Cardiac Resuscitation Training: An Integrative Literature Review

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Cardiac Resuscitation Training: An Integrative Literature Review

A Scholarly Inquiry Paper
Submitted to the Faculty
of the Department of Nursing
College of Nursing and Health Sciences
of Winona State University

by
Dominick Pahl

In Partial Fulfillment of the Requirements
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Dominick Pahl
Abstract

Despite highly trained healthcare professionals being readily available to respond to In-Hospital Cardiac Arrest (IHCA), a patient experiencing an IHCA often remains a devastating event for the patient. Each year in America, 13.5% of all deaths result from sudden cardiac arrest. Even with healthcare professionals certified in Basic Life Support (BLS) and Advanced Cardiac Life Support (ACLS), the survival rates following an IHCA are not inspiring. The median survival rate to hospital discharge of an adult experiencing IHCA is 26.4% and 49.5% for the pediatric population. Despite a continued focus on improving CPR quality from the American Heart Association (AHA), the survival to hospital discharge rates remains virtually unchanged over the past few decades, indicating that opportunity exists to better prepare medical emergency response teams. IHCA is an event requiring a synchronized and rapid response from the medical emergency response team. The purpose of this scholarly inquiry paper is to explore the existing literature on enhanced cardiac resuscitation training. An integrative literature review identified randomized controlled trials, quasi-experimental trials, and various pretest-posttest trials that provide implications and recommendations for resuscitation training advancement. This extensive literature review uncovered both background and outcome themes. Background themes included poor resuscitation outcomes, a lack of appropriate contextualization in current resuscitation training regimens, chaotic environments during an IHCA, meager execution of teamwork, and nonadherence to the guidelines put forward by the American Heart Association (AHA) and European Resuscitation Council (ERC). Through various resuscitation training implementations, the literature appraised identified superior teamwork, enhanced satisfaction and
confidence of the healthcare professional, and improved CPR quality as outcomes of the multiple interventions utilized. This scholarly inquiry paper provides recommendations to advance the successful functioning of the medical emergency response team, and technical and nontechnical skills of healthcare professionals responding to IHCA. Additionally, specific implications for nursing, recommendations for the future of cardiac resuscitation training and team dynamics, and conclusions from the literature are identified. These findings support the advancement of resuscitation training, improve the function of the medical emergency response team during an IHCA, and potentially increase the survival to hospital discharge rates of patients experiencing IHCA.
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Introduction

Introduction to the Inquiry

Despite highly trained healthcare professionals being readily available to respond, a patient experiencing an In-Hospital Cardiac Arrest (IHCA) often remains a devastating event. According to Benjamin et al. (2018), 13.5% of all deaths in the United States result from sudden cardiac arrest (p. e72). Even with healthcare professionals certified in Basic Life Support (BLS) and Advanced Cardiac Life Support (ACLS), the survival rates following an IHCA are not inspiring. Benjamin et al. (2018) place the median survival to hospital discharge rate of adult IHCA at 26.4% and the pediatric population at 49.5% (p. e365). Unfortunately, Morrison et al. (2013) report that this identified survival to hospital discharge rates has remained virtually unchanged for decades.

Mahramus, Penoyer, Waterval, Sole, and Bowe (2016) identified challenges including a “disorganized and chaotic environment during codes, lack of effective leadership and communication, and breakdown in code team processes” (p. 285). A code is an event in which a patient suffers from cardiac arrest, necessitating the response of the medical emergency response team. Mahramus et al. (2016) distinguish the need for both technical and nontechnical skills, recognizing the lack of nontechnical skills addressed by current ACLS courses, such as teamwork. Technical skills are those requiring physical action, and nontechnical skills include processes such as communication and resource management techniques. Simply put, providing healthcare professionals with only the technical skills taught in both BLS and ACLS courses is not meeting the needs of our healthcare workforce and potentially impacting patient survival outcomes. Without
addressing these gaps, highly trained, knowledgeable, and confident healthcare providers may continue to struggle to work effectively as a medical emergency response team.

Beck et al. (2019) identify that to have successful resuscitation outcomes, providing quality basic life support without delay is paramount. To effectively perform this action, the medical emergency response team must not only have proficiency in technical skills but “team members are supposed to have high non-technical skills, such as good communication and team adjustment” (Beck et al., 2019, p. 33). Moreover, Anderson, Sebaldt, Lin, and Cheng (2019) state that “current training regimens that require annual certification do not adequately support the acquisition or retention of high-quality CPR [cardiopulmonary resuscitation] skills” (p. 154). Therefore, the resuscitation training that healthcare professionals are receiving should also assure the mastery of technical skills.

Cheng et al. (2018) further highlight the importance of adherence to the American Heart Association (AHA) resuscitation guidelines, identifying that “high-quality CPR improves survival and neurological outcomes” (p. 34). Despite this broadly understood concept, “adherence to guidelines is low” (Cheng et al., 2018, p. 34). The AHA guidelines for the delivery of CPR to an adult include depth of 50 to 60 millimeters, a rate of 100 to 120 compressions per minute, and allowing for complete recoil of the patient’s chest (Anderson et al., 2019). As Cheng et al. (2018) further identifies, healthcare professionals providing CPR find themselves in a chaotic and distracting environment that could easily hinder their performance, and the researchers propose peer coaching as a potential solution to this obstacle.
As patients are living longer with multiple comorbidities, they tend to have more complex hospital courses. Thus, the need for healthcare providers to be prepared to provide high-quality team resuscitative efforts has never been greater. DeVita, Schaefer, Lutz, Wang, and Dongilli (2005) further establish this need, asserting that “although ACLS training effectively indicates what needs to be done (crisis management), it does not focus on skills directed at how to get it done (crisis resource management)” (p. 329). A new strategy for resuscitation training and competencies provided to healthcare professionals (nurses, providers, and respiratory therapists) responding to IHCA is needed to address this finding.

**Background and Rationale for the Topic**

The history of cardiac resuscitation dates back to the 1950s (DeBard, 1980). However, the identification of components of cardiac resuscitation occurred as early as the eighteenth century. The essential element of cardiac resuscitation is cardiopulmonary resuscitation (CPR). CPR involves three different parts, including artificial respiration, cardiac massage, and electrical defibrillation (DeBard, 1980).

According to DeBard (1980), the Paris Academy of Sciences recommended the use of mouth-to-mouth resuscitation for victims of drowning, a recently identified public challenge in the eighteenth century. However, manual methods of artificial respiration using equipment such as bellows quickly replaced this finding. It was not until the results of Safar, Escarraga, and Elam (1958) that mouth-to-mouth and mouth-to-airway resuscitation regained significance. This landmark study published in the New England Journal of Medicine identified that “even with the use of an artificial oropharyngeal airway the pharynx is not kept patent, unless both hands of the rescuer are used to hold
the head in extension and to support the mandible” (Safar, Escarraga, & Elam, 1958, p. 676). These findings remain pertinent in resuscitation efforts today, shifting the focus from proper equipment and positioning of the patient to appropriate airway positioning.

In 1775, Squires of London recorded the first description of electrical defibrillation in a child suffering from cardiac arrest (DeBard, 1980). However, it was not until 1926 that the research and development of the defibrillator began as an attempt to resuscitate electric utility company lineman (DeBard, 1980). The first documented successful external defibrillation on a human was performed by Zoll in 1956 (DeBard, 1980), giving birth to a critical component of cardiac resuscitation.

