7-23-2024

Reducing Door-to-Balloon Time in STEMI via Interprofessional Collaboration Protocol: A Quality Improvement Project

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A Scholarly Project Presented to the Faculty of the

Nicole Wertheim College of Nursing and Health Sciences

Florida International University

In partial fulfillment of the requirements

For the Degree of Doctor of Nursing Practice

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Acknowledgments

I extend my heartfelt appreciation to Dr. Sherman for your invaluable guidance, mentorship, and expertise. Your insights have been instrumental in shaping this project. I also wish to thank Dr. Awaida for serving as my preceptor and for sharing your knowledge and expertise. I am particularly grateful for your patience and availability throughout this process.

I am grateful to my DNP project committee, Dora Jean-Charles, Darcy Nikes, Jesse Valiente, Bryan Champagne, Cath-lab amazing Registered Nurses and Techs, the Emergency Department, and the Intensive Care Unit staff, for their valuable feedback and support along this journey. Your encouragement and belief in me have meant the world.

I dedicate this achievement to my amazing father, Tadeo, whose unwavering support, guidance, and love have been my guiding light. Your belief in me has been my greatest strength, and I am forever grateful for your sacrifices and encouragement throughout this journey.

To my lovely mother, Martha. Your solid belief in me has given me the strength to pursue my dreams, and I am deeply grateful for your encouragement throughout this journey.

I would like to express my deepest gratitude to my beautiful sisters, Brenda and Tatiana. Your resilience, curiosity, and endless enthusiasm have been my constant inspiration, pushing me forward even during the most challenging times.

To my dear boyfriend, Aaron, you played a fundamental role in this project, providing insightful feedback, lending a listening ear during moments of frustration, and offering your expertise whenever needed. You have been my rock, always offering love and support every step of the way.

Last and never least, I offer my deepest gratitude to God for granting me the strength, wisdom, and perseverance throughout this journey.

Abstract

Background: Acute myocardial infarction (AMI) is a severe medical emergency caused by the abrupt blockage of coronary arteries, resulting in insufficient blood supply and heart tissue damage (Vogel et al., 2019). Primary percutaneous coronary intervention (PCI), using a catheter with an inflatable balloon, aims to restore blood flow by reopening blocked arteries (Zurowska-Wolak et al., 2019). The door-to-balloon (D2B) indicates the time from an ST-elevation myocardial infarction (STEMI) patient's hospital arrival to balloon inflation or stent deployment is crucial for achieving better patient outcomes and reducing hospital stays (Zurowska-Wolak et al., 2019).

Purpose: This quality improvement project initiative sought to decrease door-to-balloon times to under 60 minutes for Emergency Department (ED) patients presenting with ST-elevation myocardial infarction (STEMI) in at least 85% of cases.

Methods: This quality improvement project was held in a tertiary medical center in Delray Beach, Florida, using “the STEMI tracking” form to collect data for patients seen in the Emergency Department (ED) and diagnosed with STEMI. The project compared baseline data collected in September, October, and November in the year 2023 to post-implementation data in April, May, and June in the year 2024. The intervention included to the existing protocol, including the addition of an ICU-RN to the team and use of a digital notification alert.

Results: For patients with STEMI, the times compared were ED admission-to time to EKG, time in ED, time in corridor, time in cath-lab, and overall door to balloon time. Although, no statistically significant differences were found when comparing 2023 to 2024 data, likely due to small sample size and high data variability, all of the study variables showed a decrease in time

from cases in 2023 to cases in 2024. The overall D2B time was reduced from 81.5 minutes in 2023 to 74 minutes following addition of the intervention.

Conclusion: This QI project aimed to reduce D2B times for STEMI patients at Delray Medical Center using an ICU-RN on the on-call team and a digital platform for notifications. While no significant post-intervention improvement was found (small sample, high variability), a trend toward faster times emerged which is important for the institution to meet the national standards of D2B times of 60 minutes. Limitations included sample size, population homogeneity, and data entry challenges. The project highlights the importance of interprofessional collaboration and the value of communication tools to promote positive patient outcomes. Future studies with robust methods are needed for definitive assessment.

Keywords: Myocardial Infarction (MI), ST-Elevation Myocardial Infarction (STEMI), Percutaneous Coronary Intervention (PCI), Door-To-Balloon (D2B), Emergency Department, on-call-communication, Intensive Care Unit (ICU).

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I. Introduction

Problem Background

Each year, the American Heart Association (AHA) collaborates with the National Institutes of Health (NIH) to provide the most current statistics on heart disease, stroke, and cardiovascular risk factors. As of the 2022 statistical data, it was revealed that in 2019, cardiovascular disease (CVD) was responsible for 874,613 fatalities in the United States (Benjamin et al., 2019). On average, someone in the United States experiences a myocardial infarction (MI) approximately every 40 seconds. In 2019, coronary events were projected to affect roughly 1,055,000 individuals, encompassing 720,000 new cases and 335,000 recurrent occurrences (Benjamin et al., 2019). The typical age for the first MI occurrence is 65.6 years for men and 72.0 years for women (Benjamin et al., 2019).

Acute myocardial infarction (AMI) is a critical medical emergency that occurs when the sudden blockage of one or more coronary arteries leads to a lack of blood supply and subsequent tissue damage in the heart (Vogel et al., 2019). The primary approach to treating AMI involves reperfusion therapies designed to reopen the blocked arteries. For AMI cases with ST-elevation myocardial infarction (STEMI), the preferred treatment method is primary percutaneous coronary intervention (PCI). This procedure restores blood flow by using a catheter with an inflatable balloon to reopen the blocked arteries (Zurowska-Wolak et al., 2019). The door-to-balloon (D2B) signifies the time elapsed from a STEMI patient's arrival at the hospital to the moment when the balloon is inflated (or a stent is deployed) to reopen the blocked arteries. Minimizing this delay in primary PCI is considered a crucial strategy for improving patient outcomes and minimizing hospital stays (Zurowska-Wolak et al., 2019).

Problem Identification

According to Vogel et al. (2019), coronary artery disease (CAD) refers to coronary atherosclerotic disease, leading to significant narrowing of coronary arteries and inadequate blood supply to the heart muscle. In numerous cases of ST-Elevation Myocardial Infarction (STEMI), the condition arises from the complete blockage of a coronary artery caused by a blood clot forming (Vogel et al., 2019). The suspicion of STEMI arises when a patient presents with chest pain and exhibits persistent ST-segment elevation in two or more anatomically contiguous ECG leads (Vogel et al., 2019). When a patient complains of chest pain, standard protocols are typically initiated by interdisciplinary staff and physicians to ensure a prompt and effective intervention (Vogel et al., 2019). This swift intervention begins with immediately recognizing symptoms, conducting a diagnostic electrocardiogram (EKG), and triggering a Cardiac Alert. After the initiation of the Cardiac Alert, meeting specific criteria is essential to achieve a door-to-balloon time under 90 minutes, following the American Heart Association's (AHA) recommendations (O'Gara et al., 2013). Standards by the European Society of Cardiology, advocate for a more aggressive approach, suggesting that patient outcomes improve when door-to-balloon times are under 60 minutes (Tungsubutra & Ngoenjan, 2019). Anticipating a potential alignment of U.S. standards with this trend, a needs assessment at the DNP project site has identified the imperative for process improvement. This involves incorporating an intensive care unit registered nurse (ICU-RN) into the STEMI team, followed by a mass digital alert using a secure messaging platform to notify the on-call team.

Problem Statement

In accordance with findings by Zurowska-Wolak et al. (2019), a delay in the treatment of a heart attack is associated with elevated mortality rates. Studies conducted by angioplasty sub-study investigators Zurowska-Wolak et al. (2019) revealed that when PCI was administered within the initial hour of symptoms, the 30-day mortality rate was 1%. However, when PCI treatment was delayed and took 60-90 minutes, the mortality rate increased to 4%. Furthermore, when the time exceeded 90 minutes, the 30-day mortality rose to 6.4% (Zurowska-Wolak et al., 2019). These findings emphasize the critical importance of timely interventions, particularly early PCI implementation, in reducing mortality risks for patients experiencing MI. The alarming nature of these statistics goes beyond their impact on patient care and outcomes. The Centers for Medicare and Medicaid Services (CMS) highlights the importance of linking quality to payment, as seen in initiatives like the hospital readmission reduction program, which specifically monitors readmission rates for patients with AMI (CMS, 2022). Therefore, this issue is not only pertinent to patients' outcomes but also carries financial implications for hospitals.

Knowledge Gap

Heart disease stands as the primary cause of death in Florida, including Palm Beach County. In the year 2021, heart disease was responsible for 50,027 deaths across the state, as reported by the Florida Department of Health (FDH, 2021). In Palm Beach County specifically, there were 4,060 deaths attributed solely to heart disease during the same year (FDH, 2021).

The current process when a patient presents with a STEMI on the ECG in the Emergency Department (ED) or outside the hospital, includes ED staff activating a "cardiac alert" that is also announced on the overhead intercom throughout the hospital. The overhead announcement alerts the hospital staff to get ready for a potential STEMI patient. The ED physician analyzes the ECG

followed by the notification of the on-call cardiologist about the results. The on-call cardiologist then decides to activate the Cath lab staff or to downgrade the STEMI alert. Once the cardiologist confirms that the patient is having an MI, the charge nurse in the ED notifies the house supervisor who will then call, through the hospital line, each Cath lab staff member on the daily roster. The Cath lab staff is expected to arrive within 30 minutes of receiving a phone call, particularly if the call is initiated after 5 pm or on weekends. Subsequently, the Cath lab staff will contact the Emergency Department (ED) to confirm that all Cath lab team members have arrived and are prepared to receive the patient. Once the PCI is complete, the patient will automatically be admitted to the intensive care unit.

The identified time delays in the D2B process are impacting the organization's ability to meet the institution’s goal. A source of delay can be experienced when the ED staff ineffectually prepares patients for a PCI; this preparation includes the process of shaving the patient’s groin area and removing the patient’s clothing. Another key delay is the time spent calling each Cath lab staff member to assemble the on-call STEMI team.

To address these practice gaps, best practice initiatives suggest the utilization of a specially trained registered nurse (RN) to respond to the Cardiac Alert, known as a STEMI ICU-RN. This RN from the ICU would offer additional support in completing the chest pain order set in the Cath lab and assist the on-call staff team with assistance with groin/wrist shave, ECG leads placement, and arterial line set-up. Lastly, another approach to improve D2B times is to implement a digital secure mass text to the on-call staff team. This tool will notify the on-call staff STEMI team at the same time and will have an official record of notification time.

