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Clinician Preference for Troponin Monitoring

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by

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Abstract

Cardiovascular disease is on the rise in the United States and the cost of CVD is continuing to rise to an estimated at $800 billion by 2030. Serum troponin level is one lab value that is used in early detection and evaluation of cardiovascular disease. Research to date focuses on utilizing troponins as a diagnostic tool to evaluate morbidity and predict mortality. The implication for practice includes how the results of this project can be used in practice. There remains a gap in the literature regarding how serum troponins are utilized after a patient has developed myocardial injury. The purpose of this qualitative study is to evaluate the clinician's preference of troponin monitoring after a myocardial infarction. The ACE Star Model of the Cycle of Knowledge Transformation was used as a guide in developing this project. A descriptive four question open-ended qualitative questionnaire was created to evaluate cardiac clinician preference on troponin monitoring. Ten out of 23 possible clinicians answered the questionnaire. The questionnaire showed a high level of agreement amongst clinicians as to the practices of trending troponins. All clinicians agreed that the high sensitivity troponin (hsTrop) should be utilized. In utilization of troponins as an advanced practice clinician, the recommendation is to trend troponins per hospital policy, but also to become familiar in recognizing how elevated troponins can change the plan of care. Further research on the subject of trending troponins after myocardial infarction is still needed.

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Background/Statement of the Problem

Medical costs for cardiovascular disease are anticipated to triple, from $200 to $800 billion between 2010 and 2030 (Heidenreich, Trogdon, Khavjou et al, 2011). An estimated $207 billion dollars are spent on cardiovascular care each year in the United States. The Center for Disease Control (CDC) closely monitors how various health disparities, including cardiovascular disease, impact people within the United States everyday. Some of the cardiovascular statistics collected include the cost of heart disease and the overall annual cost of health care services, medications, and lost productivity related to cardiovascular disease. Forty-nine percent of all Americans have at least three risk factors that contribute to an increased risk of cardiovascular disease. Risk factors include diabetes, obesity, poor diet, physical inactivity, or increased amounts of alcohol consumption. In the United States, one person will have a myocardial infarction (MI) every 42 seconds (CDC, 2017). With the increasing number of Americans diagnosed with cardiovascular disease, it is important as clinicians, to find ways to accurately diagnose acute coronary syndrome (ACS) and the severity of cardiac damage in a timely fashion (Liu, Shehu, Herrold, & Cohen, 2015). Troponin values can indicate the severity of the injury and research has shown an elevated troponin is highly predictive of increased mortality.

Identifying the extent of myocardial injury is critical function contributing to patient outcomes. Developing early treatment plans to best suit each individual patient is ideal. When clinicians order troponin levels for patients with a suspected MI and results of the troponin are elevated, this can provide diagnostic information, facilitate treatment

decisions, and promote early identification of a potential problem (Sara, Holmes, & Jaffe, 2015).

ST elevation noted on an electrocardiogram (ECG) along with an elevated troponin level can indicate myocardial ischemia, may reflect structural damage and precipitate further interventions. Variations in monitoring troponin levels occur in clinical practice. Understanding the clinician's thought processes after identification of an elevated troponin would be helpful in identifying diagnostic rationale and the choice of treatment. Clinicians having awareness on how to utilize a positive troponin value along with treatment options, can help facilitate understanding throughout the entire plan of care, including post MI monitoring preference. The choice of continuous troponin monitoring after invasive cardiac interventions also is not universal across clinical providers. There appears to be many clinicians who choose to monitor serial levels until a downward trend is noted, while other clinicians do not.

Clinical practice guidelines are adopted with the intention to aid clinicians in prescribing evidence based and appropriate care. Contributors that set guidelines for troponin monitoring in ACS and acute myocardial infarction (AMI) include the European Society of Cardiology (ESC), the American College of Cardiology (ACC), and the American Heart Association (AHA) (Apple, Quist, Murakami, 2004). Guidelines provide information about the timing of troponins, as well as the diagnostic criteria for a AMI. The Miriam Hospital (TMH) updated the normal values for cardiac troponin I (CTnI) on October, 2015. The new guidelines include the range of 0.006 to 0.060μg/L to represent the 99th percentile of normal which conformed with the ESC and ACC recommendations (ESC, 2017). A CTnI greater than 0.060μg/L indicates myocardial

injury. Troponin measurements should be repeated at two to three hour intervals within a six to nine hour time period following initial symptoms (ESC, 2017). In addition to a positive troponin value, at least one of the following are consistent with acute myocardial ischemia: symptoms of ischemia such as chest pain, a new or presumed new significant ST-segment-T wave (ST-T) changes or a new left bundle branch block (LBBB), development of pathological Q waves in the ECG, imaging evidence of new loss of viable myocardium or new regional wall motion abnormality, and identification of intracoronary thrombus by angiography or autopsy (ESC, 2017). TMH utilizes the ACC's and ESC guidelines for the troponin protocol. TMH currently identifies a negative troponin as a level less than or equal to 0.06μg/L. Levels above 0.06μg/L are considered positive for myocardial damage. Patients who present to the emergency room exhibiting two consecutive troponins less than 0.06μg/L, six hours apart can be considered unlikely to have cardiac injury.

The purpose of this qualitative study was to evaluate the clinician's preference of troponin monitoring after a MI. The information obtained from the study provided diagnostic reasoning and clinician preference for monitoring troponin. This project was conducted at a suburban hospital in Providence, Rhode Island.