It was not until 1878, when Rudolph Bohem performed closed-chest cardiac massage on the arrested heart of cats that the concept of compressions was first formed (Kouwenhoven, Jude, & Knickerbocker, 1960). Soon after, Koenig and Maass began to describe the successful use of closed-chest cardiac massage with humans. Still, the more advanced method of open-chest cardiac massage quickly replaced closed-chest cardiac massage. Open-chest cardiac massage would remain the standard until a case study paper was published in 1960 by Kouwenhoven, Jude, and Knickerbocker.

In what is the most important paper in the development of modern-day resuscitation methods, Kouwenhoven et al. (1960) identified that “closed-chest cardiac massage has proved to be effective in cases of cardiac arrest. It has provided circulation adequate to maintain the heart and the central nervous system, and it has provided an opportunity to bring a defibrillator” (p. 1067). This paper goes on to further describe the successful combination of closed-chest cardiac massage, mouth-to-mouth respirations, and external defibrillation in eight different patients (DeBard, 1980).
Still, the combination of compressions, manual ventilation, and external defibrillation described by Kouwenhoven et al. in 1960 is the foundation for cardiac resuscitation algorithms. Furthermore, the prioritization of compressions over ventilations and the delivery of early defibrillation (Kouwenhoven et al., 1960) remain accurate findings today. Despite sixty years of medical advancement since these findings, resuscitation outcomes remain dismal. Consideration regarding how to enhance the infrequent and skills-focused certification training that is currently preparing our healthcare workforce is essential.

Despite the strong emphasis of high-quality CPR over the last decade, the delivery of high-quality CPR remains challenging (Dewan, Pfeiffer, & Tegtmeier, 2019). As Cheng et al. (2019) identify, not only do healthcare providers struggle to deliver high-quality CPR, but they also struggle to determine when the CPR performance of a team member is meeting AHA guidelines. At first, this finding may seem insignificant. Still, without a proper understanding of performance, “poor performers who think they are doing well are less likely to change, especially if they are unaware of the nature of their performance deficit” (Cheng et al., 2019, p. e196).

Without the ability to properly understand resuscitation performance, the healthcare professional continues to be set up for failure, embracing a myth of expertise because of their unknown performance gap. Cheng et al. (2019) link this finding to the psychology phenomenon known as the “Dunning-Kruger Effect,” and goes on to further implicate that “CPR training programs contribute to this problem by requiring students [participants of BLS and ACLS classes] to demonstrate their CPR skills in 2-minute testing stations to obtain certification, a context dramatically unrepresentative of the real
patient care environment” (p. e196-e197). Healthcare providers in this type of learner environment need a properly contextualized training environment.

Dewan et al. (2019) propose an approach similar to those utilized by industries outside of healthcare, such as the aviation industry. The proposal is the implementation of the high-reliability organization framework. This framework identifies five key concepts, including “preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, and deference to expertise” (Dewan et al., 2019, p. 391). Execution of these five key concepts will require a robust training program, which is the interest of this inquiry.

**Purpose**

The purpose of this scholarly inquiry paper is to explore the existing literature on enhanced cardiac resuscitation training. Through this exploration, the author intends to provide recommendations on how to increase the team function, technical skill, and nontechnical skill of healthcare professionals responding to IHCA. Additionally, specific implications for nursing, recommendations for the future of resuscitation training and team dynamics, and conclusions from the literature will be identified. These findings may support the focus and advancement of resuscitation training for healthcare providers and potentially enhance the outcomes of patients experiencing IHCA. It is also important to note that throughout this inquiry, any mention of resuscitation encompasses cardiac resuscitation.

**Clinical Nursing Question**

The development of a clinical question guided the search and generated the best evidence from the literature. Does providing enhanced cardiac resuscitation training for
healthcare professionals (nurses, providers, and respiratory therapists) responding to in-hospital cardiac arrests positively impact their satisfaction, confidence in responding, collective teamwork, or CPR quality in comparison to only using traditional BLS or ACLS for preparation?

**Variables**

In this research question of interest, the independent variable is the enhanced resuscitation training intervention. No identification of a specific intervention occurred, allowing for a broader view of the potential best practices in resuscitation training. Appendix A provides a description of the independent variables identified in each article reviewed.

Another variable exists in this question: the healthcare professionals’ ability to respond effectively in a code situation. Because this variable depends on the proposed intervention, it will demonstrate how the researchers assess the effectiveness of their specific intervention. A validated tool identified in this literature review is the Team Emergency Assessment Measure (TEAM) survey tool (Appendix E) used for the assessment of teamwork and effectiveness (Cooper et al., 2010). Another validated teamwork assessment tool from this literature review is the Team Assessment Scale (TAS) (Appendix F) (Kiesewetter & Fischer, 2015). Future research may benefit from the utilization of this validated tool in research study design.

Still, to provide some contextual definition, Hunt et al. (2017) assert that this is ultimately a matter of the American Heart Association (AHA) guideline adherence. In the reviewed articles, the researchers measured CPR quality, perception of teamwork, staff satisfaction with the training, and both role identification and confidence during a code.
Measurement tools included specific CPR quality indicators and several questionnaires assessing these variables. Appendix A distinguishes these specific dependent variables further.

**Method of Inquiry**

An integrative literature review approach provided an understanding of the existing evidence that has sought to answer this clinical question. This method of inquiry explores the concept in question through an extensive literature review. Gray, Grove, and Sutherland (2017) define an integrative review, identifying that “through synthesis and integration, one can cluster and connect ideas from several sources to develop a personal overall view of the topic” (p. 133). In essence, an integrative review seeks to pull together the identifiable themes from the literature base and understand both the implications for nursing and the identifiable gaps for future research. With this understanding, future recommendations for research and implementation can be made.

**Literature Review**

**Introduction**

Performing a literature review can uncover various themes, opportunities, and gaps in the related research available. For this scholarly inquiry, a comprehensive review and examination of the existing literature on IHCA helped to develop an understanding of cardiac resuscitation training best practices. While the current literature is relatively robust, gaps and opportunities do remain for future investigation through research. Appendix A provides an appraisal of the literature used for this scholarly inquiry in literature table form.
Peer-reviewed scholarly articles published in the years 2014 to 2020 are included in this appraisal, though other appropriate resources date back to 1958. To obtain fourteen exceptional articles with high levels of evidence, the author searched in EMBASE, Ovid MEDLINE, Scopus, PubMed, and Google Scholar. In this literature appraisal, the bulk of the evidence queried came from Scopus. Refer to Table 1 for a concise understanding of the specific database search strategies utilized in this scholarly inquiry.

The author performed this literature search by compiling relevant keywords from each segment of the research question. In Scopus, the search terms code blue OR resuscitation OR medical emergency OR cardiac life support AND coach OR CPR coach OR feedback AND perception OR quality OR performance were compiled with the filter criteria English language, years 2009-2020, and human subjects only. The author performed an additional Scopus search with the search terms code blue OR resuscitation OR medical emergency OR cardiac life support AND train OR education OR educate AND team and the filter criteria English language, years 2009-2020, and human subjects only.

The author performed additional queries of both EMBASE and Ovid MEDLINE using the same search criteria: heart arrest OR code blue AND cardiopulmonary resuscitation education AND knowledge OR train OR advanced OR basic OR simulate OR learn OR teach AND BLS OR basic life support OR ACLS OR advanced cardiac life support and the filter criteria English language, years 2009-2020, and human subjects only. In PubMed, the author utilized the search term simulated code blue education, and in Google Scholar, the author used the search term mock code simulation.
Search queries turned up a variety of literature on resuscitation. It is essential to recognize that the literature base used in this appraisal consists primarily of various resuscitation training interventions, roles, and programs. There is minimal literature that speaks to specific clinical outcomes related to training interventions for resuscitation. This evidence was predominantly inconclusive, given the challenges of controlling for a variety of variables in the clinical setting. Patients that experience IHCA might have confounding comorbidities and experience various etiology as the cause of requiring resuscitative efforts. Many of the challenges of controlling these confounding variables in the clinical setting are mitigated in the simulated environment. Therefore, this literature primarily encompasses IHCA training in the simulated environment.