Problem Significance

The current guidelines in the United States for STEMI, recommend that the time from symptom onset to D2B intervention should be 90 minutes or less. On the other hand, the European Society of Cardiology (ESC) currently advises that the time from diagnosing STEMI to crossing the coronary artery with a wire should be within 60 minutes for patients arriving at a hospital equipped for primary PCI (Tungsubutra & Ngoenjan, 2019). Rapid reperfusion is linked to more positive patient outcomes, leading to reduced illness and lower mortality rates (Tungsubutra & Ngoenjan, 2019). A study by Rathore et al. (2018) reported that patients who passed away in the hospital experienced a median door-to-balloon time that was 14 minutes longer than those who survived. Additionally, in the Rathore et al. (2018) study, patients in the groups with extended door-to-balloon times exhibited a higher crude mortality rate when compared to those with D2B times under 60 minutes. Therefore, the optimal approach for addressing an acute coronary syndrome (ACS) episode is to begin within 60 minutes of symptom onset. This approach should involve early reperfusion and the administration of medications, such as statins, beta-blockers, and aspirin or antiplatelets, to decrease both mortality and illness rates (Rathore et al., 2018).

In 2007, the AHA established the Mission Lifeline program in collaboration with the American College of Cardiology (ACC). Its primary objective was to monitor and enhance initiatives for STEMI care within healthcare systems across the United States (Rathore et al., 2018). The most recent AHA goal now aims for reperfusion within 60 minutes for STEMI patients. Achieving this goal will require healthcare systems to address any weak areas in their Lifeline system (Tungsubutra & Ngoenjan, 2019).

Problem Solution

This quality improvement project aimed to decrease the D2B times by enhancing the current protocol to include a STEMI ICU-RN and utilization of a mass digital alert for the on-call Cath lab staff called LifeNet. The project goal was to reach a D2B time lower than 60 minutes for patients with STEMI. To improve the metric, nursing staff from the intensive care unit and house supervisors received training to assist in the Cath lab. The STEMI ICU-RN assisted in the Cath lab and helped ease the patient's arrival to the Catheterization department. The STEMI ICU-RN expedited the completion of the STEMI pathway checklist, including calling the ED before the Cath lab staff's arrival to obtain the report from the ED, adding the Cath lab order to the system, and assisting the Cath lab staff in putting ECG leads on the patient. Another problem solution was to add digital push notifications via text messages to the on-call Cath lab staff. This allowed the Cath lab staff to be notified at the same time instead of getting an individual phone call at different times.

II. Review of the Literature

Search Strategy

The literature review was conducted using the databases of PubMed Central, MEDLINE, and CINAHL. The key terms utilized within the search include the following: STEMI, reduced door-to-balloon time, Emergency Department (ED), ST-elevation myocardial infarction, percutaneous coronary intervention, cardiac catheterization, push notifications, paging, text messages, and on-call team notifications. The searches included a combination of the keywords as follows: door-to-balloon and STEMI, paging and STEMI, Emergency Department and STEMI, and communication and on-call STEMI team. The inclusion criteria were quantitative

studies, articles no older than the year 2019, and detailed study explanations about D2B improvement. On the other hand, the exclusion criteria included: articles older than 2019 and non-full text articles.

The first database used was PubMed Central with the keyword: *STEMI* with a total of 20,326 journal article results that were further refined with the keyword: *reduced door-to-balloon*, which resulted in 811 journal articles. The search then was refined to include articles published in the last five years and peer-reviewed journals, with a total of 68 journals peer-reviewed articles. Of these, only 5 were relevant to this project. An exception to the search was made when searching for *cardiac catheterization history*. This search included articles older than 2019. Only 9 articles were relevant to the study.

The second database used for the review of the literature was MEDLINE with the following keyword: *door-to-balloon times* and yielded 42,462 words. This was further narrowed to 5,948 articles by adding the Emergency Department. The search excluded articles that were older than 2019. By adding *mobile application* to the search criteria, a number of 29 articles were identified. Only 2 articles were pertinent to the research.

Lastly, the third database used for the search was ProQuest Central with a total of 43,294 results when the *percutaneous coronary intervention* key phrase was utilized. The search was narrowed by adding the word *cardiac catheterization*, resulting in a reduced total of 7,784 articles. To narrow the search the following filters were used: peer-reviewed journals, review articles, and the American Journal of Cardiology. A total of 16 articles were identified of which only 3 were appropriate for the research study.

In addition to the previous three mentioned article databases, the Gale Academic OneFile Select database was used to search intensive care units. The keywords used were *reduced door-*

to-balloon time, intensive care unit, and *team approach*. Only one article was pertinent to the research that was older than 2019.

The History of Cardiac Catheterization

Cardiac blood circulation was first explained by William Harvey in 1628. However, it was not until 1929 that the first cardiac catheterization was performed by Werner Forssman, who carried out the procedure on himself (Bourassa, 2005). Soon after, Andre Cournand and Dickinson Richards pioneered diagnostic cardiac catheterizations in the early 1940s. It allowed doctors to directly examine the heart and its surrounding blood vessels (Bourassa, 2005). The advent of catheter-based coronary interventions, such as coronary angioplasty and stenting, was made possible by Andreas Greuntzig in the late 1970s, revolutionizing the treatment of coronary stenosis. Despite its potential, catheter-based interventions did not become the standard for managing STEMIs until the late 1990s, when their effectiveness was firmly established (Smilowitz & Feit, 2016).

At the turn of the 20th century, myocardial infarctions (MI) had risen to alarmingly high mortality rates. The available treatment options were limited to bed rest, oxygenation therapy, and intravenous fluid administration (Melly et al., 2018). However, medical history took a leap in progress in 1960 when Robert Goetz successfully performed a coronary artery bypass grafting (CABG) procedure (Smilowitz & Feit, 2016). Despite its success, CABG did not become the preferred option for treating STEMIs. Thrombolytic therapy, which uses drugs to break up blood clots, began in 1947 when Sol Sherry administered streptokinase to a patient experiencing an MI episode. Consequently, inconsistent, and fatal outcomes were observed due to inadequate drug dosing (Smilowitz & Feit, 2016). However, a study conducted in 1984 by New York University

(NYU) and Mt. Sinai School of Medicine revived thrombolytic therapy. The study concluded that patients who received streptokinase had a better outcome than those who had alternatives during an acute myocardial infarction (AMI) episode (Rentrop et al., 1984).

A study made by the Gruppo Italiano per lo Studio della Streptochinasi nell'Infarto (GISSI) revealed the importance and effectiveness of 60 minutes for optimal coronary reperfusion (GISSI, 1986). In addition, the GISSI highlighted in their study that the patients who received intravenous thrombolytic therapy within 1-3 hours of an AMI onset, had a notably reduced mortality rate. This evidence-based approach has opened new possibilities for timely and effective treatment of coronary artery disease (GISSI, 1986).

In 1977, Andreas Gruentzig made a significant breakthrough in the medical field by successfully performing the first cardiac catheterization on a 38-year-old man with severe stenosis of his left anterior descending (LAD) coronary heart artery (Smilowitz & Feit, 2016). Following this medical milestone, Geoffrey Hartzler played a pivotal role in advancing angioplasty. He expanded the scope of angioplasty beyond simple discrete lesions to include complex cases involving patients with multiple vessel disease, chronic total occlusions, and AMIs (Smilowitz & Feit, 2016). However, several physicians were hesitant to do PCI interventions when compared to thrombolytic therapy, which was the prevailing treatment at that time. The Primary Angioplasty in Myocardial Infarction (PAMI) study involved the comparison of primary percutaneous coronary angioplasty (PTCA) (angioplasty without thrombolytic therapy) vs thrombolytic therapy for AMI. The results demonstrated efficacy with lasting results when the primary PTCA approach was used compared to thrombolytic therapy (Nunn et al., 1999).

The PCI techniques were refined by adding the Palmaz-Schatz balloon expandable stent. The tubular coronary device inserted into arteries transformed the field of cardiology, presenting doctors with an innovative and lifesaving tool (Smilowitz & Feit, 2016). Once implanted, the stent guaranteed that blood vessels stayed open, allowing for an unobstructed bidirectional flow to the heart (Smilowitz & Feit, 2016). According to Nunn et al. (1999), the second Primary Angioplasty in Myocardial Infarction (PAMI-II) trial provided substantial evidence, establishing coronary stenting as the standard of care for STEMI patients, enabling doctors to provide a more effective and safer treatment option for their patients (Melly et al., 2016).

With the advent of PCI and stenting as the preferred treatment for STEMI patients, research has been focused on determining the optimal time for conducting the procedure to achieve the best outcomes (Melly et al., 2016). The "Door-to-Balloon" time concept was introduced and gained prominence in trials such as GUSTOIIb (1997). This study demonstrated that PTCA within an hour of presentation could reduce 30-day mortality to just 1% (GUSTOIIb, 1997). As evidence accumulated regarding the importance of timing, STEMI systems and networks were developed. As a result, heart associations such as the American Heart Association and the American College of Cardiology worked together and develop the CATH PCI registry to monitor hospital metrics (Smilowitz & Feit, 2016).

More than fifty years ago, Eugene Braunwald put forth the time is muscle hypothesis, which has been backed by several studies over the years. Braunweld’s studies concluded that injuries with coronary arteries can be mitigated if reperfusion happens within three hours of infarction (Abreu, 2019). The PCI procedure is an effective and quick way to restore cardiac perfusion. McNamara et al. (2006) highlighted the importance of prompt Cardiac Alert activation to significantly improve the patient’s long-term outcomes.

Intensive Care Units

The field of critical care cardiology has undergone significant advancements since the establishment of the first coronary care unit (CCU) in the early 1960s (Lüsebrink & Kellnar, 2021). It has now become a rapidly evolving sub-specialty within cardiovascular medicine. Modern cardiac intensive care units (CICU) care for a diverse range of patients with a high incidence of both cardiovascular and non-cardiovascular critical conditions (Lüsebrink & Kellnar, 2021). Lüsebrink and Kellnar (2021) also highlighted that to effectively manage these patients, a multidisciplinary approach is necessary, combining specialized expertise in cardiovascular diseases with proficiency in emergency medicine, critical care, and internal medicine.

Initially created to rapidly identify and treat arrhythmias caused by acute MI, the CCU has since transformed into the CICU, which now provides comprehensive monitoring and treatment for a wide range of critical cardiovascular diseases (CVDs). As Kasaoka (2019) explains, the role of cardiovascular intensive care has evolved in response to the rapid advances in diagnostic and therapeutic approaches within clinical cardiology. With the emergence of new technologies, intensive care for CVDs has progressed significantly. As a result, the number of severely ill CVD patients admitted to the CICU continues to increase annually (Kasaoka, 2019).

Nursing Staff

Effective communication and collaboration among medical professionals, nurses, and allied healthcare professionals (AHCP) are crucial for the success of intensive care medicine. Valentin and Ferdinande (2011) highlight the significance of establishing well-defined communication processes between medical and nursing staff within the Intensive Care Unit

(ICU), accompanied by a clear delineation of tasks and responsibilities. The nursing staff is overseen by a dedicated charge nurse, responsible for maintaining the quality of nursing care and ensuring the proper functioning of the unit.

