS and ensure reduction of wait times in hospital ED to address the existing gap of insufficient information regarding implementation strategies to the anticipated findings analyzed as best solution strategies for reduction of ED wait time.

To explore the success factors that help implement and sustain wait WTMS and ensure reduction of wait times in hospital EDs, I identified a sufficient number of relevant sources of publication years up to the year 2019 based upon related key words, terms, and clinical questions. I included retrospective studies, randomized controlled trials (RTC's), and prospective observational studies in this systematic review. The articles that I selected included those that either: describe a framework of factors or model influencing WTMS success at organizational level or failure or refer to an initiative at organizational level that addresses wait time, diminishment of patient length of stay, and either national or provincial higher-level strategies or policies addressing WTMS. I screened abstracts to determine that inclusion criteria have been met including:

the author, type of study or design, setting ED, year of publication, and participants (providers). Where there was no full clarity from abstracts, I performed a full text screening. I completed the analysis through critical review of study methods, study outcomes and applicability to clinical practice as well as review of study strengths, weaknesses, gaps of information or any type of limitation that has been synthesized to form a new systematic review. I used the Prisma 2009 checklist by Moher et al. (2009) for systematic review protocol, registration, eligibility criteria, description of all information sources, strategy search, process for study selection, data collection process, data items, risk of bias, summary measures, and synthesis of results. I used the Prisma Flow Diagram Generator as a graphical representation of citation workflow. The data extraction was of qualitative nature using the web based systematic reviewing platform DistillerSR (systematic review) including definition of wait time, influential factors of WTMS, full description of WTMS, article objectives, theoretical framework used, study design, WTMS jurisdiction, and theoretical framework used. When there was no full clarity on criteria from the abstracts, I performed a full text screening.

Significance of the Study

The significant problems faced by the ED include the high volume of daily client visitations, the growing disease complexity, and ageing population along with infrastructural deficiencies and manpower, which have created hindrance to the reduction of wait time (Shen & Lee, 2018). Patients spend on average 5 hours waiting in the ED and about half of the visit waiting for the next required services (Willoughby, Chan, & Strenger, 2010). The CDC (2014) discussed that the rise in patients seeking care in an

emergency department setting has outpaced the growth of the general population, and served to strain a system already overburdened due to the closing of emergency departments and the consolidation of hospital services. A large population based retrospective cohort study using health administrative databases and involving 1,487,094 patient visits to the ED in 2011 revealed that for every extra hour of mean length of stay, there is an association with 7 day mortality and admission to hospital in those who are discharged home or leave without being seen (Guttman et al. 2011). Not only have studies shown that ED overcrowding leads to increased medical errors but, the Joint Commission on Accreditation of Healthcare Organizations has shown that out of 50% of the sentinel events that occur within the ED setting, one third of these were directly related to overcrowding, one third of a total of 50% (Treciak & Rivers 2003). The Centers for Medicaid and Medicare and the Agency for Healthcare Research and Quality have both worked together with the Joint Commission to routinely survey patient experiences in the ED and have focused on four hours as a suggested reasonable wait time limit (AHRQ, 2018). However, despite these efforts, the difficulty of implementing a sustainable and successful solution to overcrowding still exists due to the multiple causing factors that can occur during the patient journey from start to finish (Morley et al. 2018). It is evident that the root cause of ED waits due to overcrowding does not inherently reside in the ED but is rather a patient flow problem that is in desperate need of a hospital-wide solution. In this project I focused on analyzing and synthesizing literature addressing successful implementation of management strategies by hospitals for the reduction of wait time in the ED with proven sustainability.

The ED differs from other areas because it offers not only comprehensive services 24 hours a day within the hospital setting, but it is required by law to treat all incoming patients even if there is no guarantee of reimbursement. While there have been multiple studies that have addressed the amount of time it takes for a patient to be seen in the emergency room (Betz, Stempien, Trevidi & Bryce, 2017; Horwitz, Green & Bradley, 2010; Welch, 2010), as well as multiple research articles that target the issues of hospitals in Puerto Rico (Mulligan, 2010; Perreira, Peters, Lallemand & Zuckerman, 2017; Simmons, et al. 2011), there is a lack of existing research that evaluates the effectiveness of technology within the ED setting. This systematic review could help all physicians, nurse practitioners and physician assistants by presenting strategies that have effectively reduced wait time delays and patient overcrowding for improvement of performance in direct care of patients within the EDs because knowledge of successful factors through wait time improvement and sustainability can influence as an agent of positive change for timely and adequate services in meeting the end goal of delivering comprehensive patient centered care. The outcome of this study could be applied in ED universally to improve overall mortality rates, lower healthcare expenditures and overall patient outcomes in this setting.

Summary

Patient wait for health services has been a long-standing concern and lacks a clear, evidence-based standard on appropriate patient wait time. There is insufficient information as to best-practice-methods in clinical practice regarding implementation strategies by hospitals for the reduction of wait time in the ED through WTMS

implementation and more importantly its sustainability. In order to accomplish this goal, I conducted a systematic review of literature up to the year 2019 to identify success factors that help implement and sustain WTMS and ensure reduction of wait times in hospital EDs. The best strategies that I identified will have a direct impact on social change for healthcare consumers, organizations and the nursing profession by providing an unbiased and comprehensive summary of the best available strategies for clinical decision making of health care delivery whose sole purpose is to improve the human condition of the needy patient across the health system.

Patient wait for health services has been a long-standing concern and lacks a clear, evidence-based standard on appropriate patient wait time. There are no documented success factors as proven methods in clinical practice for reducing patient wait time through WTMS implementation and more importantly its sustainability. Findings will help hospital managers and /or decision makers to better manage wait times in the ED.

Section 2 of this project includes the model and framework that will guide the systematic review of the implementation and sustainability of ED WTMS to improve adherence among providers in the ED settings and provide the local background and context of the study. This section will also include the project's relevance to the nursing practice, the local background and context, and the role of the DNP student.

Section 2: Background and Context

Introduction

Emergency Departments are the most challenging setting regarding patient wait time delay due to overcrowding (Yarmohammadian et al. 2017). Associated outcomes to this global problem include access block, reduction of patient safety, depletion of inpatient bed capacity due to high volume of inpatient occupancy, rise in mortality and morbidity rates, increase in misplacement of patients to incorrect wards, deferment in the initiation of critical care and an inefficacious inpatient flow due to unnecessary peaks in demand for inpatient beds elective surgery (Wu, Zhou, Ye, Gan, & Zhang, 2015; Bellow, & Gillespie, 2014; Goulding, Adamson, Watt, Wright, 2012; Schull, Szalai, Schwartz, Redelmeier, 2001). There is substantial evidence-based research that demonstrates patients admitted through the ED during periods of high ED crowding have died more often than similar patients admitted to the same hospital when the ED was less crowded (Sun, B.C., et al 2013). According to Jane et al. (2014), a 10% increase in ED bed relative occupancy ratio was associated with 3% increases in death and hospital admission at a return visit.

A 2006 retrospective stratified cohort analysis showed association between high ED occupancy and in-hospital mortality at 10 days, estimating the magnitude of the effect at 13 deaths per year (Richardson, 2006). Another study showed ED overcrowding contributing to a relative thirty percent increase in mortality for patients requiring admission from the ED to an inpatient bed (Sprivulis et al. 2006). There have subsequently been too few systematic actions regarding the ED wait time and

overcrowding crisis creating the need for prompt recognition as well as timely management of this significant problem. It is significant that emergency care providers, professional organizations, and policy makers should heed recommendations of the Institute of Medicine in addressing ED wait time due to overcrowding as an important public health priority (Daniel, 2006).