Additionally, search queries also identified a large volume of literature pertinent to out of hospital cardiac arrest (OHCA). This particular literature base does attempt to draw out implications for patient outcomes, but the levels of evidence were variable. For this scholarly inquiry, the author utilized only literature pertinent to IHCA. OHCA literature does have utility, but generalizability to IHCA scenarios is challenging given the differing clinical environments and medical emergency response team designs in each setting.

Gray et al. (2017) shaped the methodology used for appraising the literature in this scholarly inquiry paper. To accurately appraise the research, one must examine the results of the data analysis, explain what those results mean in context, identify limitations, form conclusions while considering the limitations, appropriately generalize the findings through recommendations, consider the implications for nursing, and guide the future research needs. Additionally, when forming recommendations, it remains
critical also to consider the level of evidence, based on the research methodology. For this scholarly inquiry, the author ranked the level of evidence through a system identified by Ackley, Swan, Ladwig, and Tucker (2008). The evidence in this inquiry ranks from levels two through four and is primarily comprised of randomized controlled trials.

After completing a thorough search and appraisal of the existing literature, both background and outcome themes began to emerge. Background themes include poor resuscitation outcomes, a lack in current resuscitation training regimens, chaotic code environments, meager execution of teamwork, and nonadherence to the guidelines put forward by the American Heart Association (AHA) and European Resuscitation Council (ERC). Through various resuscitation training implementations, the literature appraised identified superior teamwork, enhanced satisfaction and confidence of the healthcare professional, and improved CPR quality as outcomes of the various interventions utilized. This extensive literature review will seek to understand which resuscitation training interventions are critical in shaping the future of cardiac resuscitation training.

**Background Themes**

Prior experiences and outcomes remain an essential part of the literature appraisal process, offering context to the intervention of interest by shaping and defining the events and instances that led up to the intervention. The articles appraised offer five different antecedents: poor resuscitation outcomes, inadequacies in current cardiac life support classes, disorganized and chaotic environment leading to code team breakdowns, ineffective teamwork during a code, and a lack of adherence to guidelines put forward by both the AHA and ERC.
Of interest to the author, Brewster et al. (2017) demonstrated a common theme that despite the necessity of cardiac life support classes, these classes are often lacking in the essential content to prepare providers to respond collectively and effectively to resuscitation events. Ten of the articles addressed this implication with the development of specific interventions and enhanced curriculum. Ten of the appraised articles identified poor resuscitation outcomes. Furthermore, ten of the articles reviewed also identified concerns with adherence to the guidelines put forward by the AHA and ERC, and seven discussed concerns with teamwork. Five of the literature sources identified chaotic code environments. Recognition of these themes in the literature gives clarity to an enhanced resuscitation training need for healthcare providers.

**Poor resuscitation outcomes.** Cardiac arrest remains a tragic event often followed with irreversible negative outcomes, including death. Cheng et al. (2018) recognize that each year in North America, CPR is performed on thousands of infants and children with dismal survival rates. Each year in the United States, approximately 200,000 patients will experience an IHCA with attempts at resuscitating (Hunt et al., 2017).

Nonetheless, some reports have suggested improvements in survival to hospital discharge rates without neurologic disability, but these findings are thought to be skewed by inconsistent and variable reporting between hospitals (Hunt et al., 2017). Furthermore, despite perceived improving trends, those surviving to hospital discharge remains well below 50%, meaning that the majority of individuals experiencing IHCA will still die (Hunt et al., 2014). Despite the complexity of resuscitation and the growing acuity of patients entering hospitals today, this seems an unacceptable finding.
Deficiency in current training regimens. One of the primary concerns brought forward consistently in the literature was the frequency of resuscitation training. Anderson et al. (2019) make the argument that if we are to expect our healthcare providers to provide high-quality CPR, then regular repetitious training regimens are needed. Without this training repetition, skills will quickly diminish. Similarly, Brewster et al. (2017) recognize the speed at which the deterioration of skill occurs, and also identify the successes of simulated resuscitation response. Lin, Cheng, Grant, Currie, and Hecker (2018) state that “effective CPR training requires optimal utilization of educational strategies” (p. 7). Additionally, the current methods of training in traditional BLS courses are demanding of both labor and time, while offering poor retention of knowledge and skills over time.

Interestingly, Hunt et al. (2017) recognize an additional challenge with traditional cardiac life support classes, pointing to the fact that many do not teach “learners how to navigate hospital-specific challenges” (p. 128). There is a need to understand how contextualized training could better prepare healthcare providers working in the hospital environment. More specifically, performing compressions on a mannequin that is either on the floor or a flat table at the proper height is not representative of the typical hospital environment. These frequently used resuscitation scenarios might be better suited for those performing basic life support in an out of hospital cardiac arrest scenario.

A final deficiency noted in current training programs was the lack of psychological safety (Hunt et al., 2014). Without an environment with learners prepared to engage in feedback and coaching, learners are likely going to deflect important and necessary feedback. Psychological safety seeks to transition the learner from anxiety
about making mistakes, to the normalizing of errors. Psychological safety changes the mindset of the learners to one that is “enthusiastic about the opportunity for dedicated coaching and practice time” (Hunt et al., 2014, p. 946). The development of this type of environment closely aligns with athletics, an industry where the pursuit of excellence and best performance continue. The pursuit of excellence in resuscitation programs not only positions healthcare professionals to succeed but also increases the likely impact on patient outcomes.

**Chaotic code environments.** It should come as no surprise, but one of the most significant challenges of a medical emergency is the ensuing response of healthcare professionals with adrenaline. Hunt et al. (2015) describe this well, identifying that many in-hospital providers quickly move to advanced life support measures when identifying the loss of a pulse, delaying the necessary and fundamental basic life support tactics such as compressions and artificial respirations. Hunt et al. (2015) describe this observed phenomenon as the “loss of first responder instincts” (p. 2).

Inevitably, as a team works to rapidly respond to the quickly fading life of a human at their bedside, one could expect some level of chaos. In some preliminary audits performed by Mahramus et al. (2016), code environments were chaotic and disorganized, leadership structures were faltering, communication was ineffective, and breakdowns were occurring in various code team processes. Chaotic code environments had unidentified team leaders where the other team members subsequently struggled to identify roles and responsibilities. Additionally, in that same preliminary work, members of the code team were reporting that often too many responders were present, causing the rooms where the resuscitation was occurring to become overcrowded (Mahramus et al.,
These crowded rooms lead to the inability to determine the code team leader, as multiple providers began to take action.

While it remains vital for an expedited response from all necessary members of a code team, having an abundance of responders can cause an increase in commotion, chaos, and unnecessary disorder.

**Meager execution of teamwork.** Unfortunately, traditional life support training courses often lack content specific to teamwork function, such as role delineation and closed-loop communication (Brewster et al., 2017). Instead, these traditional courses often remain highly focused on skills and mechanics. Beck et al. (2019) identifies that five essential components must exist to be successful as a medical emergency response team: team leadership, mutual performance monitoring, backup behavior, adaptability, and team orientation.

Unfortunately, if even one of these components is lacking, it can lead to systematic dysfunction of the medical emergency response team. Without leadership, the team will lack a clear direction. Additionally, sub-par CPR can occur without mutually monitoring performance. Without backup behavior, feedback may not be accepted or offered. Without adaptability, the team will falter in complex scenarios. Finally, without team orientation, members of the team will fail to perform optimally because of a shortfall in understanding the strengths and weaknesses of each member of the medical emergency response team (Beck et al., 2019).