Literature Review

A literature review was conducted to evaluate the benefits and effectiveness of troponin monitoring in patients who present with symptoms of ACS. The search utilized the Cumulative Index to Nursing and Allied Health Literature (CINHAL), Medline, Pub Med, and OVID. Key words included: cardiac disease, (ACS), myocardial infarction (MI), markers to determine (MI), creatine phosphokinase (CPK) test, troponin markers, high sensitivity troponin, and monitoring of troponins. Literature was reviewed from 2003-2016, with the exception of one seminal article, published in 1995, regarding early diagnosis of MI using biochemical markers. Research conducted involved viewing healthcare practices that focused on diagnosing cardiac related problems with the fewest number of tests required to accurately diagnose a patient.

Acute Coronary Syndrome

The American Heart Association (AHA) has focused on working towards saving and improving lives from heart disease and stroke for more than 90 years. Programs are available for patient and provider education, along with recommendations to reduce the risk of cardiovascular disease. The AHA acknowledges that utilizing personalized medicine and applying it to research involving cardiovascular disease (CVD) is ideal, although the funding is not currently available (Heidenreich, et. al, 2011).

Many expenses currently spent on acute coronary syndrome (ACS) and the expected rise in medical costs that are directly related to cardiovascular disease are astronomical (Heidenreich et. al., 2011). Research has been conducted to estimate the future costs of treatments for various components of cardiovascular disease, including:

hypertension, coronary artery disease, heart failure, stroke, and all other cardiac related diseases (Heidenreich, et. al, 2011).

ACS is frequently what brings individuals to a hospital. The presentation of ACS symptoms will direct clinicians to further investigate individuals in order to rule out ACS. According to the AHA, the criteria symptoms that define ACS include chest pain or discomfort that may involve pressure, tightness, or fullness in the chest and pain or a degree of discomfort in one or both arms, jaw, back, stomach, or neck. Shortness of breath, dizziness, lightheadedness, nausea, and sweating are additional symptoms that indicate ACS. A diagnostic workup includes an ECG, as well as obtaining blood tests or markers to assess for myocardial injury or an ACS (AHA, 2015).

Troponin markers are fairly new indicators, introduced in the 1990's, and have been initiated as the primary source of cardiovascular morbidity risk identification. Prior to the troponin markers, CPK markers were used to identify cardiac muscle breakdown, but many hospitals adopted the use a troponin level over a CPK due to its ability to provide a more rapid biomarker in the diagnose of an AMI. The troponin level directly correlates to myocardial muscle damage rather than skeletal muscle damage (Edwards, et al., 2013). Troponin levels are primarily ordered to determine an AMI and to assess the amount of myocardial damage, as shown by the sensitivity of the troponin assay (Wu, Bolger, & Hollander, 2013).

An extensive work up, including telemetry monitoring, ECG and serial troponin levels, can identify ACS, as well as detect any myocardial damage that may have occurred. Bjorklund et al. (2003) conducted a study in Sweden to evaluate the level of mortality risk with the combination of an elevated troponin and ST-elevations present on

the ECG. The study was a retrospective sub-study of two thrombolytic trials called the Assent-PLUS trial and ASSENT-2. A total of 516 randomized patients treated with fibrinolytic therapy were involved in the primary studies. Participants were selected for inclusion if the troponin was greater than 0.1μg/L and ST elevations occurred within a 60-minute window. Patients with a troponin level less than 0.1μg/L were excluded. Patient records were reviewed to collect data for the study. Half of the patients (n = 257) had no detectable troponin level on admission. The other half (n = 259) had a median level of 0.08μg/L. On admission, (n =116) 22.5% of patients presented with a positive troponin and ST elevation. The median time to ST-Segment resolution was 76 minutes. Patients with positive ST elevation were older, had an increased heart rate, a higher probability of anterior infarct, and a longer time from symptom onset to intervention. The researchers were able to determine that patients who had a positive troponin and ST-Elevations had a higher mortality rate within one year (Bjorklund, et al., 2003).

Troponin Benefits

Troponin testing was introduced in the early 1990's. Questions about the relationship between the physiological findings of elevated troponin as a marker of myocardial necrosis and the clinical significance of the finding have developed over time. The early testing demonstrated that an elevated troponin level identified patients who had an increased risk for adverse outcomes: whether their presenting clinical diagnosis was related to unstable angina, myocardial infarction (MI), or a non-coronary etiology. Traditionally clinicians used multiple modalities of diagnostic judgment including the physical exam, the patient history, ECG imaging, and various blood tests to determine if an admission was warranted. Research attempted to evaluate various blood tests that

were useful in diagnosing a AMI. Later, strategic goals of research included cost effectiveness and the predictive values of diagnostic studies (Luscher, Ravkilde, & Thygesen, 1998).

Rahimi, Marzano, & Richard (2003) conducted a study at a medical center in Georgia to evaluate if the serum lactate, c-reactive protein creatine phosphokinase-muscle/brain (CPK-MB) and troponin levels are useful in diagnosing an AMI. Inclusion criteria included all patients that presented to the hospital with symptoms associated with an AMI regardless of age, race, gender, or other previously identified comorbidities. Sixty-two patients met the eligibility to participate. Exclusion criteria were all patients with heart failure, cardiogenic shock, active seizure activity, alcohol intoxication, acute and chronic renal failure, smoke inhalation, received cardiopulmonary resuscitation, chest pain that had been persistent for greater than 24 hours, and acute ST-segment elevation on ECG. Blood draws were initiated on admission, 2 hours after admission, and again at the 4-hour interval. Of the 62 patients selected for the study, 18 had a documented AMI and required further interventions such as thrombolytics, angioplasty, and stenting.