Valentin and Ferdinande (2011) recommend that the charge nurse leading intensive care nursing should have extensive experience in this field. Typically, the charge nurse is also supported by a deputy head nurse who can step in when needed. In addition to overseeing the nursing team, the charge nurse should facilitate ongoing education and collaborate with the medical director to provide policies, protocols, directives, and overall support (Valentin & Ferdinande, 2011). While charge nurses and their deputies are not expected to engage in routine nursing activities, it is essential that intensive care charge nurses undergo formal training in this field. Schmalenberg and Kramer (2007), as cited in Valentin and Ferdinande (2011), highlighted the importance of implementing a specific program to ensure a minimum level of competencies among the nursing staff.

In the United States, ICUs are classified based on the level of nursing care they provide and their capacity for delivering aggressive, lifesaving treatments (Valley et al., 2019). For patients with STEMI and borderline ICU needs, enhanced nursing care in ICUs may offer advantages such as early detection of complications or decompensation. Valley et al.'s (2019) study concludes that the complexity of STEMI patients, who may also present non-cardiac conditions, suggests the potential benefits of ICU care. The study also suggests that ICUs may offer more timely access to treatments and more effective protocols for essential care compared to non-ICU units.

Current Communication Technologies

Managing STEMI is a complicated process that requires precision and collaboration among healthcare professionals. Gathering and verifying critical data quickly is crucial because any delay can predict mortality in STEMI patients who undergo PCI (Krishnamoorthy et al., 2021). Over the years, several strategies have been implemented to decrease delays in the STEMI management system, including obtaining a pre-hospital ECG by EMS (Krishnamoorthy et al., 2021). While pre-activating the Cardiac Catheterization Laboratory (CCL) is an important suggestion to reduce reperfusion time and decrease mortality. This may result in frequent cancellations due to false alarms.

Recent studies have shown that healthcare mobile applications and other communication methods have revolutionized STEMI management, especially in how patients receive medical treatment (Krishnamoorthy et al., 2021). Multiple teams working together seamlessly are required to optimally care for a STEMI patient, necessitating efficient and swift coordination of all components (Krishnamoorthy et al., 2021). Telemedicine systems, social communication platforms, and mobile apps have been successful tools in optimizing STEMI care for the past decade (Krishnamoorthy et al., 2021).

The STEMI activation protocol involves several steps to respond to the emergency and alert the cardiologist. Research has shown that mobile applications and instant messaging can improve inter-team communication and enable faster emergency alerts (Alkamel et al., 2020). For example, instant messaging apps like WhatsApp have already proven to be effective in sharing healthcare information among obstetrics and neonatal care personnel (Alkamel et al., 2020). Likewise, customized STEMI management apps can facilitate efficient coordination among the STEMI management team during emergency responses (Alkamel et al., 2020).

Moreover, recent studies highlight that mobile applications can also support shared decision-making, empower patients, and improve patient satisfaction. These apps have the potential to save healthcare providers' time, improve their work efficiency, and ultimately benefit both healthcare professionals and patients (Alkamel et al., 2020). According to Haghi et al. (2021), a data communication platform is an information technology infrastructure that facilitates the transfer of data between distinct systems, devices, or applications. Such platforms provide the requisite tools and protocols for efficient, secure, and reliable transmission, receipt, and processing of information. In essence, these platforms serve as a conduit for seamless data exchange, minimizing the risk of data loss, corruption, or unauthorized access. Given its critical role in today's interconnected digital landscape, data communication platforms are essential for businesses and organizations seeking to optimize their operations and stay ahead of the curve.

LifeNet Care is a data communication platform that aims to reduce D2B times in patients experiencing STEMI. This comprehensive program has been designed to enhance patient care and outcomes, with a focus on streamlining the entire process from symptom onset to the restoration of blood flow through PCI (LifeNet Care, 2022). The LifeNet Care platform facilitates the timely and efficient transmission of patient data, enabling healthcare providers to collaborate seamlessly and make informed decisions about patient care (LifeNet Care, 2022). The implementation of LifeNet Care represents an important step forward in the field of cardiology, providing healthcare professionals with a valuable tool to improve patient outcomes and streamline care processes.

III. Purpose, PICOT Clinical Question, and SMART Goal

Purpose

The purpose of the DNP project was to provide operational improvements in the clinical setting. In the case of Delray Medical, it was found that door-to-ballon times needed to be improved. The established process was reviewed, and two recommendations were evaluated for their efficacy on D2B time reduction. The first recommendation was to add an ICU RN to the on-call team. The second was to leverage the mobile app (LifeNet) to send mass text notifications.

PICOT Clinical Question

The acronym PICOT refers to Population, Intervention, Comparison, Outcome, and Time, as outlined by Bell and O'Donovan (2021). Its primary purpose, as elucidated by Bell and O'Donovan, is to aid in the identification of significant evidence through research by constructing a focused clinical inquiry. Bell and O'Donovan further underscore that Doctor of Nursing Practice (DNP) graduates must leverage evidence-based practice to effect changes in organizational systems and policies, yielding favorable outcomes for both patients and systems.

The PICOT question aimed to explore how the implementation of an interprofessional collaboration protocol can impact the reduction of Door-to-Balloon times. Specifically, the question focused on understanding the potential influence of the utilization of a mass digital alert for on-call staff, as well as adding an ICU-RN to the STEMI team, to bridge the resource gap on expediting the crucial timeframe of achieving balloon angioplasty, to reach a D2B time to be less than 60 minutes.

This Doctor of Nursing Practice (DNP) project explored the following question: In adult patients with ST-Elevation Myocardial Infarction (STEMI) arriving at a tertiary medical center (P), can the addition of an ICU-RN to the STEMI team, as well as implementing a mass digital alert, LifeNet Care, for on-call staff to the current protocol (I), when compared to the current practice (C), result in a significant reduction in door-to-balloon time (O), within three months of protocol implementation (T)?

SMART Goal

As per Bell and O'Donovan (2021), they describe SMART as an acronym used to guide goal setting. SMART stands for (S)pecific, (M)easurable, (A)chievable, (R)elevant, and (T)ime-bound, ensuring that goals are clearly defined and attainable. The SMART goal for this quality improvement project is as follows:

- **Specific**: Reduce the average door-to-balloon (D2B) time for STEMI patients at Delray Medical Center to 60 minutes or less by adding a dedicated STEMI ICU-RN and implementing the LifeNet Care platform within the Cath-lab on-call team.
- **Measurable**: The DNP candidate measured D2B time by tracking the time from patient arrival in the Emergency Department to balloon inflation during percutaneous coronary intervention (PCI). D2B times were tracked weekly and added to an Excel spreadsheet.
- **Achievable**: Achieving a D2B time of 60 minutes is aligned with best practices established by the European Society of Cardiology (Ibanez et al., 2018). The addition of a dedicated STEMI ICU-RN and the functionalities of LifeNet Care platform are designed to streamline communication and expedite patient preparation.

- **Relevant**: Reducing D2B time is critical for improving patient outcomes in STEMI cases. Faster reperfusion of the blocked coronary artery minimizes heart muscle damage and improves patient prognosis (Tsao & Wu, 2022).
- **Time-bound**: This goal will be achieved within a timeframe of 12 weeks.

IV. Organizational Assessment and SWOT Analysis

Setting

This project was conducted at Delray Medical Center (DMC), which is classified as a tertiary medical center in Delray Beach, Florida, USA. This tertiary medical center has served the community since 1982. This Level I Trauma Center provides a wide array of medical services, including emergency care, surgical services, cardiovascular care, orthopedics, and more. Delray Medical Center belongs to the Tenet Healthcare Corporation, which is a large for-profit healthcare services company in the United States.

Organizational "Gap" Analysis

Delray Medical Center's new goal was to decrease the D2B times from 90 minutes to 60 minutes. Its current average D2B time is 90 minutes. Several factors contribute to delays in the D2B times. One factor is the delay while calling the on-call Cath lab team. The current process consists of the charge ER nurse notifying the house supervisor of a Cardiac Alert confirmed by the on-call interventional cardiologist. The house supervisor calls each assigned Cath lab staff member via phone. Delays are observed when the staff member receives a call at various times. As Eugene Braunwald once said, *"time is muscle"* (Abreu, 2019). Every minute is essential in the D2B process.

Another factor that contributes to delays in D2B times is the time gap experienced when the ER must wait for the entire Cath lab team to arrive and give the clearance by Cath lab RN to initiate the transfer. The on-call Cath lab staff consists of two RNs and one cardiac catheterization technologist (Cath-lab tech) or two Cath-lab techs and one RN. For safety reasons, at least two out of the three Cath lab members must be present to allow the ER RN to bring the patient. Due to the staff's different home locations times, the arrival at the hospital varies.

Stakeholders

The key stakeholders in improving STEMI D2B times included: administrative personnel, healthcare providers, and education department personnel. The administrative personnel consist of one executive director of cardiovascular services with a Master of Science in Nursing Administration. One medical director of the catheterization lab with a medical degree, and the Emergency Department director with a Master of Science in Nursing Education. The health care providers consist of interventional cardiologists with medical degrees and registered nurses from Cath-lab, ER, and ICU departments. Lastly, the education department for cardiovascular services consists of one nursing educator for cardiovascular services with a Bachelor of Science in Nursing and one educator for the Emergency Department with a Doctor of Nursing Practice and a Family Nurse Practitioner degree.

Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis

Marsic (2023) defines SWOT analysis as an acronym for strengths, weaknesses, opportunities, and threats. This strategic planning tool is widely utilized in business, project

management, marketing, and organizational development. By offering a thorough assessment of internal and external factors, the SWOT tool empowers stakeholders to make well-informed decisions, as outlined by Marsic (2023). The following SWOT analyzed the D2B at Delray Medical.

Strengths

Currently, Delray Medical Center holds a prestigious certification of being a Level I Trauma Hospital. This distinguishable classification means that the hospital is deemed capable of addressing, prioritizing, and providing the maximum level of care following a traumatic injury in a patient. It is a designation that certifies that DMC is upholding national standards for trauma care in both children and adults. Another strength is that the Catheterization Lab has boosted its resources with new staff and new services.

Weaknesses

One of the weaknesses observed is a general lack of information on D2B and the adherence to time entry punctualities, sense of urgency, and awareness of D2B's impact on hospital revenue and social footprint. Another weakness that contributes to a varying delivery of care is the communication delay that occurs when either the ER or House Supervisor alerts the Cath Lab to initiate the Cardiac Alert. The process that enacts the alert is causing that delay because the on-call team is requested sequentially. With each phone call made, some minutes are added inadvertently since the calls are made in sequence of the roster. The last weakness is the inconsistent D2B times that have been detected.