**Nonadherence to guidelines.** Despite clear evidence for the need to deliver guideline compliant CPR, healthcare professionals continue to underperform, falling short of the recommendations put forward by the AHA and ERC (Anderson et al., 2019).
The AHA guidelines for the delivery of CPR to an adult include depth of 50 to 60 millimeters, a rate of 100 to 120 compressions per minute, and allowing for complete recoil of the patient’s chest (Anderson et al., 2019). The AHA also recommends the integration of CPR quality monitoring into all resuscitation programs, but “only 4% of 439 hospitals in the United States indicate use of CPR feedback devices during clinical care” (Cheng et al., 2015, p. 45). Perhaps disturbingly, direct visualization remains the primary means of assessing CPR quality. However, “research to date has revealed that code team leaders fail to recall important CPR errors during post-cardiac arrest” (Cheng et al., 2015, p. 45). Team leaders may fail to identify CPR errors because of the significant mental workload required in the high-stakes environment of a code (Cheng et al., 2018).

Cheng et al. (2018) go on to further identify that even with the presence of a visual feedback device during simulated CPR training, guideline compliant CPR often remains an opportunity. Without a focused and ongoing assessment of the feedback provided by the CPR feedback device, compromise of compression quality could occur. This finding gave way to the CPR coach role in the medical emergency response team; a concept birthed from the application of coaching concepts by Cheng et al. (2018). The CPR coach is an additional member of the medical emergency response team trained to interpret and share the feedback provided by the CPR feedback device. Training for this role lasted one hour and incorporated an expert demonstration of the role and simulated scenarios in which the CPR coach could practice the necessary concepts. The CPR coach is primarily responsible for the coordination and provision of feedback to those
administering CPR in real-time, allowing the team leader to remain focused on other components of the advanced life support algorithms (Cheng et al., 2018).

In a multicenter randomized controlled simulation trial performed by Cheng et al. (2019), researchers sought to understand the impact of a CPR coach on the perception of CPR quality performed. Interestingly enough, teams functioning with a CPR coach accurately perceived chest compression depth 47% of the time, and teams without a CPR coach were only accurate 25% of the time. Accurate chest compression depth perception was significantly ($p < 0.001$) more likely in teams with a CPR coach.

Alarmingly, on teams without a CPR coach, the quality of CPR depth achieved was overestimated 70% of the time, meaning that teams without a CPR coach perceived higher-quality CPR performance than was being performed. Therefore, not only were teams without a CPR coach inaccurate in understanding CPR depth, but they often demonstrated inflated confidence (Cheng et al., 2019). These findings clearly outline the challenges of consistently achieving guideline compliant CPR. Still, without improving the provision of guideline compliant CPR, it remains likely that resuscitation outcomes will continue to be miserable.

**Outcome Themes**

Appraisal of this literature brought forward relevant and valuable findings that necessitate practice change considerations. The appraisal process identified three primary outcome related results: improved teamwork amongst medical emergency response teams, improved staff satisfaction with the training and confidence because of the training, and superior CPR quality. A key finding in the literature was the significant improvement of the compression quality in twelve of the pieces of literature reviewed.
Learners demonstrated increased satisfaction and confidence in five of the appraised articles. Additionally, teamwork improved in four of the articles reviewed.

**Superior teamwork.** A distinct finding in the reviewed literature is the improvement of teamwork amongst the medical emergency response team. Beck et al. (2019) offered an innovative approach to enhancing teamwork by incorporating shared mental models into their BLS course. In a randomized controlled trial performed at a simulation training center in Germany, researchers randomized nurses and physicians into 95 medical emergency response teams. The control group received standard BLS training, and the intervention group received enhanced BLS training that incorporated the teachings of shared mental models. A shared mental model is the organization of knowledge amongst the team. In this particular study, the researchers engrained in the intervention group that each member of the team was responsible for the detection, delivery, and feedback associated with quality CPR. It remains important to note that both groups received the same amount of training time, with the only difference in training being the material.

Beck et al. (2019) state that “effective teams do not only have a common understanding of the task including goals and procedures, but also on the team itself” (p. 34). Therefore, the shared mental model training sought to engrain in the participants that the detection and delivery of quality CPR was the responsibility of every member of the team. Thus, it was essential for the team members to provide feedback to the compressor regarding their CPR delivery. To measure the perception of teamwork, the Team Assessment Scale (TAS) measuring team coordination, cooperation and information
exchange, and team adjustment behavior was performed by a single, blinded rater for all groups (Beck et al., 2019). Appendix F provides a detailed description of this tool.

The utilization of shared mental models not only improved teamwork but also significantly decreased the amount of time during the simulation that chest compressions were not performed. Overall, those trained with the shared mental model technique spent significantly less time off the chest, decreasing the amount of time in a scenario without CPR providing artificial circulation \((p = 0.029)\). Furthermore, findings of the team assessment scale found that by enhancing team coordination \((p = 0.010)\), cooperation and information exchange \((p = 0.001)\), and team adjustment behavior \((p = 0.001)\), time spent off the chest was significantly reduced (Beck et al., 2019).

In another trial performed by Brewster et al. (2017), researchers in Australia delivered interprofessional simulated advanced life support training to their participants. This pretest, posttest quasi-experimental designed study sought to enhance the resuscitation training of their critical care staff, including both nurses and physicians. As a means of measuring participant satisfaction, role understanding, and confidence in responding to a resuscitation event, the researchers distributed a questionnaire before, after, and at four-month increments to track these inquiries. These questionnaires sought to capture demographics, resuscitation training experience, cardiac arrest exposure, satisfaction with training experiences, role understanding, and level of confidence when responding to a cardiac arrest. Excluding the demographic questions, these questionnaires primarily utilized Likert scales for rating.

Unfortunately, and for unknown reasons, the physician response rate in this study was low, minimizing the interdisciplinary generalizability of the findings. Nonetheless, at
the four-month mark, nursing participants were found to have significant improvement in satisfaction with the training \( (p < 0.001) \), role understanding during a code in the ICU \( (p = 0.02) \), and confidence in responding to a code in the ICU \( (p = 0.02) \) (Brewster et al., 2017). Despite a low response rate, this study still demonstrates that by enriching the training process with advanced simulation, participants can gain increased confidence, role clarity, and satisfaction in the training provided. These findings further enforce the need to prepare our healthcare professionals differently for a successful response to a resuscitation event.

Hunt et al. (2015) utilized a mixed-methods approach to assess the utility of action-linked phrases during simulated cardiac arrest scenarios. The researchers noticed that “when in-hospital providers recognize a loss of pulse, many focus on advanced life support (ALS) resulting in delayed initiation of BLS. We describe this as a ‘loss of first responder instincts’” (Hunt et al., 2015, p. 2). In phase one, the researchers retrospectively observed the medical residents to determine the feasibility of action-linked phrases. An example of an action-linked phrase used by participants is “no pulse, start compressions.” These phrases sought to link the identification of a significant finding with necessary action. During this phase of the trial, the researchers discovered that medical residents using action-linked phrases were significantly \( (p = 0.002) \) more likely to start chest compressions than medical residents that did not. Additionally, medical residents using action-linked phrases started chest compressions significantly \( (p < 0.001) \) sooner than those who did not use action linked phrases (Hunt et al., 2015, p. 4).