This doctoral project is a systematic review in which I explored success factors that help implement and sustain WTMS and ensure reduction of wait times in hospital EDs. I identified the best strategies that could underpin quality improvement efforts in order to provide timely, efficient and safe health care to all clients regardless of the circumstances that up till now, have no clear best practices for reducing patient wait time through WTMS implementation and sustainability. This project constitutes a positive social change for healthcare consumers, organizations, and the nursing profession. It provides an unbiased and comprehensive summary of the best available strategies for clinical decision-making. The intended result is to improve patient conditions, decrease patient mortality, morbidity rates, healthcare costs and overall improvement of patient outcomes is expected. Hospital organizations may also benefit because these situations mean that hospital resources are wasted and patients do not receive the help they need, resulting in a return visit for the patient and a compromised revenue for the hospital (Hoyle & Grant, 2015). The healthcare profession will benefit because a systematic review of strategies to confront this problem will have a positive impact in the broader field of nursing. ED staff can improve performance in the ED through timely and adequate healthcare services in meeting the end goal of delivering prompt comprehensive

patient centered care.

I will discuss in this section the model and the theory that was used in the review of literature addressing success factors that help implement and sustain WTMS and ensure reduction of wait times in hospital EDs. The relevance of this doctoral practice to nursing as well as the local background and the context of the problem are also discussed here. Finally, I will discuss the role of the DNP student in this project.

Concepts, Models, and Theories

I used PRISMA to review each article for inclusion in order to guide this systematic review to better understand the nature, cycles, and characteristic factors that help implement and sustain successful WTMS to improve patient time, thus improving both patient care and patient outcomes by utilizing the best evidence-based practice available. Guidance is provided through PRISMA's 27 item diagnostic test accuracy checklist and flow diagram, facilitating the transparent reporting of reviews, assistance in the evaluation of validity, applicability, enhanced replicability of reviews, and making the result from this systematic review more useful (McInnes et al. 2018). The term evidence-based practice originated with Sackett et al.'s (2000) definition, as the integration of the best research evidence with clinical expertise and patient values which was derived from the evidence-based medicine model (Guyatt, 2008). The best research evidence to influence the clinical practice lays a scientifically sound foundation for safe and efficient patient centered care and delivery.

This systematic review was conducted due to the absence of documented success factors as proven methods in the ED for reducing patient wait time through WTMS

implementation and /or documented sustainability. The outcome of this study will help hospital managers and decision makers to better manage wait times in the ED.

Relevance to Nursing Practice

Wait time in the ED due to overcrowding is a major concern. The Institute of Medicine (2006) provided a credible support to the practice problem by confirming that it is not uncommon for patients in EDs to be boarded for 48 hours or more, often times in hallways, until inpatient beds become available. Despite previous efforts, there is a limited amount of clinical knowledge on how to ameliorate ED patient flow with sufficient credible literature to support this statement (Eitel et al. 2010).

Identification of effective wait time management strategies to improve the manifestations of multiple causal factors of ED overcrowding provides meaningful and relevant supporting evidence that provides the opportunity for ED clinical practice improvement. The end goal is to inform effective clinical decision-making that has a direct impact on social change for healthcare consumers, organizations, and the nursing profession by providing an unbiased and comprehensive summary of best available strategies for clinical decision making of health care delivery with the sole purpose of improving the human condition of the patient. According to George and Evridiki (2015), the six dimensions of quality described by The Institute of Medicine that include effectiveness, patient-centeredness, efficiency, timeliness, and equity are compromised when delay in treatment due to patients experiencing excessive wait times for health-care services.

Although there are numerous studies on reduction of wait time in the ED, there is an existing gap of delineated best practices regarding successful implementation strategies and sustainability by hospitals. Multiple strategies have been used in order to address this gap in practice including the use of standard process worksheets and use of visual reminders requiring minimal cost and no additional staff (Willoughby, Chan, & Strenger, 2010), application of Lean manufacturing techniques (Ng et al. 2010), doctor-nurse triage teams (Subash, Dunn, McNicholl, & Marlow, 2004), Rapid PDSA Cycles (Shen & Lee, 2018), implementation of a horizontal and vertical split flow model time (Wallingford et al. 2018), bedside registration to decrease triage-to-room time (Takakuwa, Shofer, & Abbuhl, 2006), and a 4 hour ED wait time target (Bobrovitz, Lasserson, & Briggs, 2017), amongst others. Patient wait for health services has been a long-standing concern and lacks a clear, evidence-based standard on appropriate patient wait time. There remains an obvious need to discover the best performance improvement program and imperative to effectively strategize sustainable wait time management.

Local Background and Context

Across the United States as a whole, hospitals with EDs have seen a rise in the number of patients being seen in an emergency setting. The CDC (2014) discussed that the rise in patients seeking care in an ED setting has outpaced the growth of the general population, and served to strain a system already overburdened due to the closing of EDs and the consolidation of hospital services. According to Anderson, Dobkin, and Gross (2014) many patients rely on refuge provided by the emergency department as a safeguard network as well as gaining entry because of the manner in which the

Affordable Care Act was put into effect for an already overburdened emergency care system through expanded accession of the healthcare. While the overall changing economic factors that influence hospital visits cannot be helped, there is a demonstrated need for a better way to ensure patients receive the care they need in a timely manner.

The federal government is the largest payer for overall health care. Through the Medicare and Medicaid programs, and along with the Agency for Healthcare Research and Quality, they have worked with the Joint Commission to routinely survey patient experiences in the ED and have focused on 4 hours as a suggested reasonable wait time limit (AHRQ, 2018). Locally, The Morehouse School of Medicine held a summit on the island of Puerto Rico in 2011 to analyze health matters affecting its citizens with policymakers, researchers, and advocates on how to ameliorate the regions health outcomes through effective applications linking primary care and health promotion for improvement of overall health outcomes (Sastre et al. 2014). In San Juan, the Puerto Rico capital, it is common to see beds in hospital EDs line the hallways with so few nurses that people often hire their own private nurses during hospital stays (Alvarez & Goodnough, 2015). Unfortunately, Puerto Rico is currently a health system in crisis, without the resources to provide the care that all citizens deserve. Much attention has been placed on the island's recent bankruptcy, with less attention being paid on the island's healthcare system, even though many believe it is on the verge of collapse (Roman, 2015). Statistics indicate that healthcare services provided by the ED are constantly being put to the test. According to data provided by the Health Insurance Administration (ASES), approximately 465,694, or 46% of the 1.6 million Mi Salud

participants visited the ED in Puerto Rico in 2011 (Belaval Diaz, 2013). This situation clearly demonstrates overutilization by beneficiaries that directly and negatively affect not only the resources but also the quality of services provided by the ED and its ability to effectively respond to real emergencies.

Role of the DNP Student

Currently, my role as DNP student is to optimize ED health services in the local setting. The partner organization is a Level 2 trauma center located in Puerto Rico that provides 24 hours emergency department services, resuscitation, minor surgery, and stabilization of injured patients experiencing a high volume of patient visits. I have a shared responsibility with the partner organization in providing paid services regarding implementing sustained WTMS in optimizing patient centered care by reducing the wait time and overcrowding problems they are facing as do the majority of hospitals on the island of Puerto Rico.

