IMPROVING SURVIVAL RATES IN PATIENTS SUFFERING CARDIAC ARREST WITH SPECIALIZED RESUSCITATION TEAMS: AN INTEGRATIVE REVIEW

A Scholarly Project

Submitted to the

Faculty of Liberty University

In partial fulfillment of

The requirements for the degree

Of Doctor of Nursing Practice

By

John Campbell Holcomb

Liberty University

Lynchburg, VA

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ABSTRACT

Over 300,000 hospitalized patients suffer a cardiac arrest requiring a Code Blue activation each year in the United States. These patients have an extremely high mortality rate. These rates are not uniform across all hospitals and facilities that employ specialize Code Blue resuscitation teams have a higher percentage of patients that survive resuscitation events. This Integrative Review shows that these teams are essential to patient survival but are prone to barriers that must be overcome to provide effective teamwork. Quality improvement projects centered around Code Blue teams can be created at the local level and have been found to be successful even when protocol details may differ. As long as team barriers at the facility are addressed, patient survival rates after the activation of a Code Blue can be improved.

Keywords: Cardiopulmonary resuscitation or CPR or resuscitation, teamwork, survival, hospital

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List of Abbreviations

Advanced Cardiac Life Support (ACLS)

American Heart Association (AHA)

Basic Life Support (BLS)

Cardiopulmonary Resuscitation (CPR)

Code Blue (CB)

Institutional Review Board (IRB)

Integrative Review (IR)

Return of Spontaneous Circulation (ROSC)

United States (U.S.)

SECTION ONE: FORMULATING THE REVIEW QUESTION

Since the advent of rescue cardiopulmonary resuscitation (CPR) in 1956 by Dr. James Elam and Dr. Peter Safar, medical professionals have had a system in place to help save the life of a patient suffering a cardiac or respiratory arrest. CPR has drastically changed since its inception in both quality and scale. Gone are the days where one or two rescuers would act without assistance from others during a life-saving attempt; it was quickly discovered that the more rescuers working the case, the higher the likelihood that the patient would survive. Hospitals around the U.S. and world quickly took to the idea of using more than a couple of rescuers and developed an emergency system that would urgently call more staff to a patient who was suffering from a cardiac or respiratory arrest. This notification become universally known as a "Code Blue" (CB) event.

Over the years, new information, strategies, techniques, systems, and technologies have completely changed the interventions available to rescuers performing in a CB. Portable heart monitors allowed for real time heart rate analysis, defibrillators could shock the patient's heart in the hopes of restarting its electrical system, dosages and rates of epinephrine, amiodarone, sodium bicarbonate, calcium chloride and other emergency medications have been given clinical recommendations, and rates of breathing and chest compressions have been continually revamped. When these interventions were available, they have proven to increase the chances of patient survival and as such, helped to foster the formation of roles within a CB event.

Inevitability staff within every hospital throughout the world have cared for a patient who suffered a cardiac arrest despite the quality of preceding treatments performed. In previous years, hospitals around the U.S. have dealt with roughly 300,000 cardiac arrests that required a CB response (Johnson & Dunn, 2019). It is theorized that this number will exponentially increase

over the next two decades secondary to the fact that the majority of the U.S. population has grown statistically older while coping with a greater number concurrent and advanced chronic conditions. Historically, chronic conditions such as myocardial infarction, cerebral vascular accident, congestive heart failure exacerbation, acute on chronic kidney disease, idiopathic hemorrhage, septicemia, and chronic obstructive pulmonary disease have led to the most common reasons for a hospitalization. These disease processes have no cure, and within hospital in patient populations have often been the underlying cause that preceded a cardiac arrest. For these reasons it is unrealistic to expect hospital staff members to prevent all arrest events from occurring (ECC Committee, Subcommittees and Task Forces of the American Heart Association, 2005). Medical and nursing professionals must ensure that they are prepared for these resuscitation events and properly act when required as they are common in the modern healthcare setting. Early initiation of CPR and defibrillation have been found to be a critical component to improve patient survival, given that every minute of delayed treatment decreases survival by 10% (Ali & Zafari, 2007). In response, the American Heart Association initiated two certifications, Basic Life Support (BLS) and Advanced Cardiac Life Support (ACLS), to educate providers about the nuances of performing life-saving measures. These certifications have granted professionals knowledge about resuscitation techniques, but have not provided mandated guidelines to which facilities must adhere. The AHA determined that how these trained personnel were utilized remained up to each individual hospital system. As a result, similar patients have experienced drastically different outcomes in response to a CB activation depending on the facility where they were admitted.

While the CPR process, along with the BLS and ACLS practice certifications have increased survival rates in hospitalized CB patients, which was last estimated to be about 22.3%

(Girotra et al., 2014) over the last two decades, the vast majority of patients who received CB resuscitation inevitably perished. These statistics have shown that persistent improvements to the CPR and CB process within hospitals continues to be a necessity. One of the most significant problems with a CB event has been found to be the abundance of tasks that must be simultaneously performed (Abella et al., 2005). Duties in a standard CB response have traditionally included (a) properly performing chest compressions at a standardized rate and depth, (b) determining circulatory status via pulse checks, (c) interpreting the patient's heart rhythm, (d) deciding on defibrillation based on the heart rhythm, (e) administering emergency medications such as epinephrine, (f) ensuring that there is intravenous access to administer medications, (g) giving patient rescue breaths or inserting an emergency airway device, (h) documenting each intervention performed with exact times, doses, or rhythm analysis; and (i) determining the underlying cause of the cardiac arrest that allows for patient specific medical intervention. Hamilton et al. (2009) found that factors such as, shorter response times, greater availability of trained personnel, performance of high-quality chest compressions with fewer interruptions, and post-resuscitation care elicited a greater chance of patient survival. The plethora of required CB interventions and the factors noted by Hamilton's research group demonstrated that it was impossible for only one staff member to perform a CB, but instead required the cooperation of a specialized team of professionals working in organized unison with one another.

With this litany of evidence from the literature, the project leader asked himself an interesting question: Why have survival rates not universally improved within this patient population? Though some degree of mortality reflected patients' underlying disease, inadequate resuscitation practices have also likely contributed to decreased survival (Abella et al., 2005;

Panesar et al., 2014). Some researchers theorized that inadequate resuscitation has been an outcome preceded by ineffective teamwork and organization of the CB respondents. During resuscitation attempts, any given CB team of health care providers typically face settings characterized by high levels of stress, time pressure, and impending danger to the patient (Hunziker et al., 2011; Rosen et al., 2008). These variables are exemplified if a lack of team organization and communication are present (Risaliti et al., 2018), which often results in an overall diminished resuscitation effort. Errors such as these have been linked to suboptimal rates of return of spontaneous circulation (ROSC) and survival to hospital discharge (Panesar et al., 2014). A critical aspect noted by Nallamothu et al. (2018) was that the hospitals with the best CB survival rates tended to be centers that performed and followed current quality improvement initiatives and utilized organized CB teams.

Even with the recommendations for the Institute of Medicine and the American Heart Association, Spitzer et al., (2019) found that in-hospital resuscitation teams with specific roles and responsibilities were lacking in many U.S. hospitals, while Cooper et al., (2016) discovered that the most effective resuscitation models for improving outcomes are not agreed upon between medical facilities. Reasons such as these confirmed the importance of performing an integrative review (IR) for the CB survival problem. An IR was chosen for this manuscript, as the format helped to develop a detailed evaluation answering if specialized CB teams help improve patient survival rates using already published literature. The format also allowed for exploration of how the best teams are structured around the world.

When CB-s are not effectively performed, hospitals have incurred significant financial burden secondary to a surge in length of patient stay and increase in acuity of care, which have been determined to be the fault of the organization (Chan et al., 2008). Concurrently, risks for

litigation also increased (McNamar, 2019). Direct costs in performing a CB were found to be relatively low, as crash carts, which were stocked with supplies needed for the resuscitation, cost the organization approximately $600 (Gunderman & Nelson, 2013). However, it must be considered that when the CB team did not perform effectively, the resuscitation attempt lasted for a longer amount of time and an increase in usage of these supplies resulted. Therefore, each time the CB team ineffectively performed, a greater strain was placed on the hospital's supply inventory and budget.

Because no enforceable national guidelines for CB teams have been created, the utilization of primary sources in an IR helped to identify commonalities in team structures between organizations with better overall survival rates, which were then plainly exhibited. Determination of a best practice necessitated a through and systematic review of proposed interventions. Using an integrative review process allowed the project leader to showcase that team improvements continue to be needed by hospital systems regarding CB protocol. The project leader theorized that the development of a meticulously organized and structured CB team would help to increase survival rates in patients and therefore the review brought essential insight to current modern practice.

CB events have continued to be a medical emergency with exceptionally low survival rates. Those patients who required the activation of a CB are among the most critically sick patients within a hospital system and depend on the expertise of a professionally trained staff. Girotra et al. (2014) found that three in four patients who suffered an in-hospital cardiac arrest and underwent a CB response did not survive to discharge. These researchers determined that in order to facilitate patient survival after a CB, professionals must possess critical thinking skills, keep a steadfast, calm demeanor, and work efficiently in the hectic environment. Girotra er al.

also stressed that interdependence of personnel was paramount, as there were multiple simultaneous emergent issues that had to be addressed in each resuscitation attempt. Although each member of the CB team had the ability to perform his or her role on an independent basis, it remained essential that they communicated with one another to ensure that the patient received every intervention required for survival.