In phase two of this trial, the researchers utilized a quasi-experimental approach in the training of 321 participants of either BLS or ACLS courses. Not surprisingly, those
in the BLS course trained to use action-linked phrases were significantly ($p < 0.001$) more likely to use those phrases than those without the action-linked phrase training. Additionally, those in the ACLS course trained to use action-linked phrases were significantly ($p < 0.001$) more likely to use those phrases than those without the action-linked phrase training (Hunt et al., 2015). By observing both phases of this trial, the findings establish that by teaching learners of both BLS and ACLS classes to utilize action-linked phrases, it may be possible to improve team function and deliver CPR sooner. Still, the strength of this level of evidence remains lower; therefore, it would be helpful to have additional research performed to validate these findings. Future research should consider answering the same research question but provide more robust study design, such as a randomized controlled trial.

In a trial performed by Mahramus et al. (2016), researchers sought to “assess the effectiveness of a 2-hour multidisciplinary teamwork training program on perceptions of teamwork during simulated code events for all members of the code team” (p. 285). This pretest, posttest quasi-experimental designed study provided participants with a two-hour course specific to teamwork training. Before the training, a standardized cardiac resuscitation simulation was performed and assessed. Following the training, assessment of a different, but standardized cardiac resuscitation simulation occurred. The assessment included the rating of teamwork perception by both the participants and a group of four trained observers. A validated Team Emergency Assessment Measure (TEAM) tool (see Appendix E) developed by Cooper et al. (2010) was used to quantify these perceptions. Through quantification of teamwork perception, researchers found significantly improved
(p < 0.001) mean TEAM scores and global ratings by both participants and observers (Mahramus et al., 2016).

When bringing together these various findings, it is evident that brief, but focused cardiac resuscitation training can have a significant impact on the execution of effective teamwork amongst the medical emergency response team. Simulation, action-linked phrases, shared mental models, and teamwork specific training can all enhance the function of medical emergency response teams. These findings remain essential as many organizations seek to find cost-effective ways to train their healthcare professionals better to respond to cardiac arrest events. Still, additional research would help validate and strengthen the levels of evidence available to support these findings.

**Enhanced satisfaction and confidence.** In the delivery of superior cardiac resuscitation training, it remains vital that learners demonstrate increased satisfaction in the training provided and expanded confidence in responding to resuscitation events. Without the identification of these findings in the evidence, superior training methods may lack the necessary engagement and components to advance the success of healthcare professionals. As had previously been discussed, the study performed by Brewster et al. (2017) found that after four months, nursing participants retained significant improvements in satisfaction with the training (p < 0.001) and confidence in responding to a code in the ICU (p = 0.02). In the teamwork training intervention introduced by Mahramus et al. (2016), participants gave an average rating of 3.7 on a Likert scale of 0 to 4. Appendix E provides full detail of this assessment tool.

Through improving the perception of CPR quality performed in simulated cardiac arrest scenarios, Cheng et al. (2019) improved the confidence of participants in
performing high-quality CPR. In this secondary analysis of a multicenter randomized controlled trial, the researchers desired to understand perceptions of CPR quality better. Researchers introduced a new role in the medical emergency response team, the CPR coach, to know how an individual solely focused on the quality of CPR delivered could enhance healthcare provider perceptions of CPR delivery. After extracting post-simulation CPR data from the defibrillator and providing the participants with a post-scenario questionnaire related to the perception of CPR rate and depth, researchers sought to understand how teams with a CPR coach gained a more accurate perception of their CPR quality during the scenario.

The findings of this study reveal the significance of incorporating the CPR coach into the medical emergency response team structure. Teams with a CPR coach demonstrated greater accuracy in perception of appropriate chest compression depth \( (p < 0.001) \); however, no difference in an accurate perception of appropriate compression rate was detected \( (p = 0.32) \). When compared with other team member roles, the CPR coach had the most accurate perception of chest compression depth \( (p = 0.002) \). By improving the perception of the CPR quality delivered by the medical emergency response team, healthcare providers can gain confidence in their ability to provide high-quality CPR.

In a similar randomized controlled trial performed by Cheng et al. (2015), researchers studied the impact of various CPR feedback methods on the perception of CPR quality performed by providers. This multicenter trial assembled teams into one of four different study arms: those receiving no intervention, those receiving just-in-time training, those receiving visual feedback only, and those receiving a combination of just-in-time training and visual feedback. The just-in-time training was a five-minute video on
CPR and a brief two-minute CPR performance training. An accelerometer-style CPR feedback device provided the visual feedback.

In comparison to the group receiving no intervention, all three intervention arms revealed a significantly improved accurate perception of chest compression depth ($p < 0.0001$), which was measured by comparing the performed chest compression depth with the participant perception of compression depth quality. However, neither intervention nor a combination of both interventions had a significant impact on the perception of an appropriate rate or chest compression fraction. More specifically, amongst the group receiving only the real-time visual feedback from the CPR feedback device, the perception of CPR quality was significantly better for CPR providers when compared with team leaders ($p = 0.043$) (Cheng et al., 2015). Once again, these findings reinforce the link between compression quality awareness and healthcare provider confidence in the delivery of high-quality CPR.

Majer et al. (2019) designed a similar prospective, randomized, cross-over trial to assess the effectiveness of a visual feedback device in enhancing CPR quality and provider confidence. In this simulated setting, emergency medicine residents performed two-minute cycles of CPR with and without the visual feedback device. The visual feedback device provided visual feedback on CPR quality. Before this study, no participants had previous experience with CPR feedback devices, and the residents were only given ten minutes to read about the functionality of the equipment before using it.

Following the simulated resuscitation events, the extraction of CPR data from the standardized mannequins occurred, and participants rated their confidence in performing correct CPR on a scale of one to one hundred. The researchers discovered that the use of
the CPR feedback device significantly improved chest compression depth \((p < 0.001)\), chest compression rate \((p = 0.002)\), chest recoil \((p < 0.001)\), and confidence in the delivery of high-quality CPR \((p = 0.024)\) (Majer et al., 2019).

When synthesized, these findings implicate the significance of the medical emergency response team having an awareness of the delivery of quality of CPR. Enhancement of this awareness occurs through feedback devices, timely training, and the addition of a CPR coach to the medical emergency response team structure. Furthermore, these findings draw the link between CPR delivery awareness and the confidence of the medical emergency response team. Additionally, brief and focused training can enhance the satisfaction of the medical emergency response team. Unfortunately, many of these studies have some limitations related to generalizability and validation. There is a need for further research to corroborate these findings. Future research should also incorporate a broad scope of healthcare providers and settings to allow for further generalization of the research.

**Improved CPR quality.** To address the lack of healthcare provider adherence to the AHA and ERC guidelines, many researchers introduced interventions focused on teamwork, communication, and CPR quality. The bulk of the resuscitation literature reviewed in this scholarly inquiry paper enhanced the provision of high-quality CPR through various interventions. These interventions group into different training approaches, a variety of CPR feedback methods, and the introduction of a CPR coach to the medical emergency response team structure.

**Training approaches.** As previously discussed, Hunt et al. (2015) explored a novel training approach to CPR initiation. The findings of this particular study give utility
to the implementation of simple action-linked phrases. When teaching the medical emergency response team to use action-linked phrases, it may be possible to improve team function and deliver CPR faster (Hunt et al., 2015). Another simple teaching strategy explored by Beck et al. (2019) offered an innovative approach to enhancing teamwork by incorporating shared mental models that conveyed the importance of all team members taking ownership of compression quality into their BLS course. Though the quality of BLS performance between the control and intervention groups was insignificant, the group using the shared mental models spent significantly less ($p = 0.029$) time off the chest during CPR (Beck et al., 2019). Minimizing time off of the chest is critical in maximizing perfusion of the pulseless patient.