Wait time in the ED due to overcrowding is a common global concern jeopardizing not only ED patient safety, but ED staff members committed to providing high-quality emergency care the quickest way possible to everyone. It is imperative that policy makers and hospital managers have a broader understanding of both patient utilization trends and hospital supply factors. There is a need to focus on strategies to satisfy patient demand while keeping up with ever evolving complex medical conditions affecting the target population. Being at the forefront of patient care in the ED, health-care providers need to be knowledgeable of the most recent and effective wait time management strategies to minimize ED length of stay as well as hospital stay, thus

improving patient outcomes, and reducing health care costs.

I conducted a systematic review to explore the success factors that help to implement and sustain WTMS and ensure reduction of wait times in hospital EDS due to the existing gap of insufficient information regarding implementation strategies by hospitals for the reduction of wait time in the ED. These identified factors have been presented to the partner organization so that the provided findings can then be developed into best practices for providing prompt patient centered care in the ED setting.

Summary

Wait time in EDs due to overcrowding is a major public concern that has increasingly become a problem worldwide, especially in Puerto Rico, where this project was conducted. Regardless of the effort of the ED in making sure timely and effective client interventions are offered, it simply is not enough given the sheer number of patients being served versus the number of employed medical staff. The cause of wait time due to overcrowding is multi-factorial such as insufficient inpatient beds, repeated ED visitations, delayed responses to patient consultation, deficient healthcare personnel appointed to meet demand and a growing population with non-urgent complaints (Erenler et al. 2014). While there have been multiple studies that have documented the amount of time it takes for a patient to be seen in the emergency department (Betz, Stempien, Trevidi & Bryce, 2017; Horwitz, Green & Bradley, 2010; Welch, 2010), there is insufficient information regarding successful implementation of management strategies by hospitals for the reduction of wait time in the ED and proven sustainability.

The purpose of this project was to conduct a systematic review to explore the success factors that help to implement and sustain WTMS and ensure reduction of wait times in hospital EDs due to the existing gap of information regarding implementation strategies by hospitals for the reduction of wait time in the ED. Findings may help hospital managers and /or decision makers to better manage wait times in the ED.

In Section 3 I describe the methodology of data collection that has been utilized in this doctoral project. I will also provide a list of operational definitions, review the practice focused question and sources of evidence that included published outcomes as well as research that further supports this systematic review. I will also discuss how the data collected was analyzed and synthesized.

Section 3: Collection and Analysis of Evidence

Introduction

The problem of patient wait for health services has been a long-standing concern and lacks a clear, evidence-based standard on appropriate patient wait time. There is insufficient information as to best-practice-methods in clinical practice regarding implementation strategies by hospitals for the reduction of wait time in the ED through WTMS implementation and more importantly its sustainability. The purpose of this project was to conduct a systematic review to explore the success factors that help implement and sustain WTMS and reduction of wait times in hospital EDs. This study was originated due to the existing gap of insufficient information regarding implementation strategies by hospitals for the reduction of wait time in the ED. PRISMA was used to review each article for inclusion in order to guide this systematic review to better understand the nature, cycles as well as the characteristic factors that help implement and sustain successful WTMS.

I will detail in Section 3 the practice-focused question relevant to this doctoral study, operational definitions of key aspects, sources of evidence, Published Outcomes and Research, and Analysis and Synthesis.

Practice-focused Questions

The meaningful gap-in-practice that I address in this doctoral project is the lack of information regarding implementation strategies by hospital for the reduction of wait time in the ED. Patient wait for health services has been a long-standing concern and lacks a clear, evidence-based standard for managing patient wait time. The practice-

focused question for this doctoral project was: What are the success factors that help implement and sustain ED WTMS and ensure reduction of wait times? This practice-focused question was relevant in exploring the gap in practice because an EDs main objective is to provide timely, efficient and safe health care to all clients regardless of the circumstances. Currently, there are no documented best practices for reducing patient wait time through WTMS implementation and sustainability. Findings may help hospital managers and decision makers to better manage wait times in the EDs.

The purpose of this doctoral project was to identify success factors that help implement and sustain ED WTMS and ensure reduction of wait times. There is a need to delineate best practices to demonstrate successful implementation of management strategies by hospitals for the reduction of wait time in the ED with proven sustainability.

Operational Definitions

Emergency Department: This is defined as the provider of urgency clinical and Para clinical care for patients injured in accidents and incidents (Ajami et al. 2012)

Overcrowding - A major public health problem due to degradation of the quality of care (prolonged waiting times, delays to diagnosis and treatment, delays in treating seriously ill patients), increased costs (leading to unnecessary diagnostic investigation), and patient dissatisfaction (Quickstats, 2014)

Wait Time: This is defined as the difference between the time of arrival in the Emergency Department and the time the patient had initial contact with a physician, physician assistant, or nurse practitioner (Eitel et al., 2010).

Wait Time Management Strategies: This is defined as the initiative that targets the reduction of wait time for access to healthcare services (Pomey et al. 2013).

Sources of Evidence

The sources of evidence that I used to address the practice-focused question include The Cochrane Library that consists of a collection of databases including systematic reviews and meta-analyses. I also used Evidence-Based Practice Research Guide at Walden University Library; Cumulative Index to Nursing and Allied Health Literature (CINAHL) a database that indexes top nursing and allied health literature, conference proceedings, journals, legal cases, research, dissertations and clinical trials, and covers topics such as nursing, biomedicine, alternative medicine and consumer health. I used National Guideline Clearinghouse that is a database of evidence-based clinical practice guidelines; PubMed, which covers medical journals and national health publications, not only in the United States, but around the world as well, OVID, a health science database. I also used Medical Literature On-Line, (Medline), which is also used as a searchable database on medical conditions, Centers for Medicare and Medicaid, which have a wealth of information on patients who receive healthcare through either Medicare or Medicaid; Institute for Healthcare Improvement, a non-profit organization that works with healthcare organizations to improve healthcare in hospitals and clinics and the Johanna Briggs Institute EBP Database. Data extraction includes but is not limited to resources, tools, culture and governance.

I conducted this systematic review to gather, evaluate, and synthesize the best available literature that would provide the most relevant evidence in identifying

successful strategies employed by healthcare institutions as proven methods in clinical practice for reducing patient wait time through WTMS implementation and proven sustainability. I was seeking to obtain only the highest level of evidence possible with evidence ranked in accord with the hierarchy of evidence assigned to research studies based on methodological quality of design, validity, and applicability to patient care (Ackley, Ladwig, Swan, & Tucker, 2008). I collected and analyzed evidence using The PRISMA and PRISMA's 27 item diagnostic test accuracy checklist and flow diagram for transparent reporting of the review, provide guidance, assist in the evaluation of validity, and to enhance replicability of reviews. I focused on services provided within the ED setting through an extensive electronic database search of existing articles up to the year 2019.

The end goal of this review is to be able to present strategies that have effectively reduced wait time delays and patient overcrowding. Inclusion criteria included was WTMS implementation strategies and WTMS sustainability in the ED. These identified factors can then be developed into best practices for patient centered care to create a reliable tool for managers and decision makers that have a responsibility for wait time management, leadership, and healthcare provision. The main exclusion criteria were assessment of patient flow outside of the hospital emergency department and assessment of direct real patient flow intervention or with students or faculty.