The results of the study indicated that the individuals that underwent serial blood testing, including lactate levels, creatine-kinase myoglobin (CK-MB), and troponin correlated to similar results. The lactate had a sensitivity of 75%, and the specificity of 95.5%. The positive predictive value of the lactate was 91.3%. Conclusions drawn indicated that the lactate level could be used in the emergency room as a rapid assessment tool to diagnose an AMI in an emergency, although it wasn't meant to replace the other cardiac enzymes such as CK-MB and troponin monitoring. One of the disadvantages of

this study was the small sample size, utilizing data from 18 participants (Rahimi, Marzano, & Richard, 2003).

The progression of diagnosing an AMI has dramatically changed from thirty years ago. Previously, the clinician's steps to diagnose a patient with having an AMI looked at the following criteria: the patient's clinical history, the ECG findings, and temporary changes in the CK-MB. Currently, clinicians still utilize ECG findings, patient's clinical history, and a troponin level to diagnose coronary injury (Luscher, Ravkilde, & Thygesen, 1998).

Lindahl, Venge & Wallentin (1995) conducted a seminal study to evaluate whether using a CK-MB, troponin, or myoglobin aided with the early diagnosis of an AMI. The study was conducted in two teaching hospitals and four county hospitals in Sweden. This study included 142 patients admitted to the hospital with persistent chest pain for less than 12 hours and a non-diagnostic ECG. Patients who came in with over twelve hours of chest pain were excluded from the study. The participants underwent blood draws every 30 minutes during the first three hours. Blood draws included monitoring the combination of the CK-MB, myoglobin, and troponin. At the completion of the study, the researchers indicated that both the troponin and myoglobin samples were identical in sensitivity at the 4-hour mark. However, the first blood sample wasn't sensitive or specific enough to exclude or make a confirmation of an AMI. Troponin and myoglobin was found to be slightly inferior in sensitivity in comparison to the CK-MB. Results indicated that no single marker individually provided the high sensitivity or specificity that would indicate AMI (Lindahl, Venge & Wallentin, 1995).

Serial Troponin Levels

Troponin levels have been identified as the preferred serologic biomarker to identify ACS (Wu, Bolger, & Hollander, 2013). Serial testing of troponin levels is an important component when it comes to identifying ACS. A significant increase in the troponin value is indicative of cardiac damage. A troponin that increases over time can indicate the presence of disease, where an unchanging troponin result can often be seen with chronic disease states including chronic renal failure and chronic obstructive pulmonary disease (COPD) (Wu, Bolger, & Hollander, 2013).

A retrospective case control study was conducted in 2013 to determine which troponin sample drawn out of multiple samples taken would be the most important one in diagnosing an AMI (Edwards, et al., 2013). The researchers stated that patients were formerly evaluated solely based on criteria that includes: past medical history, physical exam, ECG analysis, CK and CK-MB levels. One hundred subjects were selected for the study by the way of convenience sampling for a chart review. The subjects in both groups included both men and women who were between 40 and 79 years of age and were diagnosed with an AMI between January 1, 2010 and December 31, 2010. The control group was created by performing a chart review containing subjects that only received one blood draw. Subjects that had 3 sets of blood draws on chart review composed the experimental group. The subjects selected had angina pectoris on admission to the emergency room and the frequency of sampling was scheduled to occur for multiple other draws at hours 3, 6, 8, and 12 hours to diagnose AMI. The CTnI lower level of detection that was used was 0.4ng/mL. The high reference limit of the CTnI was 1.5mg/mL. The statistical analysis was conducted using a $\alpha = 0.05$ significance level. The AMI cases were identified retrospectively by utilizing the ICD-9 codes that indicated

chest pain or AMI. The results indicated that 78% of cases (n = 50) were diagnosed with AMI at the initial troponin draw. Fourteen percent were diagnosed at the hour six. The authors indicated that the initial troponin is clearly the most important in determining the presence or absence of an AMI. Age was mentioned as a strong contributor to an increased risk of an AMI. The results of this study indicated that the initial troponin level was the most important in diagnosing an AMI. Limitation of the study included the small sample size, and not obtaining other blood work that is frequently included as cardiac to diagnose an AMI such as the CK-MB (Edwards, et al., 2013).

High Sensitivity versus Conventional Troponin

Troponin levels have advanced to a new high sensitivity troponin assay (hsTrop). Research is beginning to evaluate if this high sensitivity troponin value is more beneficial. A recent meta-analysis and systematic review looked at the diagnostic accuracy of CTnI or high-sensitive troponin values for the presentation of MI (Sethi, Bajaj, Malhotra, Arora, & Khosla, 2014). Fifteen studies met the inclusion criteria of hsTrop sensitivity of 0.89 or higher (95% confidence interval (CI) for the primary analysis. The authors noted there were no statistically significant differences between the hsTrop and the CTnI (Sethi, Bajaj, Malhotra, Arora, Khosla, 2014).