Hunt et al. (2017) pursued this issue differently by providing a contextualized curriculum that reinforced many of the AHA guidelines, and their results also showed significantly improved CPR quality. Improved CPR quality was determined by starting compressions sooner, minimizing time spent not providing compressions, and utilizing various maneuvers and tools to maximize CPR delivery (step stool, backboard, flat bed position, and side rails down). In this randomized controlled trial performed in a simulated environment, participants were enrolled in either the traditional BLS course or a hospital contextualized BLS class. In both of the simulated scenarios, teams that had taken the hospital-specific BLS course demonstrated significantly better ($p < 0.001$) chest compression fraction scores and initiated chest compressions faster ($p < 0.001$) (Hunt et al., 2017). This training approach uncovers the importance of developing a resuscitation training curriculum that adequately prepares the healthcare provider to succeed in their natural work environment.
In another study performed by Hunt et al. (2014), researchers utilized a rapid cycle deliberate practice (RCDP) training method to enhance the quality of CPR delivered. RCDP is a training method that seeks to create a psychologically safe environment for the learner and provide an environment where rapid practice and expert feedback can be quickly incorporated to maximize learning. This pretest, posttest quasi-experimental designed study utilized a convenience sample of pediatric residents. Residents were exposed to five different scenarios and functioned in teams. When an error occurred, the researchers paused the scenario and provided corrections and scripted teaching. The learners worked together to complete each scenario.

RCDP learners were significantly more likely to administer respirations \((p = 0.004)\), significantly faster at starting chest compressions \((p < 0.002)\), spent significantly more time performing compressions \((p < 0.001)\), were significantly faster to defibrillate \((p = 0.03)\), and encountered significantly less pre-shock pause time \((p < 0.001)\). Through the utilization of the RCDP training method, researchers were able to improve the quality of BLS that was delivered significantly. Unfortunately, the study population limits the generalization of the findings, and there could be a concern for bias without the utilization of randomization.

Moreover, the contributions to the literature of Anderson et al. (2019) support the need for more frequent CPR training to assure skill acquisition and retention. This randomized controlled trial sought to determine the necessary frequency to achieve consistently excellent CPR performed by nurses. The researchers of this study defined “excellent CPR” as CPR that reached at least the ninetieth percentile in compression depth, rate, and recoil (Anderson et al., 2019). Over a year, those performing CPR every
month were significantly more likely to perform excellent CPR than those training less frequently. This study addresses the need for regular training in combatting the skill delay encountered with low-frequency skills. More specifically, the findings of this study help to address the gap of rapid skill decline not well understood in this literature review.

Lin et al. (2018) performed a similar randomized controlled trial enrolling nurses, residents, and respiratory therapists. Participants were either enrolled in a standard BLS training or required to perform CPR every month. Those performing CPR every month had access to a simulation mannequin that provided real-time feedback on CPR quality. After a year of time, the intervention group demonstrated significantly improved guideline compliant CPR depth \((p = 0.003)\), rate \((p = 0.003)\), and recoil \((p = 0.002)\). Moreover, the proportion of those providing excellent CPR, defined as achieving at least 90 percent of all AHA guidelines for depth, rate, and recoil, was also significant \((p < 0.001)\) amongst the intervention group (Lin et al., 2018). These findings align with those of Anderson et al. (2019), further enforcing the significance of training frequency in the delivery of high-quality CPR.

These findings support the implementation of simple interventions to address gaps in the quality of CPR delivered. Adjusting resuscitation courses to incorporate contextualized training and leverage shared mental models, and action-linked phrases could be simple adjustments to the current curriculum that may have a high yield. The use of rapid cycle deliberate practice training may also have utility, but this level of training may not be pertinent for all healthcare providers. Perhaps this is best suited for specific training developed for local medical emergency response teams. Finally, consideration of the training frequency of our healthcare providers is necessary.
Unfortunately, most take BLS and ACLS courses bi-annually, creating a significant opportunity for the decay of skill.

**CPR feedback methods.** Today, a variety of CPR feedback devices exist, with many feedback devices incorporated into defibrillators. Wattenbarger, Silver, Hoyne, Kuntsal, and Davis (2020) sought to understand the impact of a targeted training program coupled with a real-time CPR feedback device. In this pretest, posttest observational cohort study, various healthcare professionals from Taiwan, Singapore, China, Bahrain, and Kuwait were enrolled. Before the introduction of the targeted training and the real-time CPR feedback device, participants performed compressions in a baseline scenario. Following the training and introduction of the feedback device, participant percentage of compressions meeting both depth and rate targets increased significantly ($p < 0.001$). Though lacking in randomization, these findings do have a broad cultural context supporting the use of real-time CPR feedback devices.

The researchers in a previously discussed study further enforced these findings, discovering that the use of a CPR feedback device significantly improves chest compression depth ($p < 0.001$), chest compression rate ($p = 0.002$), chest recoil ($p < 0.001$), and confidence in the delivery of high-quality CPR ($p = 0.024$) (Majer et al., 2019). Wagner et al. (2019) further assessed the utility of the CPR feedback device, comparing it against instructor-led feedback. In this randomized controlled trial, researchers randomized residents into one of four study arms: the control group, those receiving instructor-led feedback, those receiving visual feedback from a CPR feedback device, and those receiving a combination of instructor-led feedback and device feedback. This robust trial found that participants receiving only the instructor feedback
performed significantly worse than groups receiving visual feedback or a combination of both visual feedback and instructor feedback ($p < 0.001$) (Wagner et al., 2019).

In a previously examined study performed by Cheng et al. (2015), researchers set out to understand the relationship between perception of CPR quality and the actual CPR quality performed. A diverse team of nurses, physicians, residents, and medical students were enrolled in the study and randomized into teams and study arms. Ultimately, the researchers discovered that when compared with the group receiving no intervention, all three intervention arms revealed a significantly improved perception of chest compression depth ($p < 0.001$). Furthermore, amongst the group receiving only the real-time visual feedback from the CPR feedback device, the perception of CPR quality was significantly better for CPR providers when compared with team leaders ($p = 0.043$) (Cheng et al., 2015). These study findings further corroborate the need for a real-time understanding of CPR performance. Without the proper tools to expose performance gaps, CPR quality will remain dismal.

**CPR coach.** Despite the establishment of the need for an understanding of CPR quality through CPR feedback devices, Cheng et al. (2018) sought to understand if simply having the evidence of CPR quality available was enough? Ultimately, the researchers implemented an additional role in the medical emergency response team structure, the CPR coach. In this multicenter randomized controlled trial, researchers enrolled a diverse group of healthcare professionals into medical emergency response teams. The control group operated with the usual medical emergency response team structure but were also provided with an additional team member to account for equal distribution. Researchers introduced the intervention group to the CPR coach role; a
healthcare provider solely focused on giving verbal feedback to the team related to the CPR feedback provided by the defibrillator.

The researchers learned that teams coached by a CPR coach had a significantly improved \((p < 0.001)\) percentage of overall excellent CPR, and also demonstrated a significantly improved percentage of chest compressions meeting guidelines for depth, mean compression depth, and chest compression fraction \((p < 0.001)\). CPR coached teams also demonstrated significantly shorter pauses in CPR \((p = 0.008)\) (Cheng et al., 2018). Cheng et al. (2018) concluded that institutions with defibrillators capable of providing CPR feedback should consider developing and implementing the CPR coach role in their medical emergency response team. The findings of this study have incredible implications for nursing and the transformation of medical emergency response teams in healthcare, providing evidence that a CPR coach could significantly improve adherence to the AHA guidelines regarding CPR quality. These findings further validate the effectiveness of simple interventions.