Published Outcomes and Research

Studies conducted in other countries and written in the English language were included in the literature search. Retrospective, randomized controlled trials, and

prospective observational studies on success factors that help implement and sustain WTMS and ensure reduction of wait times in hospital EDs were the types of study included in this systematic review. The scope of this review in terms of years searched through use of electronic databases and search engine sources in order to address the practice-focused question included articles published up to 2019 regarding implementation and sustainability of WTMS at the organizational level. These included The Cochrane Library consisting of a collection of databases including systematic reviews and meta-analyses, and Evidence-Based Practice Research Guide at Walden University Library. I also used Cumulative Index to Nursing and Allied Health Literature (CINAHL) a database that indexes top nursing and allied health literature, conference proceedings, journals, legal cases, research, dissertations and clinical trials, and covers topics such as nursing, biomedicine, alternative medicine and consumer health. I also used the National Guideline Clearinghouse that is a database of evidence-based clinical practice guidelines; PubMed, which covers medical journals and national health publications, not only in the United States, but around the world as well, OVID, a health science database; Medical Literature On-Line, (Medline), which was also used as a searchable database on medical conditions. I used Centers for Medicare and Medicaid, which have a wealth of information on patients who received healthcare through either Medicare or Medicaid; Institute for Healthcare Improvement, a non-profit organization that works with healthcare organizations to improve healthcare in hospitals and clinics and the Johanna Briggs Institute EBP Database. Data extraction includes but is not limited to resources, tools, culture and governance. Key search terms used included: wait

time, wait time management strategies, overcrowding, emergency department, queues, health priorities, health care delivery, personnel management, information systems, policies, and budgets.

This systematic review was exhaustive and comprehensive by gathering, evaluating, and synthesizing the best available literature that provided the most relevant evidence in identifying successful strategies employed by healthcare institutions as proven methods in clinical practice for reducing patient wait time through WTMS implementation and proven sustainability. Analysis was performed through critical review of study methods, study outcomes, and applicability to clinical practice, as well as review of study strengths, weaknesses, gaps of information, or any type of limitation that will be synthesized to form a new systematic review.

Analysis and Synthesis

The search route for screening the evidence and eligibility of scholarly and peer-reviewed articles that meet criteria was based on the PRISMA statement and its 27-item checklist, four-phase flow diagram including the stages of identification, screening, eligibility, and inclusion (Liberati et al. 2009). Liberati et al. (2009), explained that the checklist includes essential items necessary for transparency in the reporting of a systematic review through identification of evidence, screening, eligibility for inclusion and selection of said evidence.

The Prisma 2009 checklist has been used for systematic review protocol, registration, eligibility criteria, description of all information sources, strategy search, process for study selection, data collection process, data items, risk of bias, summary

measures, and synthesis of results (Liberati et al. 2009). The Prisma Flow Diagram Generator has been used as a graphical representation of citation workflow (Liberati et al. 2009). The data extraction was performed using the web based systematic reviewing platform DistillerSR (systematic review) including definition of wait time, influential factors of WTMS, full description of WTMS, article objectives, theoretical framework used, study design, WTMS jurisdiction, and theoretical framework used. The studies chosen included any that provided timely and efficient implementation and sustainability of strategies for reduction of patient wait time/length of stay. All studies conducted internationally that were written in the English language up to the year 2019 were included in this study. The setting for all studies used were in the ED and patients included range from pediatric to geriatric.

In grading of evidence, I used the hierarchy of evidence to obtain the highest level of evidence based on methodological quality of design, validity and applicability to patient care (Ackley et al, 2008, pg 80). This grading system provides guidance in the selection of evidence in order to ensure the validity of results. Once the best practices have been identified by this method, the results will be presented to the local hospital. The final results will be displayed in a summary of evidence table.

Summary

Literature shows EDs struggle with wait time due to overcrowding. There are no documented success factors as proven methods in clinical practice for reducing patient wait time through WTMS implementation and more importantly its sustainability. ED crowding leads to negative consequences on patient outcomes. Consequently, patient wait

for health services has been a long-standing concern and lacks a clear, evidence-based standard on appropriate patient wait time.

This doctoral project is a systematic review focused on services provided within the ED setting through an extensive electronic database search of existing articles up to the year 2019. My goal is to be able to present strategies that have effectively reduced wait time delays and patient overcrowding. The grading system used in choosing the research design is in accord with the hierarchy of evidence (Ackley et al. 2008). Data extraction was completed through use of DistillerSR and peer-reviewed and scholarly articles were screened using the PRISMA flowchart, Diagram Generator. The results of this project could provide an opportunity to modify existing practice in the management ED wait time due to overcrowding improving patient workflow.

Section 4: Findings and Recommendations

Introduction

I identified a total of 1,463 titles were from the databases. After I accumulated all search hits presented in the flowchart, I marked and excluded 17 redundant articles. A total of 1,446 articles' titles and abstracts were screened based on inclusion / exclusion criteria. The filtering returned a total of 27 articles and these were scanned on the basis of both title and abstract. Eleven article titles or abstracts not deemed relevant were discarded due to either being conducted in a setting different from the emergency department or not including wait time or wait time reduction / management. Inclusion / exclusion criteria were applied leaving 16 articles to be read in full extent. Of the 16 titles, 12 of these met the eligibility criteria and included for further analysis. I excluded four articles in the final review due to being nonpertinent. A flowchart presenting the article selection process is included in the Appendix B section titled Prisma 2009 Flow Diagram

Findings and Implications

Twelve systematic reviews published up to the year 2019 met the inclusion criteria. Appendix D: Table 1 Twelve systematic reviews provide a summarized review of characteristics. I chose a total of 12 systematic reviews that demonstrated best evidence topics. Of the 40 studies on Lean Healthcare (LH) interventions Tlapa et al. (2020) demonstrated that the results of the effects of Lean Healthcare on patient flow decreased wait time for patients before seeing a healthcare professional in the ED in a total of 24 studies. The longest reduction reported for WT was from 120 minutes to 30

minutes (an hour and a half wait time reduction). Nineteen studies demonstrated a decrease in length of stay for all patients after lean healthcare interventions. The longest reduction reported for LOS was 142 minutes and 11 studies reported a 76-minute length of stay decrease regarding ED discharge patients. Sustainability in this review cannot be confirmed for various reasons, including that approximately a third of the studies reported results of less than 1 year. Longer follow up performance metrics are required to evaluate sustainability. This review demonstrates that Lean Healthcare reduces not only patient wait time, but also length of stay as well while helping healthcare organizations comply with established timely targets and patient throughput as well. Combining both Lean and Six Sigma also demonstrated how together they both resolve more complex issues and help patient flow.