Sanchis et al. (2014) looked at hsTrop versus CTnI in a prospective cohort study for a total number of 1372 patients who presented in the emergency department with a non-ST elevation derived chest pain. The patients were divided into two cohort groups based on the dates and when hsTrop versus CTnI was used. The CTnI was evaluated from March 2008 to July 2010. The hsTrop was evaluated from a period from November 2010 to March 2013. One of the differences was that patients that had undergone the

CTnI blood draw had a greater increase for coronary angiography, 77% compared to 55% of individuals who were evaluated by the hsTrop. Some of the concluding data indicated that the hsTrop provided a more complex evaluation of chest pain, with fewer invasive tests and more tests such as stress tests, being done. The hsTrop group demonstrated a higher incidence of pharmacological treatments and a longer hospitalization, although at the end of six months, the clinical outcomes of both groups of patients were similar (Sanchis, et al., 2014). Research has not shown hsTrop to be more beneficial than CTnI from a cost standpoint or for diagnosing ACS. Troponin values, especially the initial troponin, are continuously being reviewed, monitored, and researched (Wu, Bolger, Hollander, 2013).

Liu, Shehu, Herrold & Cohen (2015) looked at CTnI levels within a 24-hour period in critically ill patients to determine if the serum level of CTnI in non-ACS patients admitted to the intensive care unit (ICU) or the critical care unit (CCU) have any prognostic value and whether the CTnI results will improve the quality of care and allocation of resources. The study was an observational study conducted on all patients that were admitted to the ICU or CCU at a teaching hospital in the United States. Inclusion criteria for the observational study were patients that presented with at least one elevated CTnI within a 24-hour admission period. The patients were divided into two groups based on the highest troponin level. If the peak CTnI was more than 0.049ng/mL, they were placed in a CTnI positive group. If the peak level was 0.049ng/mL or less, participants were placed into the CTnI negative group. The results of the two groups were compared. Exclusion criteria were patients with ACS in their medical history, physical examination, clinical features, cardiac biomarkers, or electrocardiographic findings.

During the 115-day period, 90 patients qualified for the study, forty patients were placed in the CTnI positive group, and 50 patients were placed in the CTnI negative group. Regardless of the baseline characteristics of individuals who participated in the study, hospital mortality was significantly higher in the CTnI-positive group than in the CTnI-negative group. The length of stay between these two groups did not differ significantly. One significant difference identified was that more patients had a history of COPD in the CTnI positive group. Sepsis, heart failure, pulmonary embolism, renal failure, and COPD can all cause an elevation of the CTnI related to cardiac-demand ischemia. An elevated CTnI within 24-hours of admission to ICU or CCU was identified as an increased risk for mortality and higher incidence of intubation in non-ACS critically ill patients (Liu et al., 2015).

Lim, Cook, Griffith, Crowther & Deveraux (2006) conducted troponin research to document the elevated levels of the CTnI with 171 patients who were admitted to a ICU for at least a 72-hour stay at a hospital in Ontario. The patients were divided into two groups for this prospective cohort study. The first group was classified as having a MI with a CTnI greater than or equal to 1.2 μg/L and ischemic ECG changes. The second group had a CTnI greater than or equal to 1.2 μg/L but without ischemic ECG changes. Troponin levels were monitored for two periods of 48 hours each. In the first 48 hours, 72 patients showed elevated troponins of which 38 patients had confirmed MIs with elevated troponins and ischemic ECG changes. The other 34 patients showed elevated troponins without ECG changes. After the first 48 hours, only 136 patients were reexamined and 16 of the remaining 136 individuals were noted for a continued elevation in the troponin level from the original 48 hours. Seven more patients met the criteria for

an AMI, and the rest only had an elevated troponin. The study was conducted over a 14-month period in an ICU. The study concluded that having an elevated troponin level may not always indicated MI or an adverse prognosis (Lim, Cook, Griffith, Crowther & Deveraux, 2006).

The ESC and ACC guidelines were used to help differentiate patients that have an elevated troponin related to ischemic ECG changes, in comparison to patients that had an elevated troponin related to non-ischemic ECG changes. Differentiating ischemic verses non-ischemic ECG changes is critical in diagnosing patients. Patients with the diagnosis of an AMI would benefit from thrombolytic therapy, coronary revascularization, anticoagulants, antiplatelet agents, beta-blockers, statins, and angiotensin-converting enzyme inhibitors (Lim, et al., 2006). An AMI not caused by an occlusion from a thrombus or calcification may not respond favorably to the aforementioned therapies and the impact of these therapies on patient outcomes is unknown (Lim, et al., 2006).

Themes found in the literature indicate that a serum troponin level is preferred over the CK-MB because troponin exclusively indicates myocardial damage or ischemia that will decrease the functionality of the myocardium, while the CK-MB is not exclusive to the myocardium (Liu, Shehu, Herrold, Cohen, 2015). Utilizing guidelines provided by the ESC and ACC, factors such as patient history, ECG changes, and changes in serum cardiac enzymes, are still important in diagnosing myocardial necrosis (Newby, K. et. al, 2012).

Advances in troponin serum monitoring have made available a newer hsTrop assay. Researchers are looking to validate if the hsTrop is better at diagnosing AMI in comparison to the previously known standard CTnI. At this time, research indicates that

hsTrop is superior in detection of the enzyme, but there are a greater number of patients receiving intervention after drawing the standard CTnI. Research reinforced that identifying cardiac versus non-cardiac causes of a positive troponin, as well as repeated serum draws at specific time intervals, can help identify whether the myocardial damage is of ischemic origin or related to a chronic disease. Further research and evaluation of the hsTrop and CTnI levels need to be conducted to validate which test provide the optimal functioning and best patient outcomes. Knowing the troponin source of origin is important to structure a treatment plan for patients (Wu, Bolger, Hollander, 2013).