Opportunities

A new opportunity, launched at the beginning of the year 2023, the Cardiac Concierge Program is serving to provide a more personalized approach for patients experiencing heart complications on ER arrival. Another opportunity that can be leveraged is optimizing the utilization of digital alert systems. Implementing a new D2B guide for RNs will help keep the process intact even during turnovers and migrations.

Threats

A major threat is that other hospitals openly advertise meeting AHA's D2B recommendation times. This indicates that they have some measures in place to meet those standards. Another related threat is the present varying levels of D2B times that can jeopardize rankings and risk penalties for non-standard scores. Lastly, staff may rush to meet D2B times which in turn compromises patients' safety and leads to the hospital incurring penalties.

SWOT Analysis of Delray Medical Center	
Strengths • Level I trauma hospital • New staff • New services	Weaknesses • General lack of information on D2B • Communication delay • Inconsistent D2B times
Opportunities • Cardiac Concierge program • Optimizing the utilization of LifeNet digital communication • D2B educational guide for RNs	Threats • Other hospitals openly advertise meeting AHA's D2B • Not meeting standards can risk penalties • Staff may rush to meet D2B times

V. Definition of Terms

The terms for a definition for this project are myocardial infarction, ST-elevation myocardial infarction, Door-to-Balloon, Cardiac Alert, hospital house supervisor, Registered Nurse, and Catheterization laboratory.

Myocardial Infarction: also known as heart attack, occurs when a part of the heart muscle is deprived of oxygen due to a blockage in blood flow caused by a blood clot. This blockage can damage or cause the death of the affected heart muscle tissue (Vogel et al., 2019).

STEMI: ST-elevation Myocardial Infarction: a cardiac event that can be identified by a specific pattern on an electrocardiogram (ECG or EKG). This pattern shows ST-segment elevation and has been documented in research studies (Vogel et al., 2019). STEMI is characterized by the presence of two main criteria. These are the Electrocardiogram presence of a new or presumed new ST segment elevation, and the presence of a new onset (LBBB) (Vogel et al., 2019).

a. For Men-2mm (0.2m V)-in-V2-V3 or 1 mm (0.1mV)-in other contiguous leads.

b. For Women-1.5mm (0.15m V)-in-V2-V3 or >1mm (0.1mV)-in other contiguous leads.

Left Bundle Branch Block (LBBB): is a cardiac conduction abnormality seen on the electrocardiogram (EKG). In this condition, activation of the left ventricle is delayed, which results in the left ventricle contracting later than the right ventricle with concordant ST elevation >1mm or ST depression >1mm in leads V1, V2, V3 (Lee at al., 2019).

Door-to-Balloon Time: is a metric that measures the time interval between a patient's arrival at the hospital (referred to as "door") and the inflation of a balloon during a percutaneous coronary intervention (PCI), such as angioplasty (Lee at al., 2019).

Cardiac Alert: medical protocol or system that is activated in response to a suspected or confirmed cardiac emergency, particularly situations related to heart attacks or other serious cardiovascular events. This alert system is designed to mobilize healthcare professionals and emergency responders promptly, ensuring a prompt and coordinated response to provide timely and appropriate care for the individual experiencing the cardiac event (Vogel et al., 2019).

Off Hours: the time period after the Cardiac Cath Lab Team has reported off to the House Supervisor for the day.

Hospital House Supervisors: responsible for providing staff with guidance and support to ensure the delivery of high-quality healthcare services. They serve as the central point of contact for employees (Stephens, 1993).

Registered Nurse: healthcare professionals who have completed the necessary education and training to obtain a nursing license. They are responsible for implementing medical interventions, educating patients and their families, and advocating for the best interests of the individuals under their care (Godsey et al., 2020).

VI. Theoretical Framework and Conceptual Underpinning

Improving the D2B times can be approached by using the Donabedian Model of healthcare quality measurement, which encompasses three dimensions: structure, process, and outcome. According to Tossaint-Schoenmakers et al. (2021), the first dimension of the Donabedian model is the structure which involves how care is delivered, including setting, equipment, and provider qualifications. The process is the second dimension refers to the delivery of care and involves treatments or services. The third dimension is outcome which involves restoration of health, patient recovery, and survival (Henien, Aronow, & Abbott, 2020).

The Donabedian Model includes all important aspects of an institution's structure, process, and outcome Tossaint-Schoenmakers et al. (2021).

The structure for delivering D2B involves the following settings. The hospital's location is in Delray Beach, FL, with its Emergency Room, Cath lab, ICU department, medical staff, and equipment. The process involves in addition to the current STEMI D2B protocol the implementation of ICU-RN to the on-call team to assist Cath-lab staff with basic patient set-up and implementation of a reliable digital notification system that will reach the Cath-lab on-call team concurrently. The outcome in relation to the Donabedian Model is to reduce D2B times to 60 minutes to ensure Delray Medical Center is continuously meeting standards.

VII. Methodology

Introduction of Quality Improvement Methodology (PDSA)

The Plan, Do, Study and Act (PDSA) model for improvement, as explained by Chen et al. (2021), offers a framework to create, test, and implement changes that will lead to improvement. The PDSA model enables users to conduct small-scale testing of an idea so stakeholders can determine if the proposed change will succeed and refine any necessary steps to achieve desired quality levels (Chen et al., 2021). The PDSA model has four stages that provide the structure for organized improvement. The stages are Plan, Do, Study, and Act, each carrying different types of requisites that move a project through the full cycle.

The "Plan" stage introduces the proposal for change describing a variety of statistical instruments used and the data findings. The "Do" stage describes the implementation of the change, collecting data as the trial is running capturing any issues that may appear. The cycle then moves onto the "Study" stage which reviews and analyses the information gathered in the

previous step. Lastly, the cycle ends with the "Act" stage where the stakeholders use the meaningful data gathered to decide whether to keep the change or retry the trial with new parameters.

Plan Stage

The D2B times at Delray Medical need to be improved to meet acceptable standards. A hospital committee was created to work with the DNP candidate to redesign the current process. The committee represents the relevant stakeholders at the leadership level to implement the trial at Delray Medical Center. The departments involved include the ER, the Cath Lab, and the ICU. Together the different teams handled a Cardiac Alert through a multi-step process capturing information on each step.

Study Design

This study employed a quasi-experimental design with pre- and post-intervention comparisons between the findings obtained. Data on door-to-balloon times were collected before and after the implementation of the intervention of an ICU RN to the team and use of a digital alert app to the existing protocol.

Setting

The setting of this project was a tertiary medical center in Delray Beach Florida. The implementation of this project was executed within the Cardiac Catheterization Laboratory and Emergency Department. The hospital is a state-designated Level One Trauma Center whose ER is available 24/7. The Cath-lab hours are Monday through Friday 7:00 AM to 5:30 PM. The

after-hours begin at 5:30 PM and include weekends. The on-call team consists of three staff members which can be two RNs, one Cath-lab tech, or one RN and two Cath-lab techs.

Sample

The inclusion criteria were adult patients who arrived at the ER with a STEMI identified on EKG. The sample size consisted of 11 patients over a three-month time frame in 2023, specifically the months of September, October, and November of 2023. This time frame was selected to ensure more complete documentation on the STEMI Tracking Form. Following IRB approval, the project was implemented in 2024 with sample size of 9 patients during the months of April, May, and June of 2024 with the QI protocol.

The exclusion criteria for this DNP Project were patients younger than 18 years of age and adult patients who were not candidates for Percutaneous Coronary Intervention.

Intervention

The protocol for handling ST-elevation myocardial infarction (STEMI) alerts was enhanced with two intervention measures.

1. **Addition of ICU to the STEMI Call Team**: An ICU RN with specialized training in cardiac care was added to the STEMI call team. The RN's role involved assisting with the order set and aiding in patient preparation such as shaving the access site placing leads and setting up arterial lines.
2. **Digital Notification App**: A digital app was introduced to facilitate real-time notifications to the Cath lab team about incoming STEMI cases. The app allowed for instant alerts, reducing the time required for manual communication coordination.

The STEMI committee was engaged for approval to start instructing staff on the test run for the proposed change. The following staff were prepped to handle future STEMI alerts with the new procedure, including charge nurses, relieve charge nurses, ED charge nurses, ICU RNs, and house supervisors. This cross-departmental effort allows for the *STEMI Tracking* Form to be utilized to measure the D2B time.

Study Instruments

To measure the outcome of this DNP project, a STEMI Tracking Form was utilized to obtain times spent from ED admission to time to EKG, time in ED, time in corridor, time in cath-lab, and overall door to balloon time. The STEMI Tracking Form was modified to obtain more detailed data to break down the time spent in each department, as well as door-to-balloon times

The DNP Candidate modified the original STEMI Tracking Form (see Appendix A). The form was modified to collect more precise data for the study. The form was a 16-item form used to collect pertinent information about the process. The form was divided into three sections, Emergency Medical Services (EMS) Documentation, ED Documentation, and Cath Lab Documentation. The form is printed with a bright yellow color to stand out. Each STEMI patient had a form. The STEMI Tracking Form was then translated into an Excel spreadsheet (see Appendix B), quantifying the data captured.

Data Collection and Management

All patients who were admitted for potential STEMI were included in the sample. The Cath-lab manager kept the original STEMI Tracking Forms containing the patient's hospital label and information. The demographics were obtained from the Cath-lab report by the Cath-lab

manager since the DNP did not have access to the patient's data. The DNP candidate collected a copy of the STEMI Tracking Forms which excluded identifiable personal data and displayed gender, age, and ethnicity. The STEMI Tracking Forms were kept in a locked file cabinet in the locked office of the DNP candidate. The data collected was stored on a password-encrypted computer on an Excel spreadsheet. The Excel document does not have a patient's name, nor their hospital account number. Only the DNP candidate has access to it.

The following parameters/labels comprise the Excel spreadsheet: time the patient arrives at ED, time of EKG in the ER, time "cardiac alert" was called in the ER, name of the ER MD calling Cardiac Alert, name of the interventional cardiologist called, time interventional cardiologist called, time the interventional cardiologist returned call, time Cath-lab notified, time patient arrived to Cath-lab, time procedure started and time balloon was inflated. The data was then sorted into five groups: ED admission-to time to EKG, time in ED, time in corridor, time in Cath-lab, and overall door to balloon time. Lastly, the monthly average D2B time was calculated using the ED-admission (door-in times), with the time-balloon-inflated times. Each patient was assigned a code number from 1 through 20 spanning a time range of September 2023 to June 2024.

Protection of Human Subjects

This retrospective review study did not require the patient's consent per Delray Medical Center the study was approved as an exempt study by the Internal Review Board (IRB) of Florida International University (FIU). The Florida International University Office of Research Integrity has reviewed the study and determined that it was Not Human Subject Research

(NHSR). Therefore, the project did not require the submission to and approval of the FIU Institutional Review Board (IRB).