Oredsson et al. (2011) found that fast track provided the best scientific method through review of 13 studies demonstrating positive effects by lowering WT and LOS on patient flow in the ED. Of the five interventions presented in its review, fast track had reduced WT in the ED demonstrated through one randomized control trial (RCT) and five before-after (BA) studies (moderate quality) and three BA studies (low quality). Fast track had also reduced LOS in the ED demonstrated through two RCT and five BA studies (moderate quality). Nurse requested x-ray was represented in a total of three RCT studies of which two were medium-quality studies and one was a low-quality study. Patients were separated by a triage nurse to either nurse first or doctor first assessment resulting in a reduction of LOS for those not in need of an x-ray yet no difference in patients in need of an x-ray. The end result was an outcome median of 10 (6-37)

min/max. Team triage effect on decreased WT through three observational studies resulted in an outcome median of 18 (16 – 2-) min. Team triage decreased LOS as seen in two RCT and two observational studies resulting in an outcome median of 40.5 (0 – 55) min. Although limited, this evidence suggests an effect on patient flow as per WT and LOS outcome measurement. The study showed Point-of care testing (POCT) through six studies; four of these are classified as medium quality and two studies as low quality. There is strong evidence of the effect of POCT on turnaround time through three observational studies providing an outcome median of 51 (51-51) min. whereas the effect of POCT on LOS as observed through two RCT and three observational studies is supported by limited evidence offering an outcome median of 21 (-8-54) min. Streaming had a median reduction for ED WT of 31 min (min 14 -max 48) and a median reduction for Streaming ED LOS was of 9.5min (min 0-max 11). In different triage categories, there was an ED LOS improvement for lower acuity patients of fourteen and 18 minutes less for level four and level five patients respectively. Median reduction for Streaming ED LOS was of 9.5min (min 0-max 11). Overall, the best scientific evidence here for improved WT and LOS through fast track implementation is moderately strong.

Jennings et al. (2014) demonstrated significant wait time and length of stay reduction by emergency nurse practitioner services in comparison to traditional medical services. Nurse Practitioner WT studies (one RCT, one cohort, two audit, one descriptive, one case series, one case-control and one before and after) of which five studies demonstrated decreased wait time and four studies demonstrated no difference in wait time. Two studies showed significant reduction. The first was a prospective

observational audit that demonstrated significant wait-time reduction by emergency nurse practitioners resulting in 14 minutes (5-27) range compared to 50 minutes (range 21-78) for emergency department medical officers. The second study was a large case series that also demonstrated significant wait-time reduction by emergency nurse practitioners resulting in 12 minutes (range 21 – 78). It is clear from this review that emergency nurse practitioners have a positive impact on ED WT.

Beckerleg, Wooler, and Hasimjia (2019) demonstrated a total of nine studies included in this review of which eight studies are observational pre- and post studies with the remaining study a retrospective chart review. Five of these studies demonstrated ED LOS reduction (106 minutes., 55 minutes., 40 minutes., 14 minutes. and 209 minutes.). The study showing ED LOS decrease of 290 min. was for patients admitted to general intensive medicine (GIM) and even more impressive demonstrated sustainability over a period of twelve months. Studies that showed ED LOS reduction of 55 minutes and 40 minutes. also demonstrated sustainability over 12 months and 13 months respectively. This review demonstrated that both audit and feedback in the form of SMS messaging, direct consultation to senior physicians as well as standardization of the admission process might be the most effective and feasible intervention for reduction of ED LOS.

Abdulwahid et al. (2015) demonstrated effective and improved senior doctor triage ED performance by significant reduction in wait time with results based on one strong RCT study, five moderate (two cohort and three BA) studies and seven weak quality studies (one RCT, one cohort, five BA). Two RCT resulted in a decrease median wait time decrease of 26.1, 95% CI (-31.6 to -20.6) and the 11 non-RCT demonstrated a

median wait time decrease of -15 min (interquartile range -7.5 to -18). There was also significant reduction in length of stay through use of senior doctor triage with results based upon four strong quality studies (three RCT, one BA), nine moderate quality studies (one CCT, two cohort, and six BA). Significant senior doctor ED LOS shown through decreased LOS in 3 RCT (RCT 1: MD -122, 95% CI (-133.38 to -110.62), RCT 2: MD -36, 95% CI (-50.97 to -21.03), RCT 3: MD -45, 95% CI (-91.48 to -1.48), RCT 4: ED LOS increase: MD 6, 95% CI (-11.58 to -23.58) representing a valuable solution for ED managers and administrators.

Bullard et al. (2011) assessed the impact of Rapid Assessment Zone / Pod on ED LOS resulting in a total of four studies (one RCT, one CCT and two before and after studies). A before and after study showed significant reduction in ED LOS (MD= -34min; 95% CI: -68.6) and one CCT showed benefit for patients with triage acuity scores of five (MD= -20.0 min; 95% CI: -23.1 to -16.9). One RCT demonstrated nonsignificant ED LOS reduction and, lastly, a before and after study reported significant ED LOS reduction associated with RAZ/RAP intervention through physician initial assessment (MD= -18.0 min; 95% CI: -22.21 to -13.8). Even though these results for the most part appear to suggest a positive effect, evidence available is limited and weak in order to support implementation.

Elder et al. (2015) presented several methods for relieving ED crowding WT and LOS through advanced practice nursing, physician assisted triage, and medical assessment units. These models of care can improve and have shown decreased ED WT and LOS. Study designs for advanced practice nursing ED WT include one RCT, two

Cohort, one Case Control and one before and after study out of which 4 studies demonstrated wait time decrease by advanced practice nursing role in the ED for WT with only one study demonstrating no difference in WT. Study designs for ED LOS included one RCT, two cohort, one before and after and 1 case-controlled study of which 4 studies demonstrated length of stay decrease of LOS with one study demonstrating no difference. Physician assisted triage was represented by a total of six articles with one CCT and one before and after study showing a decrease in ED WT and ED LOS decreased in one RCT and three before and after studies. As an example, one study showed a reduction of patient WT in the ED from 18.3 to 5.5 during 2-hour waiting room assessments. One retrospective cohort study showed the medical assessment unit offered a mean time of 170.2 minutes from medical assessment to decision. Overall, all three interventions are viable and relevant with potential to facilitate ED patient flow in decreasing WT and LOS.

Rowe et al. (2011) demonstrated that triage liaison physician interventions produced a 30-minute reduction in one RCT and a reduction of thirty-seven minutes in patient length of stay in the emergency department through multiple RCTs. Additionally, a sub-analysis of four non-RCT studies was performed with the purpose of comparing single physician triage to team triage resulting in a significant reduction in ED LOS by team triage. Subgroup analysis by type of intervention showed a 23-minute reduction in ED LOS. Based on 3 strong studies (comprised of one RCT and two CCT), 2 moderately strong studies (one ITS and one before and after) and fourteen weak quality studies (one RCT, 2CCT, one Cohort and ten BA). These results offer an outlook for possible

reduction of thirty minutes per patient using TLP in an average sized emergency department equaling 75 hours of additional stretcher space availability per day for unseen patients. A median absolute improvement of 36-minute reduction for ED LOS and 19-minute reduction improvement for physician initial assessment (PIA) offered consistent results specifically significant for triage Level 3 patients requiring urgent care.

Ross (2017) demonstrated that the implementation of rapid assessment team (RAT) at triage could reduce wait-time and length of stay in the ED. 2 RCTs showed a significant ED LOS reduction with one study demonstrating a 24 minute decrease in LOS and the second demonstrating 36 minutes. These results offer an outlook for possible reduction of thirty minutes per patient in a moderately sized emergency department through use of a rapid assessment team that could represent savings of up to 75- hours of extra space per day to see other additional patients.