Provider Preference of Troponin Monitoring

Providers have traditionally utilized the guidelines set forth by the ESC, ACC and AHA to evaluate and trend cardiac enzyme values. A key component in a patient care includes coming up with a differential diagnosis. In developing a differential diagnosis, it is still relevant to evaluate the patient for a previous cardiac history or medical history that would predispose a patient and place them at a higher risk of ACS. ECG's and blood levels all contribute to aiding the diagnosis of ACS. The ESC, ACC, and AHA have compiled current research that examines the validity and sensitivity of cardiac biomarkers, and how to best utilize them to diagnose a patient with an AMI, including timed interventions and how they can directly correlate to decreasing the morbidity and mortality with ACS. The guidelines provided by the ESC, ACC, and AHA include some of the latest research on diagnosing an AMI. Hospitals and providers can choose to adapt to the newest research, or develop policies based on the information set forth by the ESC, ACC and AHA, although this may not be mandatory. Currently some hospitals and providers do not use the serum troponin as the standard diagnostic tool for diagnosing

AMI. For example, a hospital that conducted troponin research in Georgia utilized the CK-MB assay for diagnosing and ruling out an AMI (Edwards, et al., 2013).

Clinicians spend time in finding ways to accurately diagnose ACS. After drawing troponin levels and a diagnosis of ACS is determined, many patients will undergo a cardiac intervention. After intervention, many times cardiac troponins are not routinely ordered at timed intervals for monitoring. A gap in the research includes troponin monitoring after myocardial infarction, as well as trending troponins after coronary intervention to evaluate the presence and extent of disease. Much of the research focuses on the diagnosis and prompt treatment of ACS because research indicates that a positive troponin increases the morbidity and mortality risk. Further evidence is warranted in the duration and frequency of troponin monitoring following AMI and subsequent cardiac interventions (Liu et al., 2015).

Theoretical Framework

The theoretical framework that guided this qualitative study of clinician preference regarding troponin monitoring following AMI is the ACE Star Model of the Cycle of Knowledge Transformation (Star Model)(Stevens, 2002). The Star Model utilizes evidence-based practice (EBP) to create a framework that utilizes old and new concepts to improve care as a whole (Stevens, 2002). The Star Model is "configured as a simple 5-point star that illustrates five major stages of knowledge transformation" (Stevens, 2002).

The first point of the star is identified as Discovery (Stevens, 2002). During the discovery stage, new knowledge and original research is reviewed to form a design that could be descriptive, correlational, or qualitative (Stevens, 2002). Research reviewed in the current literature reveals the importance of troponin monitoring in cardiac patients. The qualitative questions developed attempt to discover if previous research guided clinician decisions about the timing of troponin draws, as well as interpretation of the troponin results.

The second point of the star is Evidence Summary (Stevens, 2002). Evidence Summary is taking single meaningful statements to combine findings from various studies to identify bias (Stevens, 2002). Evidence summary works on combining information that includes clinical care, economic decisions, future research design and policy formation (Stevens, 2002). Evidence summary guides the questionnaire in finding out if trending troponin values are substantial in developing a plan for patient care.

The third point of the star is Translation (Stevens, 2002). Translation takes relevant and useful information and summarizes the information that can be translated

into clinical practice guidelines that defines the standards of care, clinical pathways and algorithms (Stevens, 2002). The Translation point of the star indicates current guidelines about troponin monitoring and how troponin values can be integrated into practice by utilizing current knowledge.

The fourth point of the star is Implementation (Stevens, 2002). Implementation looks at current practice that utilizes evidence based research to develop steps to implement a change within an institution to improve on patient care (Stevens, 2002).

The fifth point of the star is Evaluation (Stevens, 2002). Evaluation looks at the impact of EBP on patient's health, outcomes, efficacy, efficiency, economic analysis and the overall impact of health. The overall goal is to utilize the ACE Star Model to determine the trends of troponin monitoring and translate the information into recommendations. For the purposes of this project, this project only utilized the first three points of the Star Model.

Method

Purpose

The purpose of this qualitative study was to evaluate the clinician's preference of troponin monitoring after a MI.

Design

A descriptive four open-ended qualitative questionnaire was used to evaluate preferences of clinicians regarding troponin monitoring (Appendix A).

Site

The study took place at suburban hospital located in Providence Rhode Island. This hospital is a teaching hospital that currently holds 247 beds. The Coronary Care Unit has nine beds. Approximately 15,000 cardiac patients are cared for at The Miriam Hospital in a year. The survey was conducted in the physician's conference room.

Sample

The sample included cardiac clinicians currently working in the Coronary Care Unit. Eligible clinicians included cardiologists, cardiac fellows, cardiac nurse practitioners, and cardiac physician assistants. Clinicians who attend the cardiology meeting and are directly involved in cardiac care were included in the study. Exclusion criteria for the study were non-cardiac clinicians. Twenty-three clinicians were eligible to participate. The goal was to obtain a response from at least ten clinicians who attended the monthly meeting.