Data Analysis

This quality improvement project examined five different outcomes pre- and post-implementation: ED admission-to time to EKG, time in ED, time in corridor, time in Cath-lab, and overall door to balloon time. The results were based on a comparison between last year's three-month span of September to November of 2023 with the current year's three-month range of April to June of 2024. All times were compared between patients treated under the standard protocol (pre-intervention) and those treated under the revised protocol (post-intervention). Prior to conducting statistical analysis testing, the normality and homogeneity of variance assumptions were examined. If both assumptions were met, an Independent Samples *t*-test was used. If one or both assumptions were found to be violated, the Mann-Whitney U test, a non-parametric test suitable for analyzing ranked data, was chosen instead (Campbell, 2021). This selection is particularly appropriate because, as Xie and Li (2021) highlight, the Mann-Whitney U test analyzes the ranks of the data points rather than the means, making it ideal for scenarios where the data may not follow a normal distribution.

VIII. Results

Demographics of STEMI Cases

Table 1.

Demographics of STEMI Cases

Gender (n=20)	**Counts**	**Percent%**
Female	7	35%
Male	13	65%
Age (n=20)	**Counts**	**Percent**

18-30	1	5%
31-40	0	0%
41-50	0	0%
51-60	7	35%
61-70	5	25%
71-80	5	25%
81-90	2	10%
>91	0	0%
Ethnicity (n=20)	**Counts**	**Percent**
Black	1	5%
Caucasian	16	80%
Hispanic	3	15%
Asian	0	0%
Other	0	0%

Of the 20 STEMI patients, 7 (35%) identified as female and 13 (65%) identified as male. The age range of STEMI patients was 18 to 90 years of age, with one case between 18 to 30, seven cases between 51 to 60, five cases between 61-70, five cases between 71-80, and two cases between 81-90. Sixteen patients (80%) were identified as Caucasian; three patients were identified as Hispanic (15%); and one patient was identified as Black (5%).

Statistical Analysis

The recorded cases for the months of 2023 and 2024 were saved on the Excel spreadsheet and transferred into Jamovi (2022) for statistical analysis. Therefore, the research findings were grouped as STEMI patients from 2023 and STEMI cases from 2024, as shown below in Table 2, comparing differences in times.

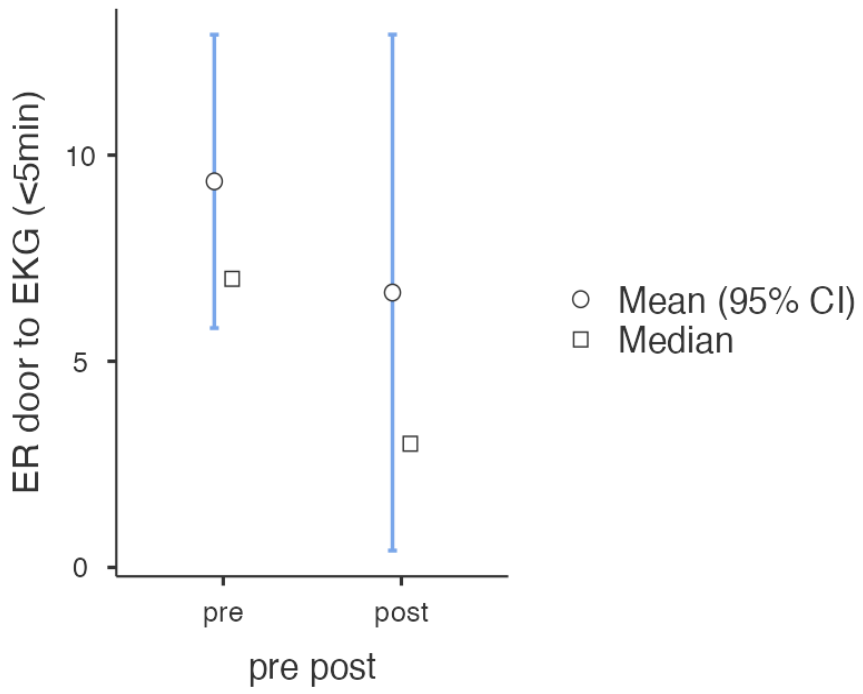
Table 2. Comparison of Average Times in 2023 (Pre-intervention) with Times in 2024 (Post-intervention)

Outcome	Average Time 2023 *M* (*SD*)	Average Time 2024 *M* (*SD*)
ED Door to Time of EKG	9.36 (6.02)	6.67 (9.58)
Time in ED	52.86 (28.80)	35.56 (18.06)
Time in Corridor	56.00 (28.58)	40.00 (16.79)
Time in Cath Lab	14.91 (3.78)	13.89 (8.59)
Overall Door to Balloon	81.55 (27.22)	74.00 (16.51)

ED Door to Time to EKG

Data examining the distribution of ED door to EKG times revealed this data to be positively skewed according to the Shapiro-Wilk test ($p = .016$). Therefore, the Mann-Whitney U test was used and was not found to be statistically significant ($U = 29.5$, $p = .136$). Figure 1 displays the change from pre- to post- for door to EKG time.

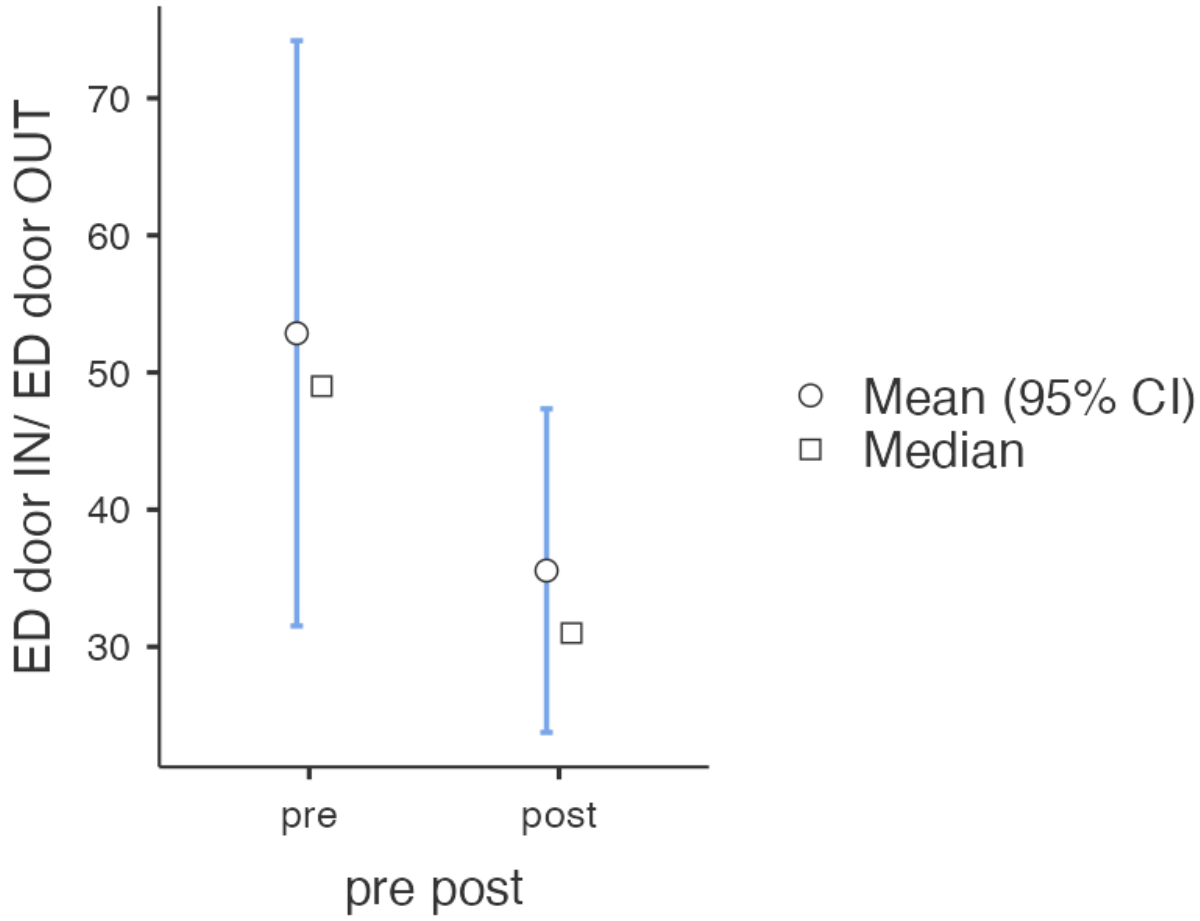
Figure 1. ED Door to EKG time Pre to Post-Intervention



Time in ED

Data examining the distribution of time in ED revealed this data to be normally distributed according to the Shapiro-Wilk test (p = .109). Therefore, the Independent Samples t-test was used. The results were not found to be statistically significant, t (14) = 1.48, p = .162. Figure 2 displays the change from pre- to post- for time in ER.