Carter and Chochinov (2007) included thirty-six articles in the analysis (3 RCT, 18 case control, 9 cohort and the remaining are survey) of which nurse practitioner intervention reduced ED WT in 6 out of 8 studies. As an example ,one study shows the average wait time to see an NP dropped from one hour and 39 minutes to 1 hour and 17 minutes MD – 22 min. Nurse practitioner effect on ED LOS was not evaluated. This review demonstrated that the addition of an NP to the emergency department could reduce wait times and additionally provide quality of care and high patient satisfaction.

Woo, Lee and, Tam (2017) included 15-studies within its review with six out of the fifteen (1 retrospective cohort, 2 RCT and 2 prospective cohort) examining nurse practitioner ED WT with one study demonstrating shorter wait time (median 14 min)

compared to physician (50 minutes). One study demonstrated an improved wait time to treatment with patients receiving analgesia within 30 minutes of arrival and the remaining three studies with no significant difference in wait time to consultation between NP and physician care and NP-physician collaborative care versus physician only. Additionally four out of fifteen studies (one retrospective cohort and three prospective cohort) examined nurse practitioner an ED LOS with two out of four studies showing significant reduction, the remaining studies found similar lengths of stay for both patients managed by either NP or physician as well as for NP/physician collaborative model of care.

Cicolo et al. (2020) demonstrated through two studies, one of high quality and the other of medium quality that the Manchester triage system (MTT) decreased the median wait time (TtT) for triaged high priority level patients by 15 minutes. A total of 2,265 patients were included in both of these retrospective before-and-after studies. The total decreased wait time lowered from 75 minutes to 60 minutes after MTS implementation among patients with a diagnosis of ischemic stroke and additionally there was an increase in the number of thrombolysis procedures performed. MTS did not however decrease median wait time for lower acuity patients with any complaint. A hypothetical plausible explanation for this result may be that the MTS in the ED has an impact on wait time or TtT because it prioritizes patients by urgency levels for need of care. Regardless, a 15-minute decrease was demonstrated for triaged high priority level patients.

In this systematic reviews quest for relevant evidence of successful strategies as proven ED methods for reducing patient wait time and length of stay and sustainability

Beckerleg et al. (2019) demonstrated out of five studies, one study demonstrated both an ED LOS reduction of 55 minutes. as well as sustainability (sustained over 12 months). A second study also demonstrated both an ED LOS reduction of 40 minutes and sustainability of over 13 months. An additional third study demonstrated ED LOS decrease of 290 minutes for patients admitted to general intensive medicine (GIM) with sustainability of 12 months. Incorporating SMS messaging, direct senior consultation as well as standardization of patient admission may be the most feasible and effective intervention.

Recommendations

In an attempt to address the growing concern of ED overcrowding responsible for the worldwide ED congestion affecting and complicating patient flow, it is important for future research to develop more vigorous studies to determine sustainability of all outcomes pertaining to ED WT and LOS because sustainability in certain reviews could not be confirmed for various reasons. There were studies reporting results of less than 1 year or not at all. Larger number of studies of suitable duration and longer robust follow-up performance metrics are needed for all wait time management strategies. Population size differentiation in these studies needs to be consistent as well as interventions occurring at different time intervals during the course of the day. Additionally, the creation of a universal ED outcome measurement tool is recommended for comparative evaluation purposes. New innovative approaches and further studies are recommended and encouraged to fully evaluate the full effect of organizational interventions.

Strengths and Limitations of the Project

The majority of interventions mentioned in this systematic review have strong points employing comprehensive approach resulting in decreased wait time and length of stay for patients in the ED. Although the systematic reviews were graded as high quality or moderate quality, there were within these some primary studies and study designs considered weak as well as some others with design limitations. It is important to highlight the wide variable diversity of methodology used in these reviews as well as small number of studies in some cases.

Section 5: Dissemination Plan

Analysis of Self

In analyzing the success factors that would help the targeted partner organization Level 2 trauma center located in Puerto Rico, providing 24 hour ED services and experiencing excessive wait time and length of stay, there is a recommendation as most effective and feasible intervention. Based on this systematic review's findings for both implementation and sustainability of WTMS for reduction of wait times, SMS messaging, direct consultation to senior physicians and standardization of the admission process could help to achieve the intended goal. ED LOS reduction has been demonstrated (106 minutes, 55 minutes, 40 minutes, 14 minutes and 209 minutes) together with the sustainability established over a period of twelve months (studies that showed emergency department length of stay (ED LOS) reduction of 55 minutes. and 40 minutes. over 12 months and 13 months respectively. Based on these successful results, recommendations will be made to the targeted partner organization to gain administrative, ED leadership team support and stakeholder inclusion for implementation of SMS messaging, direct senior physician consultation, and admission process standardization. There is no heavy capital investment involved in this management strategy to ameliorate the current ED wait time, length of stay and inefficiencies in the overall ED throughput process. Additionally, further research performed simultaneously with this new implementation is recommended to the targeted partner organization with a longer than 12-month period in order to demonstrate sustainability of at least 24 to 36 months. This would further strengthen the actual confirmed findings and offer new insight.

Summary

The purpose of this systematic review was to gather, evaluate, and synthesize the best available literature that would provide the most relevant evidence in identifying successful strategies employed by healthcare institutions as proven methods in clinical practice for reducing patient wait time through WTMS implementation and proven sustainability. The majority of interventions mentioned in this systematic review have strong points employing comprehensive approach resulting in decreased wait time and length of stay for patients in the ED. It is important to highlight the wide variable diversity of methodology used in these reviews as well as small number of studies in some cases. Further research that contributes to a larger sample is encouraged as well as obligatory documented sustainability that offers supportive conclusive evidence.

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Appendix A: Prisma-DTA Checklist