Procedures

A questionnaire (Appendix A) was developed after completing a literature review and finding gaps in the research that didn't include troponin monitoring or trending after

a percutaneous intervention. The questionnaire was developed to ask if a troponin value after intervention is necessary, and how the troponin values obtained after intervention are useful to clinicians in practice. The questionnaire was composed of four open-ended questions based on the current literature of monitoring troponins, as well as developing plans of care based on positive troponin results.

Permission was obtained from the chief medical officer of cardiology, the chief nursing officer of the hospital, as well as the coronary care unit manager to conduct a project including cardiology clinicians that currently practiced at the hospital.

The proposed study was submitted to the hospital Institutional Review Board (IRB), then Rhode Island College IRB. Once approval was obtained, a list of cardiology clinicians who attend the monthly cardiology meetings and their e-mail addresses were obtained through the cardiology office secretary. The informational e-mail (Appendix B) was sent out to all eligible participants explaining the purpose of the project. The e-mail stated that participation in the questionnaire was voluntary and anonymous. The e-mail explained that the four open-ended qualitative questions would provide information on troponin monitoring and practice trends, and the information would not be used to influence any clinicians or how they currently practice.

At the beginning of the cardiology meeting, the researcher verbally explained the study and answered questions. A hard copy of the email (Appendix B) and the questionnaire (Appendix A) were handed out to all eligible participating clinicians. The researcher instructed the participants to place all surveys, whether completed or not, in a sealed box that was available in the conference room. The researcher left the meeting to ensure anonymity and returned to collect the box after the meeting was concluded and the

last individual had left the room. The researcher placed the box in the researchers locker at the hospital where it remained locked until the researcher was able to analyze the open-ended qualitative questions. The answers were reviewed by the researcher to evaluate trends and common themes. The results of the questions were stored on a password locked computer that only the researcher had access. After completion of the project, the open-ended qualitative questionnaires were shredded.

Measurement and Data Analysis

The four open-ended qualitative questions (Appendix A) directly asked clinicians about how troponins guide and influence their practice. Data collected was analyzed and compared with the current hospital policy about trending troponin values. The responses to four open-ended questions were grouped into categories based on common themes. Trends were also evaluated and compared to the current policy and the guidelines set by the ACC in the utilization of troponin values.

Ethical Considerations

An ethical consideration of this project was maintaining confidentially of clinician participants. Cardiology clinicians may fear a sense of retribution if their practice did not coincide with the current hospital policy. A second ethical issue involved justice. Clinicians may have felt injustice if they did not attend the meeting and didn't have an opportunity to participate.

Results

A total of 10 out of 23 (43%) eligible participants completed the questionnaire. The qualitative questions along with common themes found among the participants are listed. The first question: *If a patient comes in with a positive troponin, and receives treatment by percutaneous intervention, is it your practice to trend troponins? Provide Rationale,* ninety percent of the participants stated that they would not trend troponins. Rationale provided for not trending troponins included that a percutaneous intervention has already occurred, and the risk was stratified. A few of the participants that did state no included comments suggesting that a troponin level could be trended after percutaneous intervention for patients that specifically presented with ACS symptoms, along with ECG ST-Elevation on arrival. Rationale provided for trending troponins after a patient who presents with ACS and ST-elevation included concerns about the extent of ischemic injury, along with the risk of a recurrent event.

The second question: *At what troponin level (numeric level) do you become concerned about the coronary health of your patient?,* one hundred percent of the participants stated that any troponin level that comes back positive (greater than 0.06μg/L) is concerning. The rationale from clinicians included concerns of any troponin level that was positive, along with a level greater than the last value obtained. Other comments included patients that present with a positive troponin, along with other medical comorbidities caused concern for clinicians.

The third question: *If a patient's troponin level continues to rise during the timed intervals for troponin trending, do you modify the plan of care and if so specify how.* seventy percent of participants included feedback that stated that modification to the plan

of care would be dependent on the degree of symptoms a patient is experiencing. If patients are experiencing symptoms associated with ischemia, or have a history of ACS, this may dictate the timing for a percutaneous intervention. It was implied by most clinicians that the percutaneous intervention would need to occur sooner.

The fourth question: *Do you order a high sensitivity or standard troponin? Provide rationale*. All participants stated ordering a high sensitivity troponin. The rationale included using a high sensitivity troponin because the hospital has changed over from the standard troponin to now a high sensitivity and this is the only one currently available at the hospital.

Summary and Conclusions

Medical costs of cardiovascular disease are anticipated to triple, from $200 to $800 billion between 2010 and 2030 (Heidenreich, Trogdon, Khavjou et al, 2011). It is estimated that around $207 billion dollars are spent towards cardiovascular care each year in the United States. With the increasing number of Americans diagnosed with cardiovascular disease, it is important for clinicians to find ways to accurately diagnose ACS and the severity of cardiac damage in a timely fashion (Liu, Shehu, Herrold, & Cohen, 2015). Troponin values can indicate the severity of the injury and research has shown an elevated troponin is related to increased mortality. Guidelines are put into place with the intention to aid clinicians in the right direction for the appropriate care. Contributors that set guidelines for troponin monitoring in ACS and AMI include the ESC, ACC, and the AHA (Apple, Quist, Murakami, 2004).

The literature review included various methods of how troponin levels are used to diagnose ACS. The literature provided information on how troponin levels can predict morbidity and affect mortality. Troponin values are used to diagnose and guide treatment. Various guidelines recommend trending troponins, although most of the research reviewed utilized troponins solely until an intervention occurs. Gaps in the research included the usefulness of trending serial troponin values after a patient has a MI, and how troponin values are used after percutaneous intervention.