Teams composed of professionals who are trained, educated, and practiced in the art of advanced resuscitation perform at a higher level of competence than those teams comprised of less specialized personnel. How the team is trained and organized either increases or decreases the survival chance for the patient in that team's care (Nallamothu et al, 2018). Not all facilities around the United States employ or create these specialized teams, but instead often rely on staff members to perform these heroic actions during their shift on an as needed basis within that specific unit of operation. As a result, these facilities have a lower rate of patient survival than those organizations that have adopted a stronger approach to the creation and implementation of a CB team.

Concept and Variables

The overarching concept for this integrative review was to show that quality teamwork within a CB team increases the general survival rate for patients that undergo CPR. There are many variables within the team that have to be taken into consideration such as communication, education, practice, and role utilization. As such, these variables were acknowledged and addressed within the IR to help provide the most relevant recommendations for high functioning CB teams. The higher functioning the CB team, the greater the chance of patient survival.

Rationale for Conducting the Review

The current literature showed that improvements continue to be necessary within the process of CB performance across the U.S. and world. An integrative review was a suitable style for this research since the question of team improvement is broadly focused within the spectrum of medical intervention. Previous article recommendations for team improvement have had to utilize both quantitative data and qualitative survey responses from CB team members for conclusion support. By their nature, qualitative studies leave biases and gaps within their conclusions when viewed as a single entity. Therefore, when multiple articles were synergized by the project leader with an IR review, these biases had a lessened effect on the overall discoveries within the IR.

Purpose and Review Question

The purpose of this project was to review and evaluate if creating or improving a CB response team affected the patient survival rate from in-hospital cardiac arrests; and if so, what variables optimized the CB teams the most. The IR process aided in generating strong synthesis between these research articles that otherwise had not been previously connected. Linking these articles dealing with the two major themes of survival and teamwork allowed for robust clinical recommendations to be produced and recommended to a broader spectrum of medical facilities.

The overarching goals of this project were twofold and helped to create the clinical questions that drove the IR process. Goal one was set to discover if teamwork does in fact have precedence to increase survival rates within hospitals that operate CB teams for all cardiac arrest events. Goal two then asked, if these teams did indeed improve patient survival chances, was there a more effective way to organize, train, and optimize team functionality.

Two clinical questions were created to drive the research forward:

1. In hospitalized patients, do those that suffer cardiac arrest and undergo a Code Blue resuscitation performed by a dedicated Code Blue team, have a better survival chance than those patients that did not receive resuscitation from a dedicated Code Blue team?
2. Within Code Blue teams, did teams with quality non-clinical variables such as communication, education, practice, and role clarity perform duties better than those teams without those quality variables?

The following supplemental questions helped to support and direct the IR:

1. Was there a teamwork theory that could help create an effective team dynamic?
2. Did CB teams designed with an interdisciplinary approach perform differently than teams with individuals of the same discipline?
3. What variables of training were most important in helping to bolster team performance?

Inclusion and Exclusion Criteria

For this IR it was essential to create specific inclusion and exclusion criteria for potential research that would be used within the review. There was an extremely broad array of research available that delved into different aspects of cardiopulmonary resuscitation. The project leader created a list of criteria specific to this IR to assist in discovering research pertinent to its clinical questions. Published research needed to have been gathered from hospital systems for consideration; no articles investigating out of hospital CPR studies were of use in this IR. To further enhance the quality of the project, only current articles were used and each article had to be primary research. Current articles were defined as being published within the last seven years; therefore, only articles from the years 2013-2020 were applicable for review by the project leader. Any article found within the criteria that did not have a full text to review, i.e., an abstract

only, was excluded. Only articles written in English were used, as translations from other languages could have important facets that were missed or misrepresented in translation. Table 1 provides the inclusion and exclusion criteria used in this review.

Conceptual Framework

The overall goal of an IR is to synthesize current research articles that when combined, propose a new overarching theme that the individual articles could not speculate upon. Both experimental and non-experimental data results are utilized in an IR, giving this type of analysis an incredibly broad range (Toronto & Remington, 2020). In order to successfully complete an IR, a researcher must determine a question, hypothesize an answer, perform a literature review, analyze the data, and synthesize the research in an effective and correct manner.

For this review, the methodology proposed by Whittemore and Knalf (2005) was utilized to assist with result synthesis. Whittemore and Knalf's methodology was selected, as their approach allowed for theoretical and empirical reviews to be combined in an effective and organized manner. Whittemore and Knalf deatiled the framework that one must follow to perform an IR with their method. The steps include, problem identification, literature search, evaluation of the data, analysis of the data, drawing of a conclusion from the discovered data, and finally, a presentation of the attained conclusion and recommendation.

Along with the Whittemore and Knalf (2005) methodology, each article was appraised for the evidence type that the article provided. In order to determine the level of evidence, the Melnyk & Fineout-Overholt's System of Hierarchy (2011) was charted. By performing this step, the lead researcher was able to place higher importance on stronger levels of evidence. Appendix A details this matrix. Finally, the Tuckman Team Model (2014) was used as a theoretical framework to help tie the conclusion to a practice model.

Problem Identification

Whittemore and Knalf (2005) proposed that the problem identification stage was imperative to help create a clear and concise identification of the clinical challenge, giving focus and direction for the IR. As such, the project leader performed this step of the process first. Without a clear direction, the articles that were selected for the IR may not have had a strong or relevant connection to the clinical questions. The project leader determined that in many hospital settings, composition and organization of CB teams were not optimized which led to lower rates of patient survival. National overall patient survival rates, hospital comparison survival rates, and the American Heart Association's ACLS recommendations were used to guide the focus of this IR.

Literature Search

In what may be the most important part of a quality IR, the literature search was the second step in the research process as suggested by Whittemore and Knalf (2005). The literature search utilized the identified problem framework as a guide for potential article discovery. Search strategies were well defined and reproducible, which reduced intrinsic bias from the project leader. Primary research articles were considered the most relevant sources for this integrative review. Quantitative research was primarily sought, but three qualitative data articles were found to be pertinent to the IR questions.

Data reduction assisted the project leader in using only the most relevant of the 506 articles that were discovered with the initial literature search. The initial search was based on characteristics and themes of the study as directed by the clinical question. To assist with this daunting task, the project leader used the PRISMA flow diagram (Liberati et al., 2009) to remove

articles with less relevance for the clinical questions. The specifics of the literature review and data reduction for this project are provided in detail in a subsequent section of this manuscript.

Data Evaluation

In order to effectively use the gleaned data, each article was evaluated and analyzed for type of research and level of evidence. At this point the Melnyk Level of Evidence matrix (Appendix A) was used in coordination with the Whittemore and Knalf (2005) methodology to determine the type and strength of each applicable article used in the final IR. The levels of evidence in this IR ranged from I to VI. Level I studies were systematic reviews and were seen as the best evidence. Overall, the research studies utilized in the IR tended to be predominately quantitative data but were performed in single facility environments, which limited the majority of studies to the Level III to IV range. Two qualitative data studies were found to be of relevance and were both level VI studies.

Data Analysis

Using thematic analysis, data conclusions from each individual study were recorded, coded, and summarized to make comparisons with one another against the clinical questions. According to Whittemore and Knalf (2005), this stage must be further broken down into a data display and comparison. In doing so, the data became easier to comprehend and was able to be effectively integrated into a more unbiased presentation. This analysis is discussed in greater detail later in the manuscript.

Conclusion Presentation

The final stage, according to Whittemore and Knalf (2005) is to report and provide the evidence discovered from the review process. The conclusions need to be observable with

evidence of how each article's findings correlate to the clinical question. In this way the reader is able to see how the research impacts the current clinical knowledge.

Theoretical Framework

In order to solidify IR conclusions, the project leader reviewed the Tuckman Team Model, a theoretical framework that proposed qualities of successful team building and maintenance. Incorporating a theoretical framework helped to strengthen the conclusions as it facilitated development of themes and observations (Evans, Coon, & Ume, 2011). While not directly integrated in the healthcare industry, the Tuckman Team Model has direct connections to theorized qualities needed for a successful CB team. In order to make a constructive team, the Tuckman theory proposed four essential aspects to create, monitor, and improve a team. These aspects were termed forming, storming, norming, and performing (Tuckman, 1965).

Forming a team must occur to create an effective and successful team dynamic according to Tuckman (1965). Team creators must take into account strengths, weaknesses, quirks, and other personal traits of potential members. Roles and an ensuing hierarchy must be established so orders can flow efficiently and properly. In successful teams, expectations are clearly laid out and goals are determined by the leader.

The next aspect to the creation of a successful team is storming (Tuckman, 1965). During this stage, problems within the team may have emerged which were quickly and adequately resolved. Debriefing and evaluation of the issues are not just the responsibility of the leader(s) but of each individual team member. Tuckman determined it to be impossible to create a perfect team with the initial formative steps. Issues would always arise and teams that could navigate these "storms" had a greater chance of improving team function. These successful teams would

ultimately be more proficient with better inner-team communication and cooperation than those teams that did not undergo or failed the storming process.

Tuckman's (1965) third step, norming, is the stage when a team must repeatedly practice the responsibilities awarded to its care. As the team continues to practice, the processes and teamwork become second nature and expected; thus, the functions become "the norm" to the team. As these processes become normal to the team, each individual within the team effectively helps one another while offering guidance and support to new members.