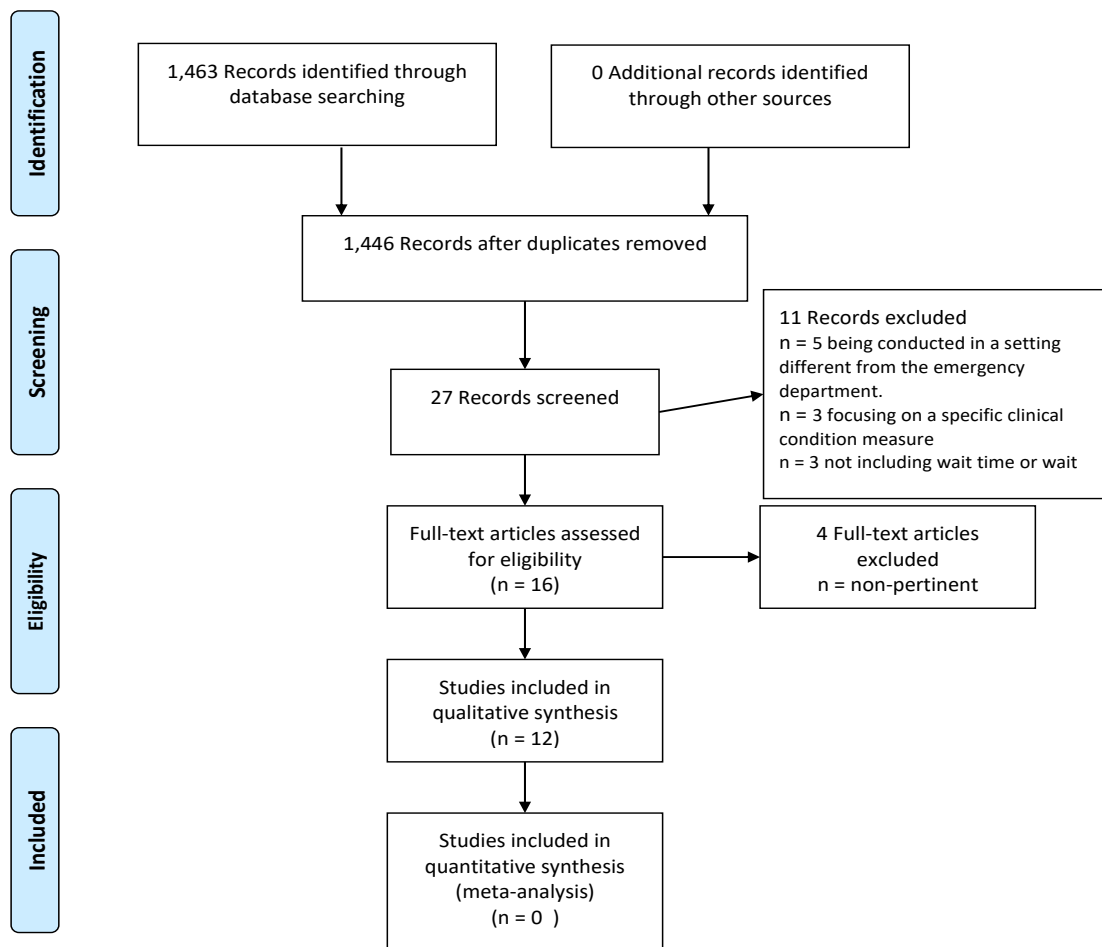
PRISMA-DTA Checklist

Section/topic	#	PRISMA-DTA Checklist Item	Reported on page #
TITLE / ABSTRACT			
Title	1	Identify the report as a systematic review (+/- meta-analysis) of diagnostic test accuracy (DTA) studies.	
Abstract	2	Abstract: See PRISMA-DTA for abstracts.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Clinical role of index test	D1	State the scientific and clinical background, including the intended use and clinical role of the index test, and if applicable, the rationale for minimally acceptable test accuracy (or minimum difference in accuracy for comparative design).	
Objectives	4	Provide an explicit statement of question(s) being addressed in terms of participants, index test(s), and target condition(s).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (participants, setting, index test(s), reference standard(s), target condition(s), and study design) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	
Search	8	Present full search strategies for all electronic databases and other sources searched, including any limits used, such that they could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	
Definitions for data extraction	11	Provide definitions used in data extraction and classifications of target condition(s), index test(s), reference standard(s) and other characteristics (e.g. study design, clinical setting).	
Risk of bias and applicability	12	Describe methods used for assessing risk of bias in individual studies and concerns regarding the applicability to the review question.	
Diagnostic accuracy measures	13	State the principal diagnostic accuracy measure(s) reported (e.g. sensitivity, specificity) and state the unit of assessment (e.g. per-patient, per-lesion).	
Synthesis of results	14	Describe methods of handling data, combining results of studies and describing variability between studies. This could include, but is not limited to: a) handling of multiple definitions of target condition, b) handling of multiple thresholds of test positivity, c) handling multiple index test readers, d) handling of indeterminate test results, e) grouping and comparing tests, f) handling of different reference standards	

Appendix B: Prisma 2009 Flow Diagram



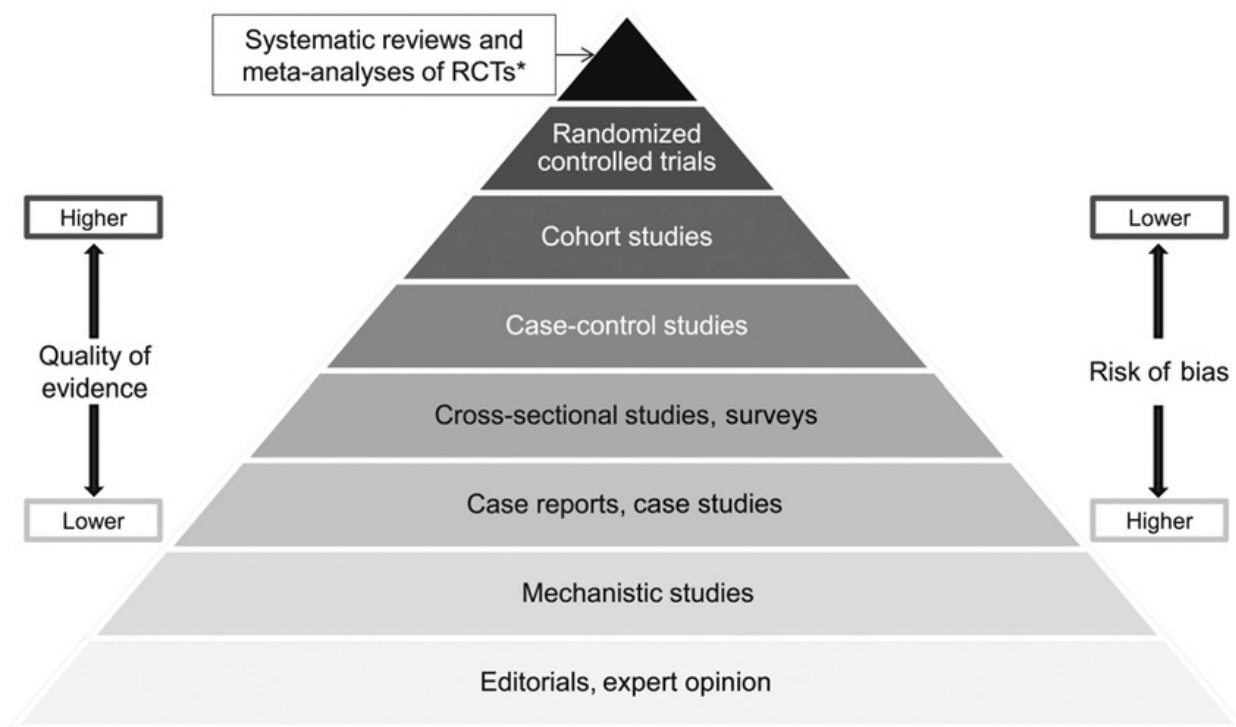
PRISMA 2009 Flow Diagram.



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

Appendix C: AACN's Level of Evidence



Appendix D: Twelve Systematic Reviews

Author, Year	Level of Evidence	Type of Intervention & Study Design	Results
Tlapa et al., 2019	Level 1	Lean WT: 24 studies within the systematic review.	ED WT: 24 studies demonstrated a decrease in wait time. The longest reduction reported for WT was from 120 min. to 30 min.
		LEAN LOS: RCTs, quasi RCTs, CBAs, Case Control, cohort, and Pre-Post Studies.	ED LOS: 19 studies demonstrated decreased LOS after LH interventions. 142 minutes was the longest reduction reported.
Oredsson et al., 2011	Level 1	Streaming WT: 3 BA	Streaming ED WT: Median reduction for ED WT of 31 min (min 14 -max 48).
		Streaming LOS: 2 BA	Streaming ED LOS: Median reduction for ED LOS of 9.5min (min 0-max 11).
		Fast Track WT: 1 RCT 8 BEFORE & AFTER	Fast Track ED WT: Median reduction in waiting time of 24.5 min (2min – 51 max).