Figure 2. Time in ER Pre to Post-Intervention

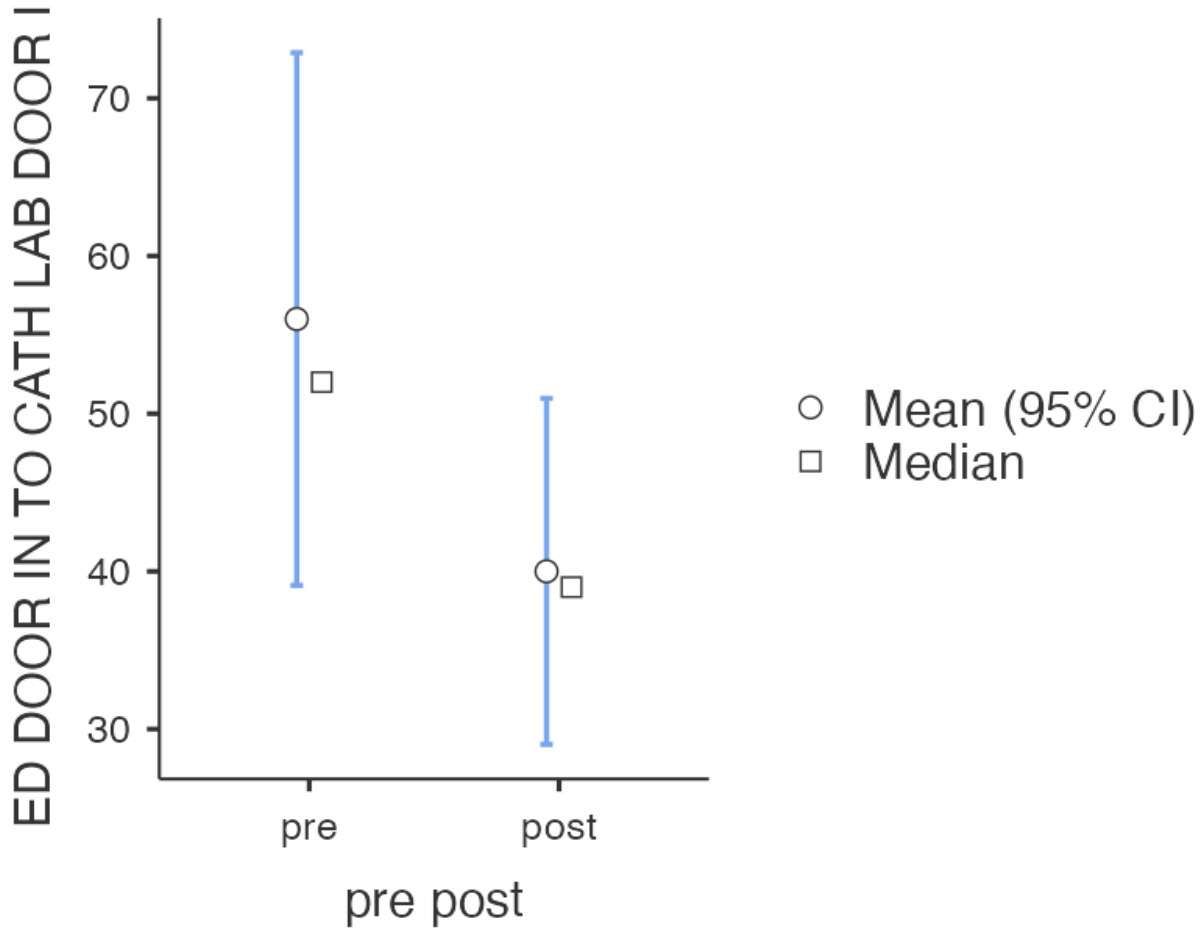


Time in Corridor

Data examining the distribution of time in corridor revealed this data to be normally distributed according to the Shapiro-Wilk test (p = .247). Therefore, the Independent Samples t-

test was used. The results were not found to be statistically significant, t (18) = 1.48, p = .156. Figure 3 displays the change from pre- to post- for time in ED.

Figure 3. Time in Corridor Pre to Post-Intervention

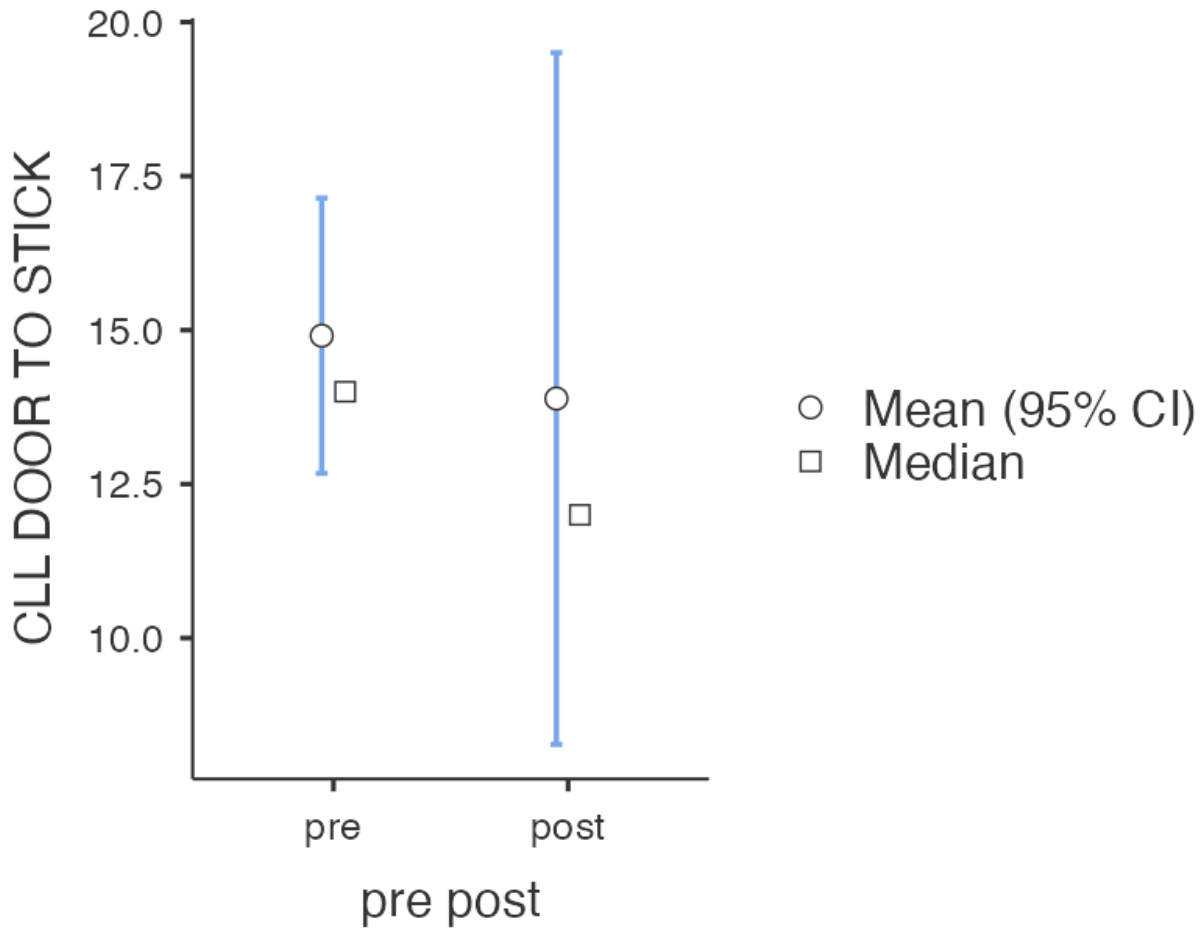


Time in Cath lab

Data examining the distribution of time in Cath lab time revealed this data to be normally distributed according to the Shapiro-Wilk test (p = .105). Therefore, the Independent Samples t-

test was used. The results were not found to be statistically significant, t (18) = 0.36, p = .726. Figure 4 displays the change from pre- to post- for time in ED.

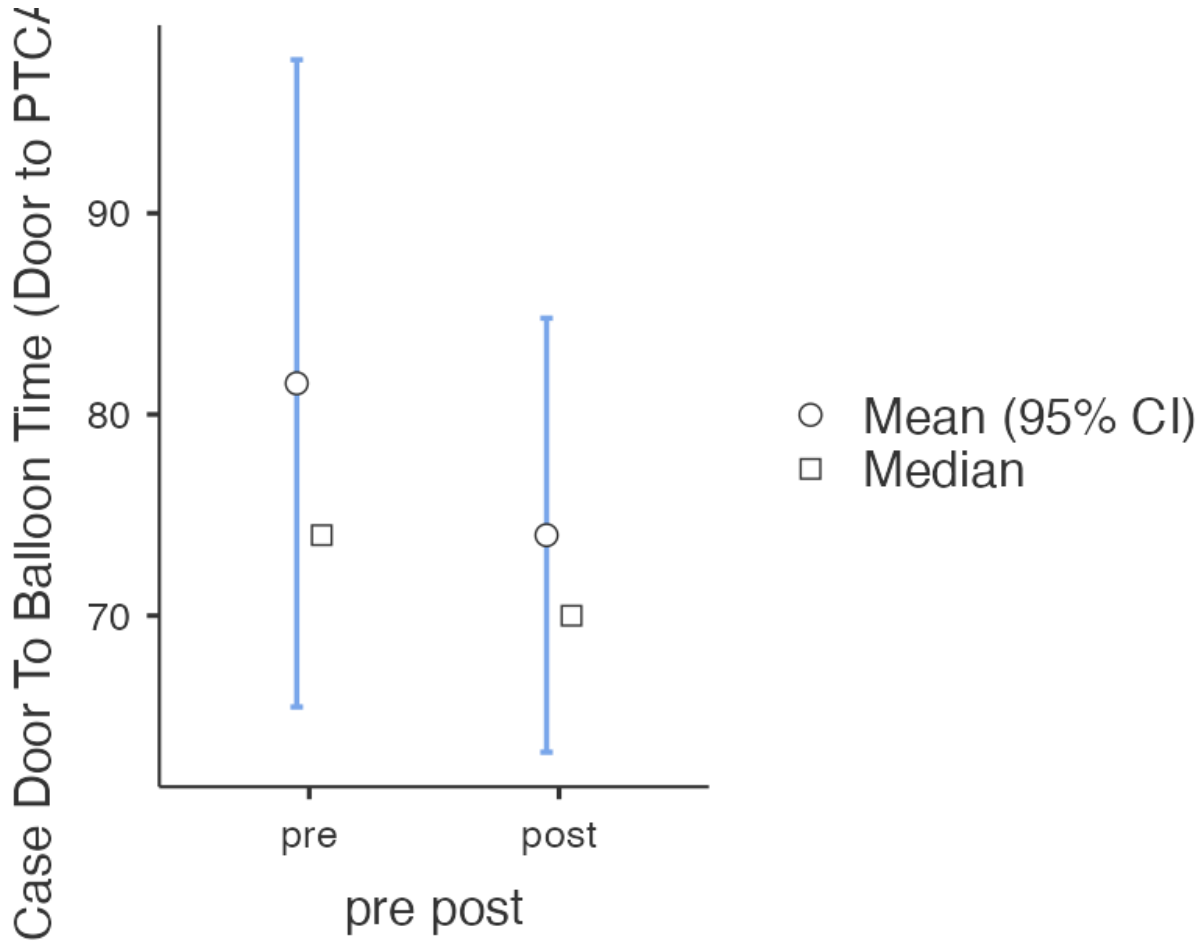
Figure 4. Time in Cath-lab Pre to Post-Intervention



Overall Door to Balloon Time

Data examining the distribution of door to balloon revealed this data to be normally distributed according to the Shapiro-Wilk test (p = .306). Therefore, the Independent Samples t-test was used. The results were not found to be statistically significant, t (18) = 0.73, p = .476. Figure 5 displays the change from pre- to post- for time in ED.

Figure 5. Door to Balloon Pre-to Post-Intervention



IX. Discussion

The purpose of this analysis was to determine whether there were significant differences on (a) ED door to EKG, (b) time in the ED, (c) time in corridor, (d) time in Cath-lab, and (e) overall door to balloon between the two research periods of September to November 2023 and April to June 2024. While none of the findings were determined to be statistically significant, it should be noted that this is likely due to two important factors. The first is the small sample size, and the second is high variability in the data. It should be noted, however, that while the findings were not statistically significant, average times were lower in 2024 compared to 2023 indicating

that the data is trending in the desired direction from 81.5 minutes in 2023 to 74 minutes in 2024 post-intervention.