The purpose of this qualitative study was to evaluate the clinician's preference of troponin monitoring after an MI. The project was guided by utilizing part of The ACE Star Model of the Cycle of Knowledge Transformation (Star Model)(Stevens, 2002).

Four open-ended qualitative questions were created and distributed to cardiac clinicians to evaluate their preference on troponin monitoring and how troponin values are useful in diagnosing and treating patients. The data was collected from 10 cardiology clinicians. The results and common themes were evaluated from the clinician response. Ninety percent of the responses indicated that clinicians would not trend troponins after a percutaneous intervention. Rationale included that the risk was stratified after intervention. All clinicians stated they became concerned about the coronary health of the patient when there was a positive troponin level above 0.06μg/L. Further rationale included concern when the current troponin level rises higher than the previous level. Seventy percent of clinicians felt that if a patient's troponin level continues to rise during the timed intervals, the plan of care should be modified. Some of the commonalities in the answers included clinicians allowing for the possibility to modify a plan of care if the clinical presentation of a patient changed or declined. The consensus included if the troponin value continues to rise and the patient is symptomatic and there is question if ischemic changes, the timing of percutaneous intervention may occur sooner. All clinicians answered that a high sensitivity troponin would be ordered because that is what the hospital currently uses as a standard of care.

Limitations of this study included a small sample size of only 10 clinicians who completed and filled out the questionnaire. A higher number of participants would have provided more supporting data to evaluate clinician preference of troponin monitoring. Another limitation included questionnaire being distributed and filled out at only one hospital.

Conclusions based on clinician feedback included some discrepancies among trending troponin values. A majority of clinicians provided information that they would only trend troponins after percutaneous intervention if the patients had ST-Elevations or symptoms of ischemic changes. Ninety percent of clinicians stated that there is no reason to trend troponin values after percutaneous intervention because risk was stratified by the procedure. One clinician said they would trend troponin levels even after percutaneous intervention because of the risk of a recurrent event or to determine the size of the infarct. The question predominately showed that clinicians would not trend after a percutaneous intervention, although many of the other questions concluded that if a patient develops any further coronary symptoms or changes in their clinical presentation, troponin levels would be trended to evaluate any other ischemic changes. A troponin level that rises could indicate an urgent need for a percutaneous intervention. One clinician implied that troponin levels should be trended until the level begins go decrease to assess the size of the infarct, as well as utilizing this for follow up if the patient returns with chest pain. Most clinicians found troponin monitoring as beneficial, but trending routinely for every single patient may not be indicated according to clinician feedback.

Recommendations and Implications for Advanced Nursing Practice

Evidence based practice and literature have indicated that higher troponin levels do correlate with higher morbidity and mortality rates. Cardiac clinicians indicated that the clinical presentation of a patient helps to determine whether troponin values should be trended or not. According to the study participant feedback, troponin values have guided clinicians in attempting to assess cardiac damage and if earlier interventions need to occur. Some clinicians erred on the side of caution and wanted to trend troponins until the value decreased. Not all clinicians felt the need to trend troponin levels after percutaneous intervention, although it was a general consensus that if a patient had a change in clinical presentation, troponins would be monitored or trended more closely.

A recommendation for practice provided by one of the clinicians who completed the questionnaire included continuous troponin monitoring until the patient is discharged. The rationale would be to determine the extent of cardiac damage as well as if the patient is readmitted with chest pain within the span of a day or a few days, the results of the last troponin could indicate a baseline troponin level after coronary intervention. If a patient is readmitted with a higher level then the last drawn value on discharge, this could indicate further disease or another valid comorbidity.

Literature reviewed included research that focused on utilizing troponins for the purpose of early diagnosis of ACS. Research also looked at the extent of morbidity and mortality rates of patients that had a positive or greater than normal level of troponin and the differences between a CTnI and a hsTrop. A gap in the research was the lack of data regarding trending of troponins after intervention. This project attempted to find out more information about clinician preference of troponin monitoring after myocardial

infarction. In utilization of troponins as an advanced practice clinician, a recommendation would be to trend troponins per hospital policy, but also to become familiar in recognizing how elevated troponins can change the plan of care. Further research is still needed on troponin monitoring after myocardial infarction.

References

American Heart Association (2015). Acute coronary syndrome. Retrieved from http://www.heart.org/HEARTORG/Conditions/HeartAttack/AboutHeartAttacks/acute-Coronary-Syndrome_UCM_428752_Article.jsp#mainContent

Apple, F. S., Quist, H. E., & Murakami, M. A. M. (2004). Diagnostic and prognostic value of cardiac troponin I assays in patients admitted with symptoms suggestive of acute coronary syndrome. *Archives of Pathology & Laboratory Medicine, 128*(4), 430-434.

Bjorklund, E., Lindahl, B., Johanson, P., Jernberg, T., Svensson, A., Venge, P., Wallentin, L., Dellborg, M., ASSENT-2., ASSENT-PLUS. (2003). Admission troponin T and measurement of ST-segment resolution at 60 min improve early risk stratification in ST-elevation myocardial infarction. *European Heart Journal,* 25, 113-120.

Center for Disease Control (2017) Acute coronary syndrome. Retrieved from: https://www.cdc.gov/heartdisease/facts.html

Edwards, B., Washington, I., Pretlow, L., Passmore, G., Dias, J., & Wise, S. (2013). Sequential assessment of troponin in the diagnosis of myocardial infarction. *Clinical Laboratory Science*, 26(2), 95.