The final stage that Tuckman (1965) discussed is performing. At this point the team has a clear direction, roles, goals, and performance matrixes. Regular supervision is no longer needed for the team to properly perform their entrusted duties. At this point, members of the team should have a clear understanding of all roles within the team and be able to act upon situations they deem incorrect. When in the performing stage, team members should be encouraging each other to perform at a high level and have pride in the work they collectively achieve.

The project leader felt that Tuckman's (1965) theory could be readily applied to the creation of a competent CB team. The formation of these teams takes an interdisciplinary collaboration between multiple hospital departments and professions. Roles are issued according to specialties, so each member can perform the actions in which he or she feels most confident. Debriefings after Code Blue events act as a good mechanism for storming and help to resolve issues that create barriers to successful CB teamwork. Norming and performing naturally take place as more CB events occur, granting each individual member of these CB teams experience and expertise within the process.

SECTION TWO: COMPREHENSIVE AND SYSTEMATIC SEARCH

Search Organization

In order to discover the most relatable evidence pertaining to patient survival secondary to CB team utilization, structure, and function, multiple professional article databases were searched. The databases included in the search were CINAHL (EBSCO), MEDLINE (ProQuest), PubMed Central, and the Cochrane Library. Each database included its own search interface for article discovery. These databases were chosen as they offered the most comprehensive collection of peer-reviewed scientific journal articles that specialize in the nursing and medical sector. Journals that dealt with the topic of CB teams and patient survival statistics had the most likelihood to be included within these databases. In order to ensure that results were accessible at a future time, the project leader saved all searches and criteria within the specific database. For better organization and reproducibility, the 2015 PRISMA guidelines and flow diagram (Liberati et al., 2009) were selected as a tool to properly perform a comprehensive search. The PRISMA flow diagram allowed for the relevant articles to be organized and reduced while the project leader performed the inclusion process.

Terminology

Databases were an electronic collection of peer-reviewed scientific works that were published by reputable academic journals. The databases used in the IR were accessed within the rights and privileges owned by Liberty University. Each database was comprised of software, known as the platform, that enabled the database to function. EBSCO and ProQuest were the platforms that these databases utilized. The search interface was where the project leader was able to electronically input search criteria for discovery of articles relevant to the IR. The

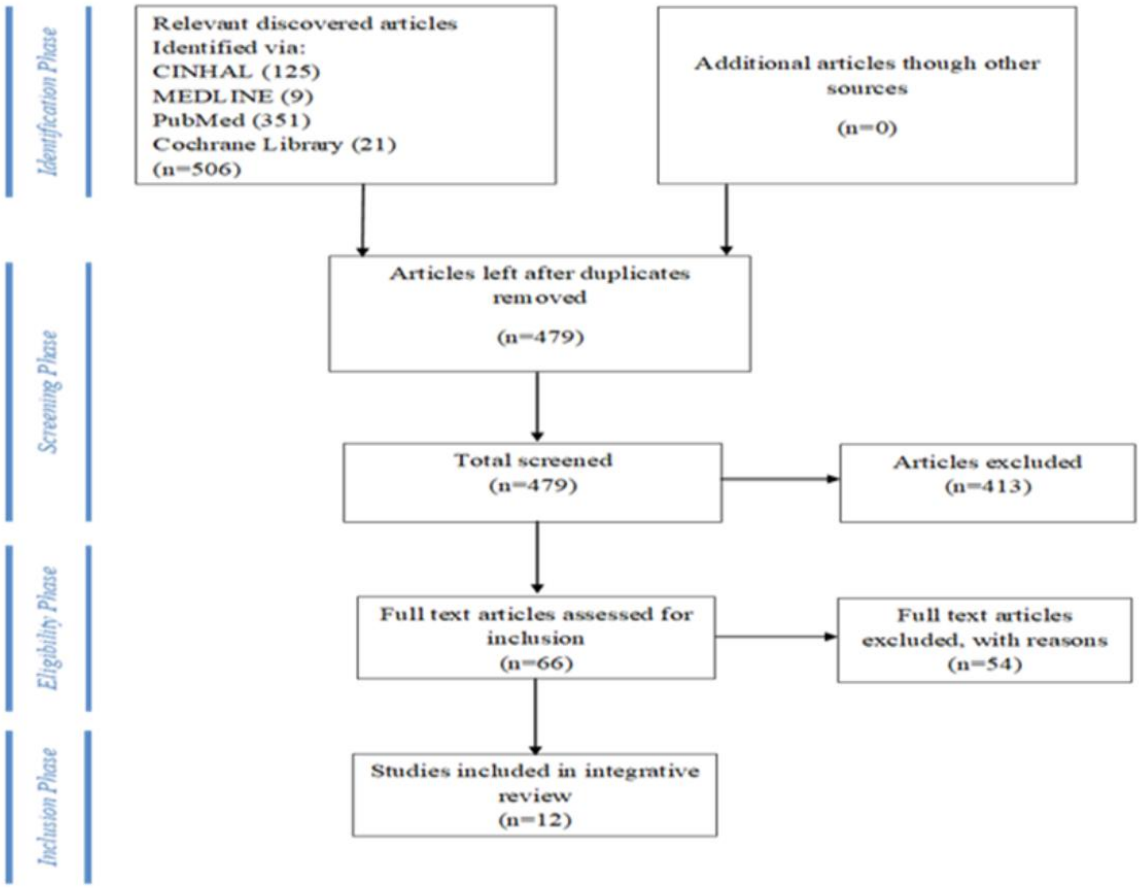
platform, database, and search engine together made up the whole system that the project leader used for the literature search.

SECTION THREE: MANAGING THE COLLECTED DATA

In order to facilitate an effective IR with quality synthesis of results and recommendations, the collected data were properly vetted using the PRISMA flow diagram (Liberati et al., 2009). After the observation of the problem and formation of the clinical question, the project leader created strict search criteria definitions. The first step determined what keywords were placed into the search engines to reveal the most relevant articles for answering the clinical questions. After using different terms, combinations, and stipulations, the final keywords ultimately used included: cardiopulmonary resuscitation or CPR or resuscitation, teamwork, survival, and hospital. These keywords were used in exactly the same manner within each of the databases' search engines. One hundred and twenty-five articles were elicited by CINAHL, nine by MEDLINE, 351 by PubMed, and 21 by the Cochrane Library which gave the project leader a total of 506 possible applicable articles for use in the IR. These 506 articles formed the base, or identification section in the PRISMA flow diagram and gave the researcher a starting point for the screening process. Figure 1 offers a breakdown of the PRISMA flow diagram. Because there was an overabundance of articles discovered within the databases, the project leader determined that searching other sources or databases for articles was not required to enhance the literature search.

Figure 1

2015 PRISMA flow diagram



Once the identification stage was completed, the screening phase began. The total number of articles needed to be further reduced to find literature that not only provided the most relevant information to answer the clinical question, but to make the project more manageable as a whole. A list of the articles was placed into EndNote X9 basic, a computer program produced by Clarivate Analytics. The basic subscription allowed the project leader to remove duplicate studies that were included within the 506 articles. After screening, found duplications were removed which left 479 articles that had potential use in the IR.

The project leader was able to further reduce the article numbers by manual inspection. To accomplish this, strict limits via inclusion and exclusion criteria were placed on the sources that could be used. Table 2 is a list of the inclusion and exclusion criteria which encompassed using only research, published within the last seven years leading up the IR, research performed inside a hospital setting, published in the English language, and full-text primary research.

Table 1

Inclusion and Exclusion Criteria for Literature Sources.

Inclusion Criteria	Exclusion Criteria
Publications published 2013-2020	Publications published prior to 2013
Hospital Setting	Out-patient setting
Primary and Secondary Research Articles	Non-research articles such as editorials
English Language	Non-English Language
Full Text Articles	Abstract only articles

After these criteria were applied by manual inspection to the articles, 66 potential articles remained eligible for use within the IR. The project leader completed further in-depth reviews of each text within the body of these remaining articles. More specific stipulations such as CPR performed by non-hospital staff (such as emergency medical technicians), initial BLS resuscitation protocols, technology focused resuscitation, and other non-teamwork models were removed from consideration. Once this process was completed, there were 12 articles remaining and this group of articles comprised the articles utilized in the IR which ultimately underwent literature review to answer the clinical questions.

SECTION FOUR: QUALITY APPRAISAL

Sources of Bias

As this IR relied on data from multiple quantitative and qualitative studies, the project leader used the PRISMA guidelines (Liberati et al., 2009) to help strengthen the literature search. These guidelines helped to place proper inclusion criteria on the studies, preventing the research from becoming too broad. Each included article in this IR was able to be transferred to other systems, had minimal measurement inconsistences, had logical methods, and had results that matched the evidence given within the body of the manuscript (Williams et al., 2019). The project leader sought these features in each article used for this IR. By using the PRISMA model and the ideas of the Williams research group, the project leader minimized the potential and natural biases that were present in the IR.

Internal Validity

Each article included in the review of this project used a scientific approach to discover its individual conclusion. These research teams used randomization, case-control trails, cohort studies, standardized interview questions, and statistical analysis to make recommendations and form conclusions. Due to the use of these scientific data gathering approaches, each of the articles had strong internal validity. The results were thus determined to be believable and had a lower risk of intrinsic bias. Since this IR used articles with strong internal validity, this review presented data that were applicable to modern day medical centers.

Appraisal Tools

In order to critically appraise each included article for the review, the project leader used a literature matrix tool (Appendix A) and the CASP checklist (Centre for Evidence-Based Medicine, 2020). The matrix included categories for title and author, article purpose, deign of

research, level of evidence according to Melnyk's hierarchy (Melnyk, & Fineout-Overholt, 2011), intervention, results, and limitations. The level of evidence was considered to be the most important factor and allowed the articles to be ranked in order of importance. The matrix also allowed for easier comparisons to be drawn between articles and determined trends that were previously not considered to become apparent. The matrix was shared with the project Chair before completion of this IR.