The findings presented here strongly support the notion that interprofessional collaboration between registered nurses, physicians, and administrative personnel can improve door-to-balloon times for STEMI patients. This collaborative approach could be further enhanced by incorporating dedicated STEMI protocols into the onboarding training curriculum for all new staff members, including ICU personnel. Beyond the proposed ICU training, the implementation of mass text alerts facilitated faster on-call team notification, demonstrating its potential as a communication tool. However, for optimal efficiency, replacing this system with a more user-friendly mass text application specifically designed for healthcare communication would be a valuable improvement. This application should facilitate seamless communication among the on-call team, Emergency Department (ED) staff, and physicians.

The benefits of the QI project were that it can increase the recognition of patients experiencing STEMI and assist ICU staff in enhancing their clinical cardiac knowledge. Another major benefit is that the hospital will be able to adhere to national standards. Adherence is something that can ensure continuous public trust.

X. Limitations

The current quality improvement (QI) project employed two statistical methods the Mann-Whitney U test and independent t-test samples for data analysis. While the statistical findings provided valuable insights, several limitations were encountered when evaluating the relationship between door-to-balloon (D2B) times and the proposed 60-minute target for ST-segment elevation myocardial infarction (STEMI) patients.

Specifically, the analysis was constrained by the following factors:

- Sample size: The project relied on data collected over a six-month period (three months in 2023 and three months in 2024), resulting in a relatively small sample size for robust statistical analysis. Limited sample size impacts the generalizability of the findings and the power to detect statistically significant differences.
- Patient population: The study population was predominantly Caucasian. This homogeneity limits the generalizability of the results to more diverse patient populations. Ideally, future studies should aim for a more representative sample that reflects the demographics of the target population.
- Data accuracy: Data entry for the STEMI Tracking Form was performed by emergency room (ED) nurses and catheterization laboratory (Cath-lab) nurses. Potential inaccuracies in data entry could introduce bias and compromise the reliability of the analysis. Implementing data quality control measures could mitigate this limitation in future studies.

XI. Implications to Advanced Nursing Practice

The D2B Time QI project at Delray Medical holds significant implications for Advanced Nursing Practice. Firstly, it aligns directly with the core principle of improving patient outcomes. By focusing on reducing D2B times for STEMI patients, this project has the potential to significantly impact their health. Faster reperfusion times can minimize heart muscle damage, leading to better long-term prognoses and improved quality of life (Vogel et al., 2019). Secondly, the project exemplifies the leadership role APRNs can play in driving quality improvement initiatives within healthcare settings. Their expertise and skills position them perfectly to spearhead similar projects, analyze data, and advocate for evidence-based practices that optimize patient care.

Furthermore, the project underscores the importance of collaboration and teamwork among nurses, physicians, and other healthcare professionals. APRNs can act as facilitators, fostering strong interprofessional communication and ensuring seamless patient care transitions throughout the D2B process. Additionally, this project highlights the vital role of research in guiding clinical practice. APRNs are uniquely positioned to bridge the gap between research and practice by integrating research findings into daily routines and championing evidence-based interventions. This not only improves current standards of care but also paves the way for continuous improvement in the future. Finally, the project underscores the need for ongoing education and competency development for nurses and other staff involved in the D2B process. APRNs can play a key role in developing and delivering educational programs that ensure all staff are equipped with the latest knowledge and best practices for achieving timely reperfusion in STEMI patients.

XII. Conclusion

This quality improvement (QI) project aimed to decrease door-to-balloon (D2B) times for patients experiencing ST-segment elevation myocardial infarction (STEMI) at Delray Medical Center. Two interventions were implemented. The first implementation was to add an ICU-RN to the on-call team to accelerate patient preparation for the Percutaneous Coronary Intervention (PCI) procedure. The second implementation was to utilize a digital platform to replace traditional phone calls with mass text notifications for the on-call Cath Lab staff.

The project aimed to achieve a D2B time of 60 minutes or less within 12 weeks of implementation. The data analysis did not reveal statistically significant differences between pre- and post-intervention D2B times. This could be attributed to the relatively small sample size (20 patients) and high variability within the data. However, there was a trend toward improvement

across all measured time intervals which is very promising in moving toward achieving a 60 minute or less time frame for patients admitted with STEMIs, which is an important quality benchmark in the care of cardiac patients in reducing morbidity and mortality rates.

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XIX. Appendix

IRB Approval Letter

FIU | Research & Economic Development
FLORIDA INTERNATIONAL UNIVERSITY

MEMORANDUM

To: Dr. Deborah Sherman

CC: Lina Mosquera-Rosales

From: Carrie Bassols, BA, IRB Coordinator Ceb

Date: February 22, 2024

Proposal Title: "Reducing Door-to-Balloon Time in STEMI via Interprofessional Collaboration Protocol: A Quality Improvement Project"

The Florida International University Office of Research Integrity has reviewed your study and has determined that it is **Not Human Subject Research (NHSR)**. Therefore, your project will not require the submission to and approval of the FIU Institutional Review Board (IRB).

IRB Protocol NHSR #:	IRB-24-0072	**NHSR Review Date:**	02/22/24
TOPAZ Reference #:	114128		

Research *means a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge.*

Human subject *means a living individual about whom an investigator (whether professional or student) conducting research obtains (1) Data through intervention or interaction with the individual, or (2) Identifiable private information.*

Special Conditions: N/A

For further information, you may visit the IRB website at http://research.fiu.edu/irb.

Letter of Approval from the Facility

January 30, 2024

Delray Medical Center
5352 Linton Blvd.
Delray Beach, Florida 33484
Reducing door-to-balloon time Project Investigator: Lina Mosquera Rosales, MSN, APRN, FNP-BC

Re: Reducing Door-to-Balloon Time in STEMI via Interprofessional Collaboration Protocol: A Quality Improvement Project. This is a proposed evidence-based Quality Improvement Project (QIP) which is designed to add to the current ST-elevation myocardial infarction process an ICU-RN to the Catheterization laboratory (Cath-lab) team and a digital mass device called Alert Media to STEMI calls.

Study Objective:

Door to balloon is a metric that measures the time interval between a patient's arrival at the Emergency Department (refer to as door) and the inflation of a balloon inside the heart vessels during a heart attack. The door-to-balloon (D2B) times should be 60 minutes or less, the current practice at Delray Medical Center is more than 90 min. The DNP candidate is proposing to add an intensive care unit registered nurse (ICU-RN) to the Cath lab team and a digital mass device called Alert Media to STEMI calls to the current process. This quality improvement project followed the Plan, Do, Study, and Act (PDSA) model. The project is analyzed by looking at door-to-balloon times after the implementation of the revised STEMI protocol is executed the year 2023 on March to April compared to the following year 2024 on March to April on the month of March to April. The data is collected via the STEMI tracking form that is filled in by emergency registered nurses and cardiac catheterization nurses. The form is the tool that will be used to collect data that then will be transferred to an excel spreadsheet. To reduce door-to-balloon times, the DNP candidate is proposing to add to the current ST-elevation myocardial infarction process an ICU-RN to the Catheterization laboratory (Cath-lab) team and a digital mass device called Alert Media to STEMI calls. The ICU-RN will assist the Cath-lab team to expediate the process. The digital Alert Media tool will send a mass text/call to the on-call team simultaneously. Adding an ICU-RN to the team and implementing Alert Media will assist in reducing D2B times to less than 60 minutes which could improve patient's outcomes. There are no expected risks associated with adding an ICU-RN and Alert media tool to the STEMI process.

Dear Investigators:

Delray Medical Center Inc. doing business as **Delray Medical Center** (the "Hospital") is pleased to provide you access to certain patient health records (the "Records") in support of the above-named Study on the terms and conditions set forth in this Letter of Agreement.

The Records are the Hospital's medical records of patients for whom you are treating/have treated. You will identify the patients for whom the Records will be disclosed. They are provided for the purpose of facilitating your obligations as an investigator under this Letter of Agreement and the Study Protocol. Additionally, they may be used for the purpose of the continued care of your patient(s).

In all respects, you will use the information only in accordance with the Protocol, applicable IRB approval and the terms of this Letter of Agreement. The information abstracted from the Records will be utilized in a deidentified manner, consistent with the exemption granted by the **FIU IRB**.

In addition to the investigator, the Records will be available to your research coordinator/assistant for purposes of the Study and your clinical care team for purposes of patient care services. You agree to use appropriate safeguards to prevent inappropriate use or disclosure of the Records or the patient's protected health information other than as provided for by this Agreement. Should such an unauthorized use or disclosure occur, you agree to report it to the Hospital including without limitation, any disclosure of PHI to an unauthorized subcontractor, within five (5) days of its discovery. Finally, you agree to ensure that any agent, including a subcontractor, to whom you provide access to the Records agrees to the same restrictions and conditions that apply through this Letter of Agreement to the you with respect to such information.

As a condition of the Hospital's agreement to provide the Services, you represent and warrant to the Hospital that (1) the Study has been approved or given exemption by a duly authorized institutional review board (IRB); (2) you will carry out the study in accordance with the Protocol and any and all applicable laws and regulations; and (3) all of the Records to be provided by the Hospital are required by the Protocol. If any of these representations fail to be true during the duration of this Letter of Agreement, you will immediately notify the Hospital in writing.

Additionally, each of us represents and warrants to the other party that it, and to its knowledge, its officers, directors and employees (i) are not currently excluded, debarred, or otherwise ineligible to participate in the federal health care programs as defined in 42 U.S.C. §1320a-7b(f) (the "federal healthcare programs"), (ii) have not been convicted of a criminal offense related to the provision of healthcare items or services but have not yet been excluded, debarred, or otherwise declared ineligible to participate in the federal healthcare programs, (iii) will not violate the Anti-Kickback Statute or Stark Law in dealing with the other party; and (iv) is not, to the best of its knowledge, under investigation or otherwise aware of any circumstances which may reasonably be expected to result in the party or such individual being excluded from participation in the federal healthcare programs. We agree to immediately notify one another of any change in the status of these representations and warranties in writing.

This Letter of Agreement will remain in effect from the date you accept its terms until terminated, provided that it will automatically terminate upon the termination of the Study. It may be terminated by either of us without cause by giving the other party at least thirty (30) days' prior written notice. Additionally, the Hospital may terminate this Letter of Agreement immediately by written notice to Investigator upon the occurrence of any of the following: (i) the suspension or termination of the Study

by the responsible IRB; (ii) your breach of any of the representations and warranties or failure to notify Hospital as required; or (iii) Investigator's conviction of a criminal offense related to health care, or Investigator's listing by a federal agency as being debarred, excluded or otherwise ineligible for federal program participation.

Please signify your agreement with these terms by signing in the space provided below and return a copy of this letter to me. Additionally, please provide a copy of the IRB approval letter applicable to the Study.