Fast Track LOS: 2 RCT 8 Before & After	Fast Track ED LOS: Median reduction for ED LOS of 27 min. (4 min – 74 max). <u>Fast track provided the best overall scientific method here for improved WT and LOS</u>
Team Triage WT: No RCT 3 Before & After	Team Triage ED WT: Median reduction in waiting time of 18 min (min 16-20 max).
Team Triage LOS: 2 RCT 2 Before & After	Team Triage ED LOS: Median reduction for ED LOS of 40.5 min. (min 0-55 max)
Point-Of-Care WT:	Point-Of-Care ED WT: No wait time reported
Point-Of-Care LOS: 2 RCT 3 Before & After	Point-Of-Care ED LOS: Median Reduction in ED LOS of 21 min. (- 8 min – 54 max).
Nurse Requested X-Ray WT/LOS: 3 RCT	Nurse Requested X-Ray ED WT/LOS: Median reduction of 10 min. (min 6 – 37 max).

Jennings et al., (2014)	Level 1	Nurse Practitioner WT: 1 RCT 1 Cohort 2 Audit 1 Descriptive 1 Case Series 1 Case-Control 1 Before & After	Nurse Practitioner ED WT: Five studies demonstrated decreased wait time. Four studies demonstrated no difference in wait time.
		Nurse Practitioner LOS: 1 Cohort 2 Descriptive 2 Audit 1 Case Series 1 Case-Control	Nurse Practitioner ED LOS: Five studies demonstrated ED LOS decrease. Three studies demonstrated no difference.
		SMS Messaging	ED WT: Not evaluated
Beckerleg et al., (2019)	Level 1	SMS Messaging	ED LOS: 5 studies demonstrated ED LOS decrease. The highest decrease for ED LOS was 106 min. decrease. ED LOS decreased by 290 min. for patients admitted to General Internal Medicine
		Senior Doctor WT: 2 RCT 3 Cohort 8 BA	Senior Doctor ED WT: 2 RCT results: Wait Time decrease MD – 26.1, 95% CI (-31.6 to -20.6). 11 Non – RCT demonstrated a median wait time decrease of -15 min (interquartile range - 7.5 to -18)

Abdulwahid et al., (2015)	Level 1	Senior Doctor LOS 4 RCT 1 Case Controlled 3 Cohort 11 Before & After	Senior Doctor ED LOS: 3 RCT decreased LOS 1 ED LOS increase 12 Non RCT LOS median wait time decrease. RCT 1: MD -122, 95% CI (-133.38 to - 110.62). RCT 2: MD -36, 95% CI (-50.97 to - 21.03). RCT 3: MD -45, 95% CI (-91.48 to - 1.48). RCT 4: ED LOS increase: MD 6, 95% CI (-11.58 to - 23.58). 12 Non-RCT: demonstrated ED LOS median increase of -26 min (interquartile range - 6 to -56).
		Rapid Assessment Zone / Pod WT: None	ED WT: No wait time reported
		Rapid Assessment Zone / Pod LOS: 1 RCT 1 CCT 2 Before & After	Rapid Assessment Zone / Pod ED LOS: RCT: MD – 20 min, 95% CI (-47.2 to 7.2 BA: MD -192 min, 95% CI (-211.6 to - 172.4

Bullard et al., (2011)	Level 1	Advanced Practice Nursing Role WT: 1 RCT 2 Cohort 1 Case Control 1 Before & After	Advanced Practice Nursing Role ED WT: 4 studies demonstrated wait time decrease. 1 study demonstrated no difference
Elder et al., (2015)	Level 1	Advanced Practice Nursing Role LOS: 1RCT 2 Cohort 1 Before & After 1 Case Control	Advanced Practice Nursing Role ED LOS: 4 studies demonstrated length of study decrease. 1 study demonstrated no difference
		Physician Assisted Triage WT: 2 CCT 1 Before & After	Physician Assisted Triage ED WT: 1 CCT demonstrated decreased wait time 1 Before & After demonstrated decreased wait time 1 CCT did not demonstrate decreased wait time
		Physician Assisted Triage LOS:	Physician Assisted Triage ED LOS: 1 RCT demonstrated decreased wait time 1 Before & After demonstrated decreased wait time
		Medical Assessment Unit: Other 1 Retrospective	Medical Assessment Unit offered a mean time of 170.2 min from medical assessment to

			decision
		Triage Liaison Physician WT: Not Evaluated	Triage Liaison Physician ED WT: not evaluated
		Triage Liaison Physician LOS: 2 RCT 4 CCT 11 Before & After 1 ITS 1 Cohort	Triage Liaison Physician ED LOS: demonstrated decrease in 2 RCT: MD -36.8, 95% CI (-51.1 to -22.8) reduced LOS with an average of 37 minutes.
Rowe et al., (2011)	Level 1	Rapid Assessment Team WT: 1 (RCT) 1 (Cohort) 5 (Prospective or Retrospective)	ED WT: 1 (RCT) showed significant reduction in wait time. Non-RCT studies showed significant reduction.
		Rapid Assessment Team LOS: 3 (RCT) 9 (Prospective/ Retrospective) 2 (Cohort)	ED LOS: 2 RCTs demonstrated significant ED LOS reduction (24 and 36 minutes less respectively). 10 non RCT demonstrated a significant reduction in ED LOS 2 Non RCT: demonstrated no significant change in ED LOS
Ross, B. (2017)	Level 1	Nurse Practitioner WT: 3 (RCT) 18 Case Control	Nurse Practitioner ED WT: Wait time in general is reduced in 6 out of 8 studies.

		9 (Cohort) Remaining: Survey	One study shows the average wait time to see an NP dropped from one hour and 39 minutes to one hour and 17 minutes MD – 22 min. and after introduction of this model, wait time dropped for all patients in the department.
		ED LOS: not evaluated	Nurse Practitioner ED LOS: not evaluated
Carter & Chochinov (2007)	Level 1	Nurse Practitioner WT: 2 (RCT) 1 (Retrospective Cohort Study) 3 Prospective Cohort Study)	Nurse Practitioner ED WT: One study demonstrated shorter wait time (median 14 min) compared to physician (50 min). One study demonstrated an improved wait time to treatment with patients receiving analgesia within 30 min. of arrival and the remaining three studies found similar wait time to consultation between NP and physician care and NP-physician collaborative care vs. physician only

Woo et al., (2017)	Level 1	Nurse Practitioner ED LOS: 1 (Retrospective Cohort) 3 (Prospective Cohort)	Nurse Practitioner ED LOS: 2 out of 4 studies demonstrated significant reduction, the remaining studies found similar lengths of stay for both patients managed by either NP or physician as well as for NP/physician collaborative model of care.
Cicolo et al., 2020	Level 1	Triage System (Manchester) WT: 2 (both retrospective, before - and - after studies)	Triage System (Manchester) ED WT: demonstrated decrease in 1 study: MD -15, CI (-75 to -60) reduced WT an average of 15 minutes only for highest priority patients. MTS did not decrease the median wait time for low acuity priority patients.
		↓	
		ED LOS: not evaluated	ED LOS: not evaluated