The CASP tool (Centre for Evidence-Based Medicine, 2020) was specifically created to evaluate qualitative research. It is comprised of 10 questions that were answered (affirmatively) to determine if the potential qualitative study had statistical merit. Within this IR, there were two articles that utilized qualitative data. The project leader analyzed each article scrupulously using the 10 CASP questions. Each included article had "yes" answers throughout the CASP tool and therefore, the qualitative articles used in the IR were deemed to have value concerning the answering of the clinical questions.

Applicability of Results

The matrix (Appendix A) noted in the appraisal section also served to ensure that the applicability of each of the articles' results were sensible. The project leader verified that each article had conclusions and recommendations that paired with the design, data, limitations, ethical issues, and discussion presented within the body of the article. These findings were listed within the results and strengths/weaknesses section of the literature matrix.

Reporting Guidelines

In order to properly report the structure, biases, and recommendations from this review, the 2009 PRISMA checklist for systematic reviews was utilized as the structure of this

manuscript. The structure of the manuscript included sections for a title, abstract, introduction, methods, results, and discussion. Identification of being an IR was presented in the title of the work, while rationale objectives, details of the literature search, eligibility requirements, discussion of bias, synthesis of results, limitations, and recommendations were all clearly reviewed within the body of the text per the PRISMA guidelines.

SECTION FIVE: DATA ANALYSIS AND SYNTHESIS

Data Analysis Methods: Thematic Analysis

In order to properly analyze the data gleaned from each article, the project leader applied thematic analysis. The thematic data analysis strategy was selected since the studies included in the review were of both quantitative and qualitative design. Braun and Clarke (2006) proposed six phases to properly outline patterns and similarities between studies that otherwise were not connected with one another. The project leader first became deeply familiar with each article by reviewing each work with critical analysis and appraisal. In order to guide this process, the literature matrix was created. Next, the project leader highlighted common phrases, themes, and conclusions within the literature matrix by manual inspection. These variables were color coded within the matrix to help the researcher notice patterns and similarities among the results. After each article was reviewed and coded, themes were uncovered across the articles. Themes included CB team improvements that led to improved resuscitation with better patient survival, communication as the primary driver of quality teamwork, and lack of communication, leadership, and education as the major barriers to effective teamwork within CB teams.

These patterns, found with thematic analysis, strongly linked each articles' conclusions with one another and helped to solidify the answers to the proposed clinical questions. Discovered patterns and trends included, communication (seven articles), role clarity (six

articles), leadership (five articles), team improvement projects resulting in resuscitation improvements (four article), and teamwork barriers (five articles). There were three major themes discovered when analyzing the articles including:

1. The greater the quality of teamwork in a CB situation, the greater the statistical significance of patient survival.
2. Ineffective communication, role confusion, lack of leadership, and minimal education opportunities are the biggest barriers to having quality CB teams, according to bedside personnel.
3. Creating or improving resuscitation guidelines tailored to the specific aspects of the facility lead to improved CB outcomes.

Descriptive Results

Clinical Practice Guidelines

The most recent clinical recommendations for cardiac arrest care were noted in the updates of the 2015 *Get With the Guidelines* resuscitation tool created by the American Heart Association. These guidelines laid out technical data such as compression rate, medication administration, timeline for pulse checks, and other physical assessments or interventions. Different age groups were given different recommendations of care culminating in four groups, adults ≥18 years, pediatrics <18 years but ≥ 1 year, neonate/infant < 1 year but ≥ 24 hours, and newly born <24 hours old. It did not include any recommended systematic approach to effectively carry these tasks out, i.e. team organization. Using these guidelines assisted the research by showcasing the clinical goals that must be achieved to perform a successful resuscitation attempt. For example, ensuring that the CPR team member abided by the guidelines to maintain a rate of 100 compressions per minute with a push depth of at least 2 inches was a

requirement that a CB team must maintain to provide the best resuscitation attempt. These variables could be applied to each function of the team. The *Get With The Guidelines* tool also created a registry for hospitals to display resuscitation data and clinical traits which were instrumental in systematic reviews that were included in this IR.

Systematic Review

Two systematic reviews were found that related to the effect of CB teams on patient survival. Castelao et al. (2013) performed a systematic review of 63 articles pertaining to planning, leadership, and communication during CPR. The purpose of their work was to identify and evaluate what effect CB team coordination has on medical outcomes in these patients. A strong relationship between CPR and team performance was directly correlated with team communication and leadership. Castelao's team concluded that clinical treatment with substantial coordination efforts improved CPR in a significant way. While the systematic review did not focus on how to measure the quality or methods of teamwork it did support the theory of training and operating a specialized CB team in order to make drastic improvements in the resuscitation process which led to better rates of patient survival.

The second systematic review was performed to determine if survival rates in patients of cardiac arrest had increased uniformly across all hospital systems (Girotra et al., 2014) over the last decade. Adult cardiac arrest cases totaling 93,342 in-hospital events across 231 hospitals were evaluated via the *Get With The Guidelines* reportable database. The researchers used hierarchical regression models to determine the traits of the patient, hospital, and resuscitation techniques used to discover if there were any patterns in survival to discharge. Over a 10-year timeframe (2000-2010), it was discovered that survival rates improved across hospitals; however, these survival rates were not uniformly better across all organizations. Some hospitals

had a much more significant increase in survival rates to discharge (10-11% increase), while others had only minimal survival increases of 1-3%. Improvements in these survival rates were attributed to a better understanding of resuscitation practices via education from the AHA (such as ACLS certification) but it was interesting that marked differences in the extent of survival improvement were observed. Girotra et al., noted that the top performing hospitals must be doing something different such as using better CB teamwork techniques, simulations, or communication during CB resuscitation (2014) than hospitals with small incremental increases in survival rates.

Cohort Studies

In the literature review performed for this manuscript, multiple articles with experimental interventions classified as cohort studies were discovered. Each of these cohort studies was of a quasi-experimental design utilizing retrospective control groups as a baseline and then non-randomly instilling the intervention within the system. Data were collected, compared, and cross checked between the control and experimental cohorts. While Level IV experiments do not provide strong evidence when presented by themselves (secondary to natural bias), they do provide validation to treatments or interventions. When multiple cohort studies are linked, the effect of bias is lessened and the correlated recommendations gain strengthened validation, as was the case with this IR.

In the first article, staff at two different facilities were surveyed to determine how resuscitation team members felt about how effective teamwork was within their group. After these data were collected, staff was educated via briefings about improving teamwork within resuscitation attempts (Cooper et al., 2016). Examples of good, average, and bad teamwork were presented during these briefings and it was suggested that staff apply the traits from the good

teamwork presentation. Once education was completed, senior nursing staff members were immediately given a survey after subsequent resuscitation attempts to determine how the teamwork was perceived. Between the two facilities there were 106 cases where surveys were issued. Teamwork scores averaged to a mean score of 34.6 which indicated that teamwork was in the "Good" range (34-39) before the intervention. This directly led to an immediate survival rate of 67.3% of the patients that suffered a cardiac arrest. Survival to discharge was not measured in this article. Leadership was noted to be the lowest scoring aspect of this intervention which supports the theory that improvements to teamwork will further increase survival rates. There was a notable negative correlation between team size and score indicating that the bigger the team the poorer the teamwork evidently due to deterioration in team communication (Cooper et al., 2016).

Rashid et al. (2014) reviewed the impact on patient care after the creation of a rapid response team in a facility where one did not previously exist. This improvement process created and implemented an emergency response team within an academic teaching hospital located in the country of India. The team was composed of multiple intensivists, respiratory therapists, and RNs. There was always at least one of each of these professionals working in the facility at any given time allowing for a complete a team. Mortality rates and total hospital length of stay were compared with descriptive retrospective analysis before and after the team's inception. Rashid et al. found that after the rapid response team began to practice, there was a decrease in mortality by 4.88% with a minimal to no impact on total length of stay (Rashid et al., 2014). These results suggest that even a rudimentary response team helps to improve patient survival rates.

A trio of studies performed similar retrospective cohort analysis to determine if the creation and use of a resuscitation quality improvement bundle positively impacted resuscitation

quality, compliance, and consequently patient survival. The improvement bundles were locally created by the quality improvement and medical teams at the facility where the research took place. One bundle was designated as CODE-ACES2 (Hunt et al., 2018); one was named the "Pit-Crew Model," (Spitzer et al., 2019); and the final intervention bundle performed by Price et al. (2014) did not include a name.

Hunt et al. (2018) performed logistic regression to assess the relationship between compliance and year of event. Over a period of three years, 317 consecutive cardiac arrests were debriefed, and it was discovered that after the implementation of CODE-ACES2 there was an association with progressively increased compliance with hospital and AHA CPR protocols. Spitzer's team discovered that the Pit-Crew Model provided statistically significant improvements in compression rates, adequate team communication, reduction in missed defibrillations for shockable heart rhythms, a reduction in average time to shock, and overall improved patient survival to discharge (Spitzer et al., 2019). Finally, Price et al. (2014) restructured and improved teamwork within the hospitals' CB responders by defining the number of code team participants, clarifying the responsibilities of each team member, providing set positions for each team member during the resuscitation, and initiating team training events via mock codes.