Kind Regards,

Signed by: DocuSigned by: 8B42D59200D94B0... Date: 1/30/2024 | 10:10 AM CST

Printed Name: Daniel Listi
Title: President/CEO Delray Medical Center

AGREED AND ACCEPTED:

Signed by: DocuSigned by: Lina Mosquerarosales E3AA95AB9B9542C... Date: 1/30/2024 | 10:00 AM CST

Printed Name: Lina Mosquera Rosales, MSN, APRN, FNP-BC
Title: Investigator

DELRAY MEDICAL CENTER
PALM BEACH HEALTH NETWORK

Stronger Together. For You.

#PBHNProud

Letter of Institutional Site Commitment

To: Institutional Review Board
Florida International University
01/30/2024

To whom it may concern,

This letter outlines the Submission, Review, and Approval of the following Quality Improvement Project.

Project Title: "*Reducing Door-to-Balloon Time to STEMI via Interprofessional Collaboration Protocol: A Quality Improvement Project*", by Lina Mosquera Rosales, MSN, APRN, FNP-BC

Location: Delray Medical Center

Time Frame: March 01 – July 01, 2024

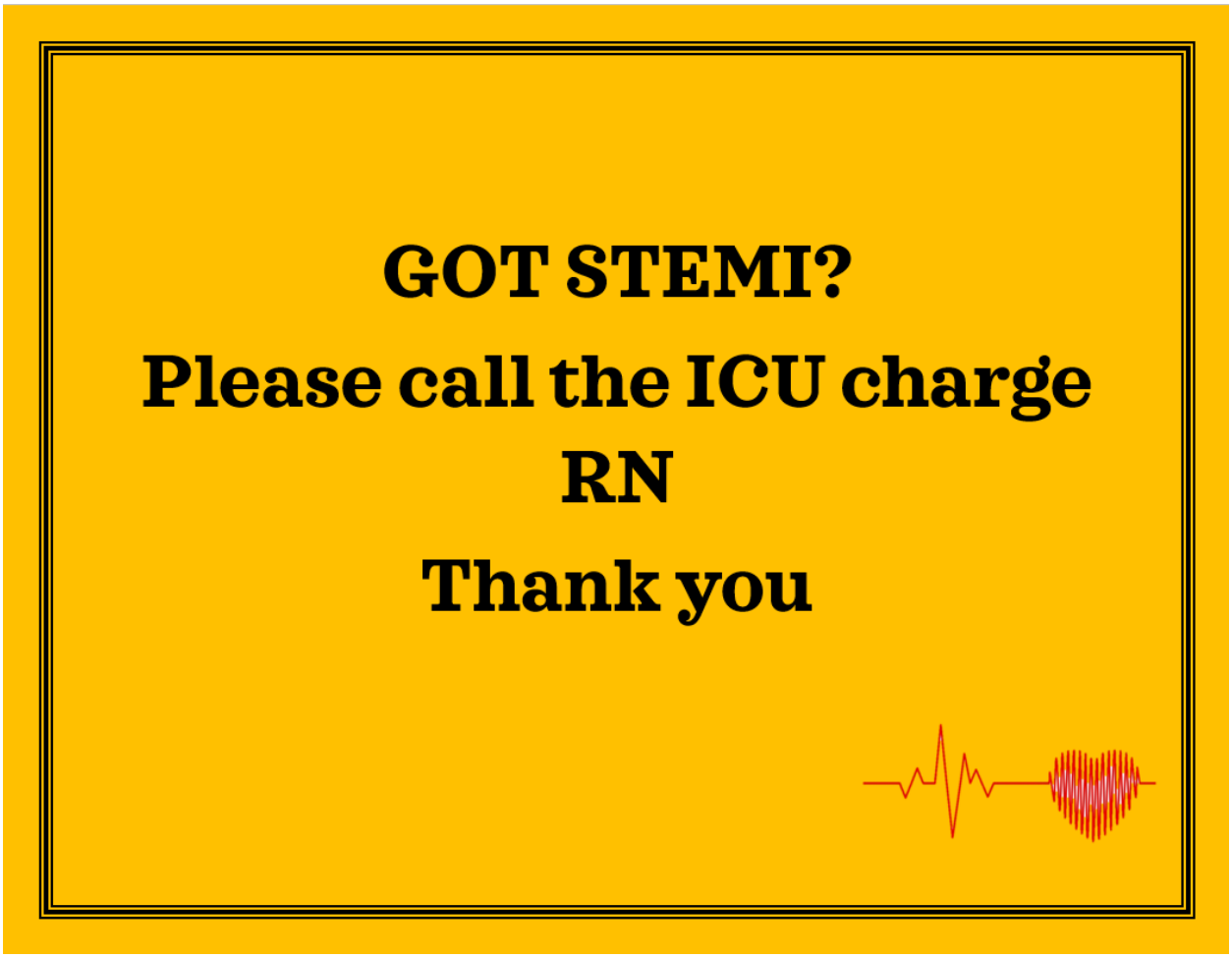
The following items have been submitted and acknowledged:

1. Acknowledgement from Lina Mosquera Rosales that she will follow HIPPA/privacy policies
2. Copy of email dated 18AUG2023 - Jennifer Shoemaker, Chief Nursing Officer approved project commencement
3. Copy of CITI training certificates submitted (human subject research, good clinical practice, and conflict of interest)
4. Copy of CV signed/dated, and RN License
5. Quality Improvement Study Objective
6. Data Sharing Agreement – Executed 30JAN2024
7. IRB Approval/acknowledgement – pending approval

Signature: DocuSigned by: Jennifer Shoemaker EE628D62FFD4445... Date: 1/30/2024 | 1:42 PM CST

Name: Jennifer Shoemaker, Chief Nursing Officer at Delray Medical Center

Flyer



Study Instruments

A- STEMI Tracking Form

This form is not part of the medical record.

DELRAY Medical Center
Tenet South Florida HealthSystem

WEST BOCA Medical Center

DATE: _____

CARDIAC ALERT

Door-to-Balloon Flowsheet **D2B goal <60 minutes**

EMS DOCUMENTATION:

Time symptoms started: _____
Time 911 call received: _____
EMS provider contact time: _____
First 12-lead EKG time: _____
EKG Transmission from Field: [ ] Yes [ ] No

Mode of Arrival: ☐ POV ☐ Other: _____
☐ EMS Transport (Rescue Unit #: _____)
From: ☐ Boca ☐ PBC ☐ Margate ☐ Delray
☐ Lighthouse Point ☐ Boynton Beach
☐ Other: _____

ER DOCUMENTATION

1) Patient arrival time: _____
2) Reason for delay: _____
3) EKG time: (goal – w/in 5 min of arrival) _____
Comment_____
4) Time Cardiac Alert called: _____
ED Physician at DMC: _____ (MD Name) _____
Interventionalist On-Call: _____ (MD Name)
Comment_____ _____
EKG sent to Physician: _____ (time) VIA_____ _____
5) Time Interventionalist returned call: _____
6) Transfer from WBMC – Time leaving WBMC: _____
7) Time Cath Lab Notified: (goal w/in 5 min of identified STEMI) _____
8) Time Cath Lab Team Notifies ED to bring patient: (RN initials) ____/_____ _____
9) Time patient left ED to CCL (goal w/n 5 min ED to Cath lab): _____

ED RN name Initiating form: _____

CATH LAB DOCUMENTATION

10) Time of patient's arrival in Cath Lab: (goal w/in 30 min of arrival) _____
11) Time of Physician arrival to CCL: _____
12) Time procedure started: _____
13) Time PTCA wire inserted: _____
14) Time Balloon inflated/atherectomy devices: (Reperfusion – goal 30 min after stick time) _____
15) Reason(s) for reperfusion delay: ☐ Difficult coronary anatomy ☐ Hemodynamic Instability ☐
Other: _____
16) Reason(s) for Cath Lab Downgrade: ☐ Clean Coronaries ☐ Takotsubo ☐ Other: _____

*Cath Lab RN name finishing form*_____

Send form with patient to Cath Lab.
Cath Lab phone: 561-495-3110

B- Monthly Excel Spreadsheet

MONTH, 2024 - Cardiac Cath Lab Door-to-Balloon

DELRAY MEDICAL CENTER
PALM BEACH HEALTH NETWORK

Monthly Counts		Monthly Benchmarks	
Total 'Counted' STEMI Cases:	0 Patients	Average time for EKG for Month	00 Minutes
STEMI Transfers:	0 Patients	Average time for Cath Lab Activation	00 Minutes
Non-Counted Cases for Metric:	0 Patients	Arrival of Patient to Cath Lab	00 Minutes
Total Cardiac Alerts for Month	0 Patients	Reperfusion Reached within 30 min	00 min. Minutes

Reperfusion Times	
Transfer Door to Balloon	In-House Door to Balloon
00 Minutes	00 Minutes

	DTB START	Benchmark 1- EKG		Benchmark 2 - Activation of CCL									Benchmark 3 - Patient to CCL				Benchmark 4 - Reperfusion								
	ER Door Department												Corridor	Cath Lab Department											
Date	ER door IN Arrival Time in ED	EKG Time	ER door to EKG (<5min)	Time Cardiac Alert Called in ED	Name of MD Calling Cardiac Alert	Name of Interventional Cardiologist Called	Time Interventional Cardiologist Called	Time of Return Call	Cath Lab Notified	Minutes CA activated to CCL notified (GOAL - <5min)	ER DOOR OUT	ED door IN/ ED door OUT	ED door OUT to CLL door IN <3min	Activation to arrival in CCL	CATH LAB DOOR IN Arrival of Patient in CCL	ED DOOR IN TO CATH LAB DOOR IN	STICK TIME Time Procedure Started	CLL DOOR TO STICK	PTCA Wire Inserted	Time Balloon Inflated	STICK TO BALLOON	Reperfusion Reached Within 30 Min of Cath Lab Activation?	Case Door To Balloon Time (Door to PTCA wire)	MD arrival time	Comments
Counted Cases																									
This section below is used for all counted cases towards Door-to-Balloon Metric. Place all cardiac alerts without adverse events below.																									
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.	00 min.	00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.	00 min.	00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.	00 min.	00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.	00 min.	00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.	00 min.	00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.	00 min.	00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.	00 min.	00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.	00 min.	00 min.		
Non-Counted Cases towards Door-to-Balloon																									
These are non-counted cases towards the monthly Door-to-Balloon averages. Non-Counted cases are as follows: (Codes, ICE, IABP, Impella, Intubated Patients, Takotsubo, Clean Coronaries, etc…)																									
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.	[redacted]						
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.			[redacted]						
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.	[redacted]								
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.									
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.									
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.									
Transfers from other Facilities																									
Door-to-Balloon metric changes from 90 minutes to 120 minutes for all transfers. Please place all transfers below as this gets counted differently in the monthly metric.																									
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.		00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.		00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.		00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.		00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.		00 min.		
			00 min.							00 min.		00 min.	00 min.	00 min.		00 min.		00 min.			00 min.		00 min.		