European Society of Cardiology, (2017). Acute myocardial infarction in patients presenting with ST-segment elevation (Management of). Retrieved March 15, 2018, from https://www.escardio.org/Guidelines/Clinical-Practice-Guidelines/Acute-Myocardial-Infarction-in-patients-presenting-with-ST-segment-elevation-Ma

Heidenreich, P., Trogdon, J., Khavjou, O., Butler, J., Dracup, K., Ezekowitz, M… Woo, J. (2011). Forecasting the future of cardiovascular disease in the United States: A policy statement from the American Heart Association. *Circulation,* 123(8), 933-944.

Lim, W., Cook, D. J., Griffith, L. E., Crowther, M. A., & Devereaux, P. J. (2006). Elevated cardiac troponin levels in critically ill patients: Prevalence, incidence, and outcomes. *American Journal of Critical Care,* 15(3), 280-288.

Lindahl, B., Venge, P., Wallentin, L., (1995) Early diagnosis and exclusion of acute myocardial infarction using biochemical monitoring. *Coronary Artery Disease (6)* 4, 321-328.

Liu, M., Shehu, M., Herrold, E., & Cohen, H. (2015). Prognostic value of initial elevation in cardiac troponin I level in critically ill patients without acute coronary syndrome. *Critical care nurse*, *35*(2), e1-e10

Luscher, M., Ravkilde, J., Thygesen, K. (1998). Clinical application of two novel rapid bedside tests for the detection of cardiac troponin T and creatine kinase-MB mass/myoglobin in whole blood in acute myocardial infarction. *Cardiology,* (3)89, 222-228

Rahimi, A., Marzano III, P., & Richard, C. (2003). Evaluation of lactate and c-reactive protein in the assessment of acute myocardial infarction. *Southern Medical Journal (96)*11, 1107-1112

Sanchis, J., Garcia-Blas, S., Mainar, L., Mollar, A., Abellan, L., Ventura, S… Nunez, J. (2014). High-sensitivity versus conventional troponin for management and prognosis assessment of patients with acute chest pain. *Heart Journal* (100) 1591-1596

Sara, J. D., Holmes, D. R., & Jaffe, A. S. (2015). Fundamental concepts of effective troponin use: Important principles for internists. *The American Journal of Medicine, 128*(2), 111-119.

Sethi, A., Bajaj, A., Malhotra, G., Arora, R. R., & Khosla, S. (2014). Diagnostic accuracy of sensitive or high-sensitive troponin on presentation for myocardial infarction: a meta-analysis and systematic review. *Vascular Health and Risk Management, 10*, 435.

Stevens, K. R. (2002). ACE Star Model of EBP: The cycle of knowledge transformation. Academic Center for Evidence-based Practice. Retrieved from http://nursing.uthscsa.edu/onrs/starmodel/star-model.asp

Wu, A. H., Bolger, A. F., & Hollander, J. E. (2013). Growing pains with the use of high-sensitivity cardiac troponin assays. *Journal of the American College of Cardiology, 62*(14), 1250-1251.

Appendix A

Appendix A

Open-ended Qualitative Questions

Troponin Monitoring Practice

Instructions: Please do NOT put your name or any identifier on the survey. The answers will be anonymous. Please answer all of the open-ended questions. When you have completed the questions, place it in the sealed box that is provided in the room. Your answers will be used to learn about clinician preference regarding trending troponins after a patient has ruled in for a MI and will not be used to make any changes to current practice.

1. If a patient comes in with a positive troponin, and receives treatment by percutaneous intervention, is it your practice to trend troponins? Provide rationale.

2. At what troponin level (numeric level) do you become concerned about the coronary health of your patient?

3. If a patient's troponin level continues to rise during the timed intervals for troponin trending, do you modify the plan of care and if so specify how.

4. Do you order high sensitivity or standard troponin? Provide rationale.

Appendix B

Appendix B

E-mail Script

We would like to ask you to take part in a research project that looks at clinician preference for troponin monitoring after a myocardial infarction. This research is being conducted by Kristen Wojewudski, an MSN student at Rhode Island College, in conjunction with the Principal Investigator, Dr. Cynthia Padula. The opportunity to participate in this research project will occur at an upcoming cardiology meeting. If you choose to participate in this study, you will be asked to respond to four open-ended qualitative questions that address preferences for troponin monitoring. Your completing of these questions will probably take a few minutes of your time. The questionnaires will be handed out at the meeting and a box will be available to drop in the responses which will be totally anonymous.

There are no questions that should cause you any discomfort. Your taking part in this project is completely voluntary. If you do not wish to complete any or all questions, you are free to choose to not complete them. Your completion of these questions may not benefit you personally. It is hoped that the responses will provide some information about provider trends in troponin monitoring.

Your responses to these questions will be remain confidential. None of the information you provide will have your name or any other identification that could identify you personally.

If you have any questions about these questions, or the research study itself, you may contact Kristen Wojewudski at kwojewudski_8947@email.ric.edu or Dr. Cynthia Padula at cpadula@lifespan.org

If you have any questions about your rights as a research subject please feel free to call our Research Protections Office Director, Janice Muratori, at 444-6246 or the IRB designate at Rhode Island College at IRB@RIC.edu

Thank you very much for your time!

Cynthia Padula RN PhD

Kristen Wojewudski RN