In a secondary analysis performed by Cheng et al. in 2019, teams with a CPR coach demonstrated greater accuracy in the perception of appropriate chest compression depth \((p < 0.001)\). Furthermore, when the researchers compared the CPR coach perception with other team member roles, the CPR coach had the most accurate perception of chest compression depth \((p = 0.002)\). Consequently, these findings gave way to the application of the Dunning-Kruger effect. The research performed on the CPR coach role exhibits some of the most profound discoveries in this body of literature, giving light to the possibility of solidifying the delivery of high-quality CPR at all times.
Synthesis of Evidence

**Strengths.** Overall, this query produced an acceptable volume of literature. Additionally, this literature search attained a relatively high level of evidence. With evidence ranging from level II down to level IV, the rigor of this literature will be difficult to dispute. Despite cardiac resuscitation being a relatively vast topic, the narrowed focus of the clinical nursing question guided a focused review of the available literature. Several themes emerged from this literature review, necessitating further discussion regarding implications for nursing and recommendations for healthcare. Pulling together strengths from this evidence will be the primary focus of the recommendations made regarding cardiac resuscitation training change.

**Gaps.** Despite the relatively high level of evidence obtained for this inquiry, the generalizability of the findings will remain a limitation because many of the utilized research designs were randomized controlled trials. Future research should look to address this limitation through additional multicenter trials, systematic reviews, and meta-syntheses. Though the literature identified chaotic code environments and a lack of effective teamwork, it would be of benefit to formulate a qualitative research design to understand better these challenges and others that medical emergency response teams encounter. Though qualitative evidence is not a high level of evidence, it does provide insight that can sometimes be challenging to understand through quantification.

Another concern of this body of evidence is the ability to conclude patient outcomes. Much of this body of literature speaks to the implications for clinicians in clinical practice, but there is not a specific link to patient outcomes. Future research should validate these simulated findings in clinical practice. However, the randomization
and choice to use or not use particular techniques or training in clinical practice could raise ethical concerns. Furthermore, the inability for researchers to adequately control for the many extraneous variables in clinical situations poses significant challenges for future research in the clinical setting. It would seem that a considerable sample size would be needed to demonstrate power over the confounding variables present in the clinical setting. Another consideration not well understood from this literature base is the impact of family presence during an IHCA. Specific training may be needed to better prepare healthcare providers to support family members during this traumatizing event. Future research could address this gap through both quantitative and qualitative approaches.

A final gap to address with future research and healthcare reform is the standardization of reporting cardiac resuscitation events. Today, voluntary national cardiac resuscitation registries such as the *Get with the Guidelines* registry may provide additional clinical guidance in the future. By pulling together a large volume of deidentified resuscitation events, researchers can begin to assess the clinical implications of practice changes previously only understood in the simulated environment.

**Conceptual Framework**

**Introduction**

A concept analysis provides a conceptualized understanding of the findings identified in a literature appraisal. Gray et al. (2017) define a concept analysis as “a strategy that identifies a set of characteristics essential to defining the connotative meaning of a concept” (p. 141). Through the process of conceptual analysis, one can develop a conceptual framework to provide a structured understanding of the research.
Concept and Concept Map

In this particular inquiry, the concept in question is that of enhanced resuscitation training strategies. It is pictured in the middle of Figure 1, which provides a visual depiction of the conceptual framework through a concept map. Also identified in this figure is the direction of relationship to the various antecedents and consequences identified in the literature. Furthermore, each antecedent and consequence is categorically ranked based on the empirical level of evidence that supports it. On the left-hand side of Figure 1, the antecedents and associated literature are all identified by negative relationships. On the right-hand side of Figure 1 are the various consequences and relevant literature sources. All of the identified consequences in this concept map have a positive relationship with the concept.

Antecedents and Consequences

Antecedents remain an essential part of literature appraisal, offering context to the concept of interest by shaping and defining the events and instances that lead up to the concept. The appraised literature offers five different antecedents: poor resuscitation outcomes, nonadherence to resuscitation guidelines, current training regimens are insufficient in maintaining competence, lack of effective teamwork and collaboration, and the code environment is chaotic. These identified antecedents propelled the various researchers to pursue differing means of resuscitation training for their participants, the defined concept of this appraisal.

Following a concept are the results of that intervention, otherwise known as the consequences. Consequences can be both positive and negative in the relationship as well. The appraisal process identified three primary consequences: increased guideline
compliant CPR quality, improved healthcare provider satisfaction and confidence, and enhanced teamwork amongst medical emergency response teams.
Figure 1. Concept map of appraised literature.
Conclusions, Implications for Nursing and Recommendations

Introduction

The purpose of this scholarly inquiry paper is to explore the existing literature on enhanced cardiac resuscitation training. Through this exploration, the author intends to provide recommendations on how to increase the medical emergency response team function, technical skill, and nontechnical skill of healthcare professionals responding to IHCA. Additionally, specific implications for nursing, recommendations for the future of resuscitation training and team dynamics, and conclusions from the literature will be identified. These findings may support the focus and advancement of resuscitation training and potentially enhance the outcomes of patients experiencing IHCA.

Again, the question in focus for this scholarly inquiry states: does providing enhanced cardiac resuscitation training for healthcare professionals (nurses, providers, and respiratory therapists) responding to in-hospital cardiac arrests positively impact their satisfaction, confidence in responding, collective teamwork, or CPR quality in comparison to only using traditional BLS or ACLS for preparation?

Conclusions

In consideration of this appraisal of research, it would seem appropriate to recommend transformative efforts in how resuscitation training is administered for inpatient healthcare providers responding to an IHCA. The body of research reviewed in this appraisal identifies that simulated, contextualized, and focused, but brief education can be highly effective. Additionally, developing role-specific champions can also improve the effectiveness of the entire team by providing additional real-time feedback during resuscitative efforts.
The addition of the CPR coach by Cheng et al. (2018) proved to be effective amongst multiple centers. Cheng et al. (2019) furthered these findings, establishing the importance of the CPR coach role in providing medical emergency response teams with accurate perceptions of their CPR quality, uprooting the challenges of unawareness regarding poor performance. Without the ability to properly understand CPR performance, the healthcare professional continues a misperception of expertise because of their unknown performance gap, an effect identified as the “Dunning-Kruger Effect” (Cheng et al., 2019). Therefore, the introduction of the CPR coach role seems to offer the most impact, with minimal requirements of time and monetary investments.

**Implications for Nursing**

Identifying an evidence-based practice model that is an appropriate fit for the specific practice change and organization is critical to successful implementation. This particular practice change is an exemplar approach to be utilized by a healthcare organization in changing their practice. The Iowa Model is a validated, effective, and widely used practice change model (Iowa Model Collaborative, 2017, p. 175). The Iowa Model is the best fit for this practice change and organization.

Precisely, the focus on designing and piloting the change for the context of the organization is valued. Historically, healthcare organizations value the use of pilot programs when considering a practice change. Additionally, this particular model provides a concise and clear progression to follow in the design, validation, and dissemination of a practice change. Finally, this model asks three specific questions that act as checks and balances throughout the process to assure that the practice change is a priority, is supported by evidence, and is appropriate for adoption into practice (Iowa
Model Collaborative, 2017, p. 178). It is important to note that to provide a recommendation, the author established assumptive answers to these questions. Appendix C provides a detailed adaptation of how the Iowa Model guides the implementation of the CPR coach role.