While these studies were not connected, each came to the same conclusion noting that creating or improving upon CB teamwork and processes with a location specific model, ultimately led to improved resuscitation and improved patient survival chances after a cardiac arrest. As these articles showcase, improvements did not have to come from nationalized guideline or requirements and were effectively initiated at a local level with successful outcomes.

Tak et al. (2017) retrospectively compared a cohort of 1,145 patients each of whom underwent CB resuscitation for cardiac arrest at the same research hospital, located in South Korea, over a three-year period (2013-2016). The goal of the research was to compare patient outcomes via rates of ROSC, 10-day survival, 30-day survival, and live discharge, when executed by resuscitation teams of different professional structures. The first team was an arrangement of resident physicians; the second was composed of emergency medicine specialists (EMS technicians); and the third was a rapid response team whose members consisted of different disciplines, each of whom were specially trained in emergency resuscitation of cardiac arrest situations. This rapid response team utilized MDs, RNs, and airway specialists. During the research's time frame, there were 444 resuscitation attempts completed by the resident team, 431 by the rapid response team, and 270 by the EMS team. Since the EMS team were activated for cardiac arrests occurring outside of the hospital, it performed in emergency situations with variables that could not be mimicked or linked with the other two teams. Therefore, the project leader determined that the data from the EMS group were not practical for this literature review, and ultimately was not evaluated or presented. Between the two remaining teams at the facility, Tak et al., found that the teams had no significant differences in rates of patient 30-day survival and live discharges; however, the rapid response team did provide its patients with a higher rate of 10-day survival and ROSC (0.71, $p = 0.037$). In comparison, patients revived by the resident team had a slightly lower rate of 10-day survival and ROSC (0.59, $p = 0.001$). It is noteworthy that a limitation does exist, as the two teams may have approached functionality in a different manner, which could have caused disparities in these outcomes. Nevertheless, these results invoke substance to the theory that an individual patient may statistically have a better chance at survival when treated by a specialized CB team.

Nallamothu et al., (2018) designated hospitals as being in the top, middle, or bottom quartiles of resuscitation quality by analyzing in-hospital cardiac arrest (IHCA) survival rates against their discharge rates between the years 2012-2014. These figures were calculated via the *Get With The Guidelines* registry. After creating these quartiles, the research team selected nine geographically and academically diverse hospitals to participate in the research with representatives from each of the quartiles included. The team commenced site visits while performing in-depth interviews of clinical and administrative staff at each locale. A total of 158 individuals of multiple disciplines across these facilities were interviewed. From these interviews the team elicited that the resuscitation teams at the top-performing hospitals demonstrated the following features: had designated resuscitation teams that were comprised of interdisciplinary members, the roles and responsibilities were clear and understood during resuscitation, there was effective communication and leadership, and finally, these teams regularly performed in-depth mock codes for training purposes (Nallamothu et al., 2018). Lower quadrant hospitals reported utilizing some of these features, but not to the extent or quality of the top-performing hospitals. The research provided firsthand evidence showcasing how resuscitation teams were organized and applied across hospitals with different rates of resuscitation success.

In order to describe current first-world hospital practices regarding resuscitation care Edelson et al. (2014) showcased that improvement processes were indeed necessary in many current medical communities. The researchers first, distributed a nationally representative descriptive survey from a random sample of 1,000 hospitals from the American Hospital Association database. The 27-point questionnaire was addressed to each hospital's CPR Committee Chair or Chief Medical/ Quality Officer and assessed details such as resuscitation responder teams and barriers for improvements. The researchers received 439 responses and

discovered that there is wide variability between hospitals and within practices for resuscitation care in the U.S. Some hospitals even reported that they had no resuscitation team contingency.

The final cross-sectional cohort research article described the composition of in-hospital cardiac arrest teams and reviewed allocation of tasks across different hospitals in Denmark. A nationwide cross-sectional study of 44 hospitals was conducted via telephone interviews and email correspondence by Lauridsen et al. (2015). Mimicking Edelson's (2014) team findings, Lauridsen et al., discovered major differences among cardiac arrest teams across different hospitals. These disparities included team size, profession of team members, communication techniques, educational opportunities, and simulated practice. Nearly half of the respondent hospitals did not define a cardiac arrest team leader nor the tasks of the other team members. Denmark, like the U.S., possesses a first world state of the art medical system, and therefore provides comparable evidence to hospitals within the United States.

Descriptive and Qualitative Studies

The use of descriptive or qualitative studies can be necessary when exploring specifics within a process change. The VI studies helped to identify barriers perceived by those that changes in policy impacted, i.e. nursing staff, as well as provided data on factors that work within or enhance the process change. In order to provide quality recommendations, the project leader of this integrative review determined that it was essential to discover quality details that must be overcome by hospitals or CB teams and what has worked for other facilities. Two descriptive or qualitative studies were included in this IR.

Barriers provided challenges to organization, function, and implementations to CB teams. Addressing barriers before making recommendations helped to strengthen the conclusion of a research article. Two articles that addressed the issue of barriers were found. The first

descriptive barrier article came from Einav et al. (2018), who set out to discover and make recommendations to overcome barriers before the implementation of a proposed hospital resuscitation policy and team. Einav et al. found that lack of education, communication failures, and limited simulated practice were of the greatest concern to the proposed resuscitation team members. Because of these fears, there was a clear resistance to the proposed changes that the researchers presented to the local coordinator. The researchers concluded that these issues needed to be addressed before implementation of a CB team and policy could take place.

Mahramus et al. (2013) aimed to discover barriers to teamwork during resuscitation attempts among code team members as well as to determine if differences in perception existed between disciplines within the code team. By interviewing 67 MDs, RNs, and respiratory therapists the researchers discovered that the team only perceived communication between members as average. Because of this barrier all respondents felt that the team's resuscitation efforts were hampered. New training and interventions were able to be developed by the hospital's administration, but the results of these actions were not reported. Barriers, such as those addressed in these two articles, were assumed to also be real threats at other hospitals.

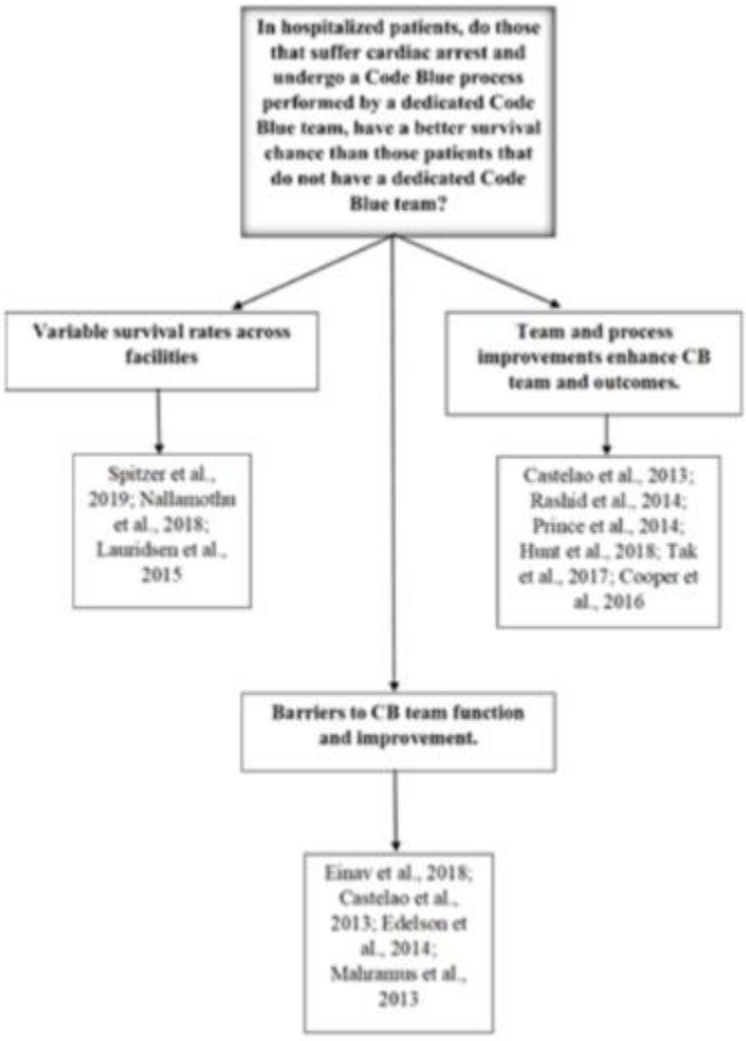
Synthesis

After the data were analyzed via the methodology from Whittemore and Knalf (2005), the project leader synthesized the themes and patterns to create an organized and clear conclusion. Synthesis was organized via a flow chart (see Figure 2) to designate which studies provided rationale to each major theme. Synthesizing the data showed that patient survival was indeed correlated to the quality of the teamwork exhibited by the CB resuscitation team. These teams were not uniformly trained or dedicated across all hospitals, but all were able to be improved. In hospitals with ineffective CB teams, barriers that were consistently reported were

poor communication, role confusion, poor leadership, or lack of education about the resuscitation process. These barriers were able to be addressed at the local level and when protocols or team functionality went through systematic quality improvements, resuscitation quality drastically improved which led to better patient outcomes.

Figure 2

Synthesis of Literature



Ethical Considerations

Human subjects were not directly used in this IR, nor was any identifiable information for patients or providers discoverable by the project leader. Thus, ethical dilemmas were not existent in this research. However, the Liberty University Institutional Review Board was made aware and consulted about the project. From the findings by the IRB, this review was deemed exempt from ethical considerations. A copy of the IRB's decision is provided in Appendix B.

TIMELINE

This integrative review was completed during the first half of the year 2020. The clinical question was formulated and approved by the scholarly Chair in March. Once the clinical question was solidified, the project leader performed the initial literature search which was completed in mid-April. The detailed literature review, PRISMA analysis, data reduction, and synthesis were completed by the last week of June. The first rough draft of the manuscript was written and submitted to the scholarly Chair on June 30, 2020. Revisions to the first draft, submission to a third-party editor, and submission of the final draft were completed by the end of July. The project was presented and defended to the Liberty University Doctor of Nursing Practice faculty July 30, 2020 and then submitted to Liberty University's Scholarly Crossing.

SECTION SIX: DISCUSSION

Although over the last few decades, in-hospital cardiac arrest survival rates have progressed, this review showed that there is a continued need for clinical improvements to be implemented by quality improvement projects within individual hospitals. The synthesis clearly outlined that the best hospitals for cardiopulmonary resuscitation (Girotra et al., 2014) managed a coordinated CB team that followed a thorough resuscitation protocol. These variables correlated to better overall patient survival rates within these clinics. Despite the evidence, there

are many medical facilities in the U.S. that continue to employ no or poorly functioning CB teams under ineffective protocols. The examples within this integrative review demonstrated that organizations are able to change these ineffective teams into serviceable ones. Those facilities that determined which barriers stood in the way of proper team organization and function ultimately were able to tailor interventions that benefited its resuscitation response and overall patient survival.

Barriers in communication, leadership, role responsibility, and education were discovered to be the primary causes for team discrepancies and disorganization. These barriers mirrored the recommendations that Tuckman's (1965) Theory suggested eliminating to promote effective team roles and purpose. CB teams need to be organized, practiced, and have good report with one another to effectively manage the rigors that coexist with resuscitation interventions. Providing staff with educational opportunities is the first step in addressing improvements for team functionality. When personnel have been properly educated about the CB process, and team leadership and distinct roles, responsibilities, and rationale of each step within the process are delineated, communication becomes clear, effective, and natural within the team. The natural chaos that enveloped resuscitation attempts did not have a significant impact on the teams trained with the previously stated improvements. With the overall chaos minimized, the team members would calmly report aspects of the interventions with one another resulting in clear, concise, and efficient communication (Einav et al., 2018). Once CB teams were established, continuing to use practice simulations ensured that the learned skills were maintained and sharpened within the team (Spitzer et al., 2019) and helped to discover any new barriers that posed a threat to team functionality (Cooper et al., 2016).

National standardizations of CB improvements or teams most likely will not be beneficial across all hospital systems. Personnel, technology, and resources are not equally distributed across hospitals. Therefore, it is up to the clinical and managerial teams at each facility to incorporate protocols and teams that act within the specific variables and barriers present at that facility. Different methods for process changes have been met with improvements in the resuscitation process and patient survival across multiple studies. Effective CB teamwork was the common variable that linked all of these trials. It is recommended that when creating a new CB team or policy, teamwork be the first aspect considered in the improvement process.

Implications for Practice/Future Work

The conclusions drawn from this IR have shown that there are direct implications for modern day practice regarding improvements within CB resuscitation teams. These protocols and teams should be reevaluated at each facility if it has not performed a review in the last five years. There is an opportunity for each hospital to improve the care provided to its patient population by ensuring that its CB team is optimized with properly trained and motivated members. In following through with the proposed recommendations, hospitals may increase survival chances of patients by up to 11% (Girotra et al., 2014). An 11% increase throughout the U.S. would give roughly 33,000 more patients a chance at survival every year.

Future work can be derived from this IR. There is great potential to conduct multiple evidence-based practice projects from the outline presented by this work. Projects could include multicentered case-control studies that directly measure the impact of team organization. Directly observing how factors such as notification systems impact performance of a team could provide helpful analysis in protocol strategies. Another aspect that should be researched is the most effective way to allow CB teams to practice its skills. Setting up different simulations,

scenarios, or educational opportunities all have the potential to improve the understanding of quality teamwork. It is crucial for future works to determine what interventions and policy changes lead to the best teams and can be measured via patient survival rates. Future work can also detail physical attributes most conducive to effective teamwork, such as having a cleared room, with minimal non-essential persons in attendance.

The project leader plans to conduct an evidence based practice project detailing how using personal pagers to notify only CB team members impacts its resuscitation attempt. It is theorized that by using a notification system such as this, that the CB team will have minimal distractions from needless onlookers. Communication, roles, and interventions will be able to be carried out in a more effective manner.

Dissemination

The project leader envisions presenting the findings of this IR could be on a macro and micro level. The project leader seeks to have the work published in a nationally recognized medical or nursing journal, thus making the data available to a broad audience of medical professionals. This macro level strategy would help to further clinical practice and research potential across a large range of the medical community. Locally, the project leader produced a PowerPoint presentation which will be presented to the resuscitation committee at a local hospital for consideration. The project leader also plans to produce a poster of the work and present its findings at the Virginia Henderson Poster symposium in Lynchburg, VA.

References

Abella, B. S., Sandbo, N., Vassilatos, P., Alvarado, J. P., O'Hearn, N., Wigder, H. N., Hoffman, P., Tynus, K., Vanden Hoek, T. L., & Becker, L. B. (2005). Chest compression rates during cardiopulmonary resuscitation are suboptimal: a prospective study during in-hospital cardiac arrest. *Circulation*, *111*(4), 428–434. https://doi.org/10.1161/01.CIR.0000153811.84257.59

AGREE Next Steps Consortium. (2013). *Appraisal of guidelines research & evaluation II* . https://doi.org/10.1503/cmaj.090449

Ali, B., & Zafari, A. M. (2007). Narrative review: Cardiopulmonary resuscitation and emergency cardiovascular care: Review of the current guidelines. *Annals of Internal Medicine*, *147*(3), 171–179. https://doi.org/10.7326/0003-4819-147-3-200708070-00006

Andersen, P. O., Jensen, M. K., Lippert, A., Østergaard, D., & Klausen, T. W. (2010). Development of a formative assessment tool for measurement of performance in multi-professional resuscitation teams. *Resuscitation*, *81*(6), 703–711. https://doi.org/10.1016/j.resuscitation.2010.01.034

Castelao, E. F., Russo, S. G., Riethmüller, M., & Boos, M. (2013). Effects of team coordination during cardiopulmonary resuscitation: A systematic review of the literature. *Journal of Critical Care*, *28*(4), 504–521. https://doi-org.ezproxy.liberty.edu/10.1016/j.jcrc.2013.01.005

Chan, P. S., Khalid, A., & Longmore, L. S. (2008). Hospital-wide code rates and mortality before and after implementation of a rapid response team. *JAMA*, *300*(21), 2506–2513. https://doi.org/10.1001/jama.2008.715

Cooper, S., Cant, R., Connell, C., Sims, L., Porter, J. E., Symmons, M., Nestel, D., & Liaw, S. Y. (2016). Measuring teamwork performance: Validity testing of the Team Emergency Assessment Measure (TEAM) with clinical resuscitation teams. *Resuscitation, 101*, 97–101. https://doi-org.ezproxy.liberty.edu/10.1016/j.resuscitation.2016.01.026

ECC Committee, Subcommittees and Task Forces of the American Heart Association (2005). 2005 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation, 112*(24 Suppl), IV1–IV203. https://doi.org/10.1161/CIRCULATIONAHA.105.166550

Edelson, D. P., Yuen, T. C., Mancini, M. E., Davis, D. P., Hunt, E. A., Miller, J. A., & Abella, B. S. (2014). Hospital cardiac arrest resuscitation practice in the United States: A nationally representative survey. *Journal of Hospital Medicine, 9*(6), 353–357. https://doi-org.ezproxy.liberty.edu/10.1002/jhm.2174

Einav, S., Kaufman, N., & Varon, J. (2018). Barriers to effective in-hospital resuscitation: Lessons learned during implementation of a hospital-wide code system. *Critical Care & Shock, 21*(3), 128–139.

Evans, B. C., Coon, D. W., & Ume, E. (2011). Use of theoretical frameworks as a pragmatic guide for mixed methods studies. *Journal of Mixed Methods Research, 5*(4), 276–292. https://doi.org/10.1177/1558689811412972

Girotra, S., Cram, P., Spertus, J. A., Nallamothu, B. K., Li, Y., Jones, P. G., & Chan, P. S. (2014). Hospital variation in survival trends for in-hospital cardiac arrest. *Journal of the American Heart Association, 3*(3), e000871. https://doi-org.ezproxy.liberty.edu/10.1161/JAHA.114.000871

Goldberger, Z. D., Chan, P. S., Berg, R. A., Kronick, S. L., Cooke, C. R., Lu, M., Banerjee, M., Hayward, R. A., Krumholz, H. M., Nallamothu, B. K., & American Heart Association Get With The Guidelines—Resuscitation (formerly National Registry of Cardiopulmonary Resuscitation) Investigators (2012). Duration of resuscitation efforts and survival after in-hospital cardiac arrest: an observational study. *Lancet*, *380*(9852), 1473–1481. https://doi.org/10.1016/S0140-6736(12)60862-9

Gunderman, R., & Nelson, P. (2013). *Exchanging a blanket for a code blue: How some hospitals are prioritizing comfort and connection at the end of life*. https://www.theatlantic.com/health/archive/2013/08/exchanging-a-blanket-for-a-code-blue/279125/

Hamilton, N., Freeman, B. D., Woodhouse, J., Ridley, C., Murray, D., & Klingensmith, M. E. (2009). Team behavior during trauma resuscitation: A simulation-based performance assessment. *Journal of Graduate Medical Education*, *1*(2), 253–259. https://doi.org/10.4300/jgme-d-09-00046.1

Hunt, E. A., Jeffers, J., McNamara, L., Newton, H., Ford, K., Bernier, M., Tucker, E. W., Jones, K., O'Brien, C., Dodge, P., Vanderwagen, S., Salamone, C., Pegram, T., Rosen, M., Griffis, H. M., & Duval-Arnould, J. (2018). Improved cardiopulmonary resuscitation performance with CODE ACES2: A resuscitation quality bundle. *Journal of the American Heart Association*, *7*(24), 1–16. https://doi-org.ezproxy.liberty.edu/10.1161/JAHA.118.009860

Hunziker S, Laschinger L, Portmann-Schwarz S, Semmer NK, Tschan F, Marsch S, Hunziker, S., Laschinger, L., Portmann-Schwarz, S., Semmer, N. K., Tschan, F., & Marsch, S.

(2011). Perceived stress and team performance during a simulated resuscitation. *Intensive Care Medicine, 37*(9), 1473–1479. https://doi-org.ezproxy.liberty.edu/10.1007/s00134-011-2277-2

Institute of Medicine (US) Committee on Quality of Health Care in America, Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (Eds.). (2000). *To err is human: Building a safer health system*. National Academies Press.

Johnson, D. W., & Dunn, J. (2019). *A GPS for cardiac arrest: In life-or-death moments clinical apps save lives.* https://www.4sighthealth.com/a-gps-for-cardiac-arrest-in-life-or-death-moments-clinical-apps-save-lives/

Lauridsen, K. G., Schmidt, A. S., Adelborg, K., & Løfgren, B. (2015). Organisation of in-hospital cardiac arrest teams - a nationwide study. *Resuscitation, 89*, 123–128. https://doi-org.ezproxy.liberty.edu/10.1016/j.resuscitation.2015.01.014

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *PLoS Medicine, 6*(7), e1000100. https://doi.org/10.1371/journal.pmed.1000100

Mahramus, T., Frewin, S., Penoyer, D. A., & Sole, M. L. (2013). Perceptions of teamwork among code team members. *Clinical Nurse Specialist: The Journal for Advanced Nursing Practice, 27*(6), 291–297. https://doi-org.ezproxy.liberty.edu/10.1097/NUR.0b013e3182a8729d

McNamar, S. (2019). *Code Blue litigation – Legal issues in cardiac arrest documentation.* https://www.formathealth.com/code-blue-litigation-legal-issues-in-cardiac-arrest-documentation/

Nallamothu, B. K., Guetterman, T. C., Harrod, M., Kellenberg, J. E., Lehrich, J. L., Kronick, S. L., Krein, S. L., Iwashyna, T. J., Saint, S., & Chan, P. S. (2018). How do resuscitation teams at top-performing hospitals for in-hospital cardiac arrest succeed? A qualitative study. *Circulation*, *138*(2), 154–163. https://doi-org.ezproxy.liberty.edu/10.1161/CIRCULATIONAHA.118.033674

Panesar, S. S., Ignatowicz, A. M., & Donaldson, L. J. (2014). Errors in the management of cardiac arrests: An observational study of patient safety incidents in England. *Resuscitation*, 85(12), 1759–1763.

Prince, C. R., Hines, E. J., Po-Huang Chyou, & Heegeman, D. J. (2014). Finding the key to a better code: Code team restructure to improve performance and outcomes. *Clinical Medicine & Research*, *12*(1/2), 47–57. https://doi-org.ezproxy.liberty.edu/10.3121/cmr.2014.1201

Rashid, M. F., Imran, M., Javeri, Y., Rajani, M., Samad, S., & Singh, O. (2014). Evaluation of rapid response team implementation in medical emergencies: A gallant evidence-based medicine initiative in developing countries for serious adverse events. *International Journal of Critical Illness and Injury Science*, *4*(1), 3–9. https://doi.org/10.4103/2229-5151.128005

Risaliti, C., Evans, K., Buehler, J., Besecker, B., & Ali, N. (2018). Decoding code blue: A process to assess and improve code team function. *Resuscitation, 122*, e15–e16. https://doi.org/10.1016/j.resuscitation.2017.11.039

Rosen, M. A., Salas, E., Wilson, K. A., King, H. B., Salisbury, M., Augenstein, J. S., Robinson, D. W., & Birnbach, D. J. (2008). Measuring team performance in simulation-based training: Adopting best practices for healthcare. *Simulation in Healthcare: Journal of the Society for Simulation in Healthcare*, *3*(1), 33–41. https://doi.org/10.1097/SIH.0b013e3181626276

Spitzer, C. R., Evans, K., Buehler, J., Ali, N. A., & Besecker, B. Y. (2019). Code blue pit crew model: A novel approach to in-hospital cardiac arrest resuscitation. *Resuscitation*, *143*, 158–164. https://doi-org.ezproxy.liberty.edu/10.1016/j.resuscitation.2019.06.290

Tak K. O., Young M.P., Sang-Hwan D., Jung-Won H., & In-Ae S. (2017). ROSC rates and live discharge rates after cardiopulmonary resuscitation by different CPR teams - A retrospective cohort study. *BMC Anesthesiology*, *17*, 1–9. https://doi-org.ezproxy.liberty.edu/10.1186/s12871-017-0457-5

Toronto, C. E., & Remington, R. (2020). *A step-by-step guide to conducting an integrative review*. Springer.

Tuckman, B. W. (1965). Developmental sequence in small groups. *Psychological Bulletin*, *63*(6), 384–399. https://doi.org/10.1037/h0022100

Appendix A

Literature Matrix

Name: John Holcomb
Clinical Question 1: In hospitalized patients, do those that suffer cardiac arrest and undergo a Code Blue resuscitation performed by a dedicated Code Blue team, have a better survival chance than those patients that did not receive resuscitation from a dedicated Code Blue team?

Clinical Question 2: Within Code Blue teams, did teams with quality non-clinical variables such as communication, education, practice, and role clarity perform duties better than those teams without those quality variables?

Title, Author, Year	**Study Objective(s)**	**Design, Sampling Method, & Subjects**	**Level of Evidence**	**Intervention**	**Results**	**Strengths and Limitations of Study**
Effects of team coordination during cardiopulmonary Resuscitation. **Castelao, E.F., Russo, S.G., Riethmüller, M., & Boos, M.** (2013).	To identify and evaluate what effect team coordination during CPR has on clinically relevant medical outcome.	Systematic review of 63 articles pertaining to planning, leadership, and communication during CPR.	Level I	Performed a synthesis of articles with detailed literature review.	Found that coordination, planning, leadership, and communication are the most relevant factors predicting CPR performance quality within a resuscitation team.	Strengths: Supports the theory that organized and well led teams perform better resuscitation thereby giving the patient a better chance of survival. Limitations: Does not focus primarily on the quality of methods for measurement of Teamwork.

Hospital Variation in Survival Trends for In-hospital Cardiac Arrest. **Girotra, S., Cram, P., Spertus, J. A., Nallamothu, B. K., Li, Y., Jones, P. G., & Chan, P. S.** (2014).	To determine if survival rates in patients of cardiac arrest has increased uniformly across all hospital systems, or just those that have adhered to quality improvement .	Evaluated hospital-level trends in survival to discharge with hierarchical regression models.	Level I	Identified 93,342 adults with an in-hospital cardiac arrest at 231 hospitals in the Get With The Guidelines-Resuscitation registry during 2000–2010. Using hierarchical regression models. Evaluated trends in survival to discharge.	In-hospital cardiac arrest survival has improved during the past decade; however, the magnitude of improvement varied across hospitals.	Strengths: There was a correlation with larger hospitals that have adhered to quality improvement and CPR team creation and optimization have had a greater proportional increase in survival rates. Limitations: Limited information regarding hospital Characteristics. Different hospitals begin and end improvement projects at different intervals.
Finding the Key to a Better Code: Code Team Restructure to Improve Performance and Outcomes. **Prince, C. R., Hines, E.J., Chyou, P. -**	To improve the overall performance of researchers' hospital code team with	Subjective survey collection after implementation of interventions. Qualitative data results.	Level IV	The code team restructure included a defined number of code team participants, clear identification of team members and their primary responsibilities and position relative to the patient, and initiation of team	Interventions resulted in a code team with improved confidence in their role specific skills, clarity in their role positions, and team leadership, as well as a decrease in the time-to-defibrillation.	Strengths: This research gives a detailed summary of interventions needed for a successful code team, including placement of participants in a code event. Limitations: Performed at one hospital setting.

H., & Heegeman, D.J. (2014).				training events and surprise mock codes. Team member assessments of the restructured code team and its performance were collected through self-administered electronic questionnaires.		Data collection surveys relatively low, only quantitative data is time to defibrillation. No baseline data gathered.
Improved Cardiopulmonary Resuscitation Performance With CODE ACES2: A Resuscitation Quality Bundle. **Hunt, E. A., Jeffers, J., McNamara, L., Newton, H., Ford, K., Bernier, M., Tucker, E. W., Jones, K., O'Brien, C., Dodge, P.,**	Determine if the creation and use of a resuscitation quality improvement bundle created at the facility of the research would positively impact resuscitation quality and compliance with AHA CPR guidelines.	A prospective observational study looking at quality of resuscitation attempts after the implementation of the CODE ACES2 Improvement bundle.	Level IV	Logistic regression was used to assess the relationship between compliance and year of event. Over 3 years, 317 consecutive cardiac arrests were debriefed.	CODE ACES2 was associated with progressively increased compliance with AHA CPR guidelines during in-hospital cardiac arrest.	Strengths: Gives evidence that putting together organized improvement bundles can have a positive impact on CPR teams and process. Improvement projects can be done at the local level and tailored to the facility of implementation. Limitations: As this is performed in one hospital, the process may not be compatible with other facilities. There was a smaller proportion of reviews from 2013 codes

Vanderwagen, S., Salamone, C., Pegram, T., Rosen, M., Griffis, H. M., & Duval-Arnould, J. (2018).						compared to that of 2015.
ROSC rates and live discharge rates after cardiopulmonary resuscitation by different CPR teams - a retrospective cohort study. **Tak K. O., Young M.P., Sang-Hwan D., Jung-Won H., & In-Ae S** (2017).	The aim of this study was to compare patient CPR outcomes across resident, emergency medicine, and rapid response teams. The rapid response team is organized as a specialized CPR team with a multidisciplinary makeup.	A retrospective cohort study of 1145 CPR cases. 444 were completed by the resident team, 431 by the rapid response team, and 270 by the emergency medical team.	Level IV	The records of patients who underwent CPR at the hospital of the study from January 1, 2013 to December 31, 2016 were analyzed retrospectively. Return of spontaneous circulation, 10- and 30-day survival, and live discharge after return of spontaneous circulation were compared across patients treated by the three CPR teams.	Patients receiving CPR from the rapid response team may have higher 10-day survival and return of spontaneous circulation rates than those who receive CPR from the other teams.	Strengths: Shows that teams composed of multidiscipline members which focus on CPR and rapid response have better outcomes thank teams composed of multiple physicians. Limitations: Performed in South Korea. Approaches from the different teams may be inconsistent and not directly correlatable. Retrospective study so bias may be inevitable.

Code blue pit crew model: A novel approach to in-hospital cardiac arrest resuscitation. **Spitzer, C.R., Evans K., Buehler, J., Ali, N.A., Besecker, B.Y.** (2019).	To describe the implementation of a "pit crew" model to provide in-hospital resuscitation care after the institution of study needed to improve resuscitation team and performance.	Reviewed continuous variables and normal distribution data from case control pre- and post-pit crew implementation data.	Level IV	Created new CPR "Pit-crew" team, improved clarity of roles and functions of team members, improved Code Blue action education via frequent mock codes.	There were statistically significant improvements in compression rates post-intervention, adequate team communication, reduction in the number of shockable rhythms that were not defibrillated, average time to shock, and overall survival to discharge.	Strengths: Shows the influence that a properly organized team with extensive training has on CPR and survival rates. Communication was greatly improved with this model. Limitations: Study performed in only one hospital. Bias may be present in study because of some subjective nature.
Evaluation of rapid response team implementation in medical emergencies. **Rashid, M. F., Imran, M., Javeri, Y., Rajani, M., Samad, S., & Singh, O.** (2014).	To evaluate the impact of emergency team implementation on patient outcome during medical emergencies.	Retrospective observational study of team records in a super specialty academic teaching hospital.	Level IV	Creation and implementation of an emergency response team. Monitored outcomes mortality and length of stay in hospital/ICU.	Implementation of emergency team in this hospital was associated with reduced code blue events and its attendant mortality.	Strength: Evidence to support the use of emergency response teams to improve survival chance after CPR for hospitals that do not already have a system in place. Limitations: Performed at one hospital in India. Level IV study.
Hospital cardiac arrest resuscitation	To describe current US hospital	A nationally representative descriptive	Level IV	A 27-item questionnaire was mailed to	There is wide variability between hospitals and within	Strengths: Gives proof that many facilities do not

practice in the US: a nationally representative survey. **Edelson, D. P., Yuen, T. C., Mancini, M. E., Davis, D. P., Hunt, E. A., Miller, J. A., & Abella, B. S.** (2014).	practices with regard to resuscitation care.	survey from a random sample of 1,000 hospitals from the American Hospital Association database.		resuscitation leaders of aforementioned hospitals.	practices for resuscitation care in the US with opportunities for improvement.	implement code teams and there is a potential clinical need that can be addressed. Limitations: Level IV data.
How Do Resuscitation Teams at Top-Performing Hospitals for In-Hospital Cardiac Arrest Succeed? A Qualitative Study. **Nallamothu, B. K., Guetterman, T. C., Harrod, M., Kellenberg,**	To discover how top-performing hospitals organize their resuscitation teams to achieve high survival rates for in-hospital cardiac arrests.	Identified geographically and academically diverse hospitals in the top, middle, and bottom quartiles of cardiac arrest survival and performed a qualitative study that included site visits with in-	Level IV	Used thematic analysis to identify salient themes of perceived performance by informants. Across 9 hospitals, 158 individuals from multiple disciplines were interviewed	Resuscitation teams at top-performing hospitals demonstrated the following features: dedicated or designated resuscitation teams; participation of diverse disciplines as team members during IHCA; clear roles and responsibilities of team members; better communication and leadership during	Strengths: Gives firsthand evidence showcasing how resuscitation teams are organized and applied at both the most successful and least successful facilities for survival. Limitations: Hospitals were visited at a single point in time so non-performing hospitals may have been working toward improvement. Results used personal interviews which can let in adherent biases.

J. E., Lehrich, J. L., Kronick, S. L., Krein, S. L., Iwashyna, T. J., Saint, S., & Chan, P. S. (2018).		depth interviews of clinical and administrative staff at 9 hospitals.			IHCA; and in-depth mock codes.	
Organization of in-hospital cardiac arrest teams – A nationwide study. **Lauridsen, K. G., Schmidt, A. S., Adelborg, K., & Løfgren, B.** (2015).	To describe the composition of in-hospital cardiac arrest teams and review pre-arrest allocation of tasks.	A nationwide cross-sectional study. 44 hospitals participated.	Level IV	Data was collected through telephone interviews and email correspondence. Data on cardiac arrest teams and pre-arrest allocation of tasks were collected from protocols on resuscitation required for hospital accreditation in Denmark.	Major differences among cardiac arrest teams across different hospitals were found. Differences included team size and profession of team members. Nearly half of the hospitals did not define a cardiac arrest team leader and the majority did not define the tasks of the remaining team members.	Strengths: Although the study is based in Denmark, there are direct correlations with hospitals in the USA. This shows that often hospitals do not have proper teams in place for CPR emergencies which can be fixed with an improvement project. Limitations: Study performed in Denmark; however, Denmark is a first world country and can be correlated with hospitals in the USA. The protocols collected from each hospital adherence to their own

						protocols and adherence cannot be proven.
Barriers to effective in-hospital resuscitation: lessons learned during implementation of a hospital-wide code system. **Einav, S., Kaufman, N., Varon, J.** (2018).	To discover and overcome the barriers involved in effecting a hospital-wide code system.	Observational descriptive study of the situation existing before implementation of an effective in-hospital resuscitation system and description of the implementation processes.	Level VI	Created CPR team and process via making a standard operating procedure for all resuscitations. Installed an oversight mechanism.	Discovered the major barriers to creation of CPR team and protocols. These included resistances to change, lack of training, and communication failures.	Strengths: Helps to give a framework in creation of CPR team. Shows relevance of poor clinical outcomes when no team is in place. Limitations: Only performed in one hospital. Level 5 evidence does not have a strong foundation. Used staff opinions, i.e. qualitative data, to determine the barriers to team functions.
Perceptions of Teamwork Among Code Team Members. **Mahramus, T., Frewin, S., Penoyer, D. A., & Sole, M. L.** (2013).	The purpose of this study was to explore the perceptions of teamwork during CPA events among code team members and	A prospective, descriptive, comparative design using the Code Teamwork Perception Tool online survey was used to assess the perception of teamwork	Level VI	Sixty-six code team members completed the Code Teamwork Perception Tool.	Teamwork perception among members of the code team was average. Teamwork training for resuscitation with all disciplines on the code team may promote more effective teamwork	Strengths: Helps to support that CPR teams are made of multidisciplinary members and each may have different perceptions during CPR. All disciplines must be addressed and on the same page to have a successful and organized CPR team.

	to determine if differences in perception existed between disciplines within the code team.	during CPA events by medical residents, critical care nurses, and respiratory therapists.			during actual CPA events.	Limitations: Level VI study performed at one hospital, but still gives good insight as noted above. Surveys result in qualitative data and were not issued directly after CPR events but relied on memory from events that could have happened within the last 3 months.

Appendix B

IRB Exemption Letter

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

July 10, 2020

John Holcomb
Sharon Kopis

Re: IRB Application - IRB-FY19-20-477 Improving Survival Rates in Patients Suffering Cardiac Arrest with Specialized Resuscitation Teams: An Integrative Review

Dear John Holcomb, Sharon Kopis:

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Decision: No Human Subjects Research

Explanation: Your study does not classify as human subjects research because:

(1) it will not involve the collection of identifiable, private information.

Please note that this decision only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued non-human subjects research status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this determination or need assistance in determining whether possible modifications to your protocol would change your application's status, please email us at irb@liberty.edu.

Sincerely,

[redacted]
Administrative Chair of Institutional Research
Research Ethics Office

Appendix C

CITI Training Certificate