An additional implication for nursing includes the need for nursing to take ownership of their individualized professional practice. Ultimately, all of the best teaching and training cannot overcome a learner that is unwilling to be taught. As nursing continues to seek opportunities to lead in healthcare transformation, one of the greatest assets of nursing will be the willingness to take personal accountability for the transformation of an individualized practice. As Cheng et al. (2019) described with the Dunning-Kruger effect, it is after we understand our gaps and opportunities that actual growth and change can occur. Taking ownership of our reception and engagement with teaching is profound learning from this literature.

**Recommendations**

Implementation of the CPR coach role to the medical emergency response team through a developed pilot program is the best approach. The training plan and role description will be the basis of this protocol. As established by Mahramus et al. (2016), practical training in a short amount of time is feasible. Therefore, scheduling this two-hour training into the biannual training provided for all members of the medical emergency response team at the simulation center or similar teaching venue is best practice. Purposely, the training will be one hour of didactic and one hour of rapid cycle deliberate practice simulation. This particular training method was found useful by Hunt et al. (2014).
The Nursing Education Specialist (NES) that supports the medical emergency response team will develop the training for this role. All members of the medical emergency response team should receive the training. The training strategy will follow similar principles provided by Cheng et al. (2018) on CPR coach training. Additionally, incorporation of the shared mental model offered by Beck et al. (2019) into this training will occur. This shared mental model requires all participants to take ownership of the detection and delivery of quality CPR. Finally, the CPR coach training will also include instruction on the use of action-linked phrases evidenced to be effective by Hunt et al. (2015). A role description and detailed framework for this training are in Appendix D.

**Required Resources.** The minimization of the financial footprint of this practice change is paramount. To execute this practice change, each organization should consider evaluating the equipment and technology available for implementation of this recommendation. This full recommendation requires access to robust simulation equipment and teaching venues. A cost-benefit analysis may have utility for some organizations. Adjusting this implementation plan may be necessary, depending on organizational resources. Additionally, having access to a simulated training facility and training equipment is vital.

Furthermore, the training provided for all members of the medical emergency response team will align with their regular training sessions, minimizing scheduling conflicts and additional nursing, provider, and respiratory therapy salary for the training time. Aside from the potential cost of training equipment and technology, the only expense for this practice change is the time needed to develop the training session. An estimated eight hours from an NES would be necessary at an approximate cost of $480.
Facilitators and Barriers. For this recommendation, the author assumes that this focus on enhancing and improving the medical emergency response team aligns with organizational strategy. The author also recommends the evaluation of recent events to determine the need to provide additional training for this team. This practice change also aligns with the future of healthcare by leveraging technology. Utilizing advanced defibrillator technology to its full potential is another consideration.

Extensive consideration has been given to this practice change to minimize financial impact while also maximizing effectiveness. Nonetheless, approval from various organization committees or teams may be necessary to determine the feasibility of full implementation accurately. This process would likely hinder the speed of this project but mitigate organizational disruption by involving essential stakeholders.

However, the implementation plan provided by the Iowa Model in Figure 2 of Appendix C should garner confidence from these groups regarding the attention to detail given to the successful implementation of the CPR coach role.

Desired Outcomes and Evaluation. The implementation of the CPR coach role has two main objectives. The primary aim is to enhance the teamwork and effectiveness of the medical emergency response team. The author recommends the use of the validated Team Emergency Assessment Measure (TEAM) tool to measure the teamwork and effectiveness of the medical emergency response team (Mahramus et al., 2016). Each member of the medical emergency response team following each resuscitation event should receive this survey. The team leader of the resuscitation event will be in charge of administering, collecting, and submitting the surveys to the NES that supports the
medical emergency response team. To use the TEAM survey tool, online registration is required. Appendix E provides an in-depth look at this survey tool.

The secondary outcome of this intervention is improved CPR quality. Following each resuscitation event that the medical emergency response team responds to, CPR data extracted from the defibrillator will measure this objective. Specific CPR data provided by the defibrillator will include reports on depth, recoil, and rate. It will be necessary for each organization to consult with the team that manages their defibrillator fleet regarding data extraction. This data extraction process is essential in determining the effectiveness of this recommendation.

Evaluation of these findings will occur through a pre and post-intervention methodology. Six months of data collection will occur before the CPR coach training occurs. Following the training, an additional six months of data collection will occur. At the end of this pilot program, comparing the pre and post data through statistical analysis will determine the effectiveness of the intervention.

**Dissemination Plan.** Following the analysis of this pilot program, dissemination will occur through the BLS and ACLS courses used to train all inpatient healthcare professionals at the organization. As described by Hunt et al. (2017), a contextualized curriculum can be useful in preparing healthcare professionals to succeed in their specific environment. Applying these findings to the incorporation of the CPR coach role would assure successful implementation and solidify a sustainable process for training. Also, developing and submitting a manuscript of these findings for publication would further the evidence base that exists for resuscitation science.
Summary

Though a relatively simple intervention, the addition of the CPR coach has the potential to be a significant addition to the medical emergency response team. This intervention comes at little cost to the organization with the potential to improve patient outcomes during resuscitation events. Healthcare organizations should consider this opportunity as a means to lead in healthcare innovation and reliability.

Healthcare needs to shift to the high-reliability organizational framework that includes a “preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, and deference to expertise” (Dewan et al., 2019, p. 391). Execution of these five key concepts will require a robust resuscitation training program similar to that of the recommendation of this inquiry.

Ultimately, healthcare professionals need to be better prepared to provide their best resuscitation efforts for the patients they care for each day. This literature appraisal demonstrates the effectiveness of applying simple interventions to traditional BLS or ACLS courses to positively impact the satisfaction, confidence in responding, collective teamwork, and CPR quality performed by medical emergency response teams during an IHCA. The missing link for many medical emergency response teams today is the addition of the CPR coach. Without a dedicated role focused on the delivery of high-quality CPR, no deference to expertise occurs, hindering the medical emergency response team from becoming a highly reliable team.
References


https://doi.org/10.1016/j.resuscitation.2018.10.033


https://doi.org/10.1016/j.resuscitation.2019.08.040


doi:10.1016/j.resuscitation.2018.08.021


http://dx.doi.org/10.1016/j.resuscitation.2014.11.015

doi:10.1016/j.resuscitation.2009.11.027


recommendations: A consensus statement from the American Heart Association.

_Circulation, _127_, 1538-1563. doi:10.1161/CIR.0b013e31828b2770


doi:10.1056/NEJM195804032581401


https://doi.org/10.1016/j.jemermed.2019.09.027
### Table 1

*Databases Searched and Data Abstraction*

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### Literature Review

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<th>Implications/ Critique</th>
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<tr>
<td>Anderson, R., Sebaldt, A., Lin, Y., &amp; Cheng, A. (2019). Optimal training frequency for acquisition and retention of high-quality CPR skills: A randomized trial. <em>Resuscitation</em>, 135, 153-161. <a href="https://doi.org/10.1016/j.resuscitation.2018.10.033">https://doi.org/10.1016/j.resuscitation.2018.10.033</a> Scopus</td>
<td>“The primary objective is to determine the training interval associated with the highest quality CPR performance at one year” (p. 154).</td>
<td>Sample: 122 participants were needed for moderate effect size. 244 nurses were recruited into the study with 167 completing the full study course N=167</td>
<td>Design: Randomized Controlled Trial</td>
<td>Variables: CPR Training Frequency / CPR Quality</td>
<td>Instruments: CPR data extracted from adult CPR torso manikin</td>
<td>Results: At the end of the 12-month period, those performing CPR training at 1-month intervals were significantly more likely to perform excellent CPR (≥ 90% of compressions had correct depth, rate, and recoil) than all other training interval groups: • 3-Month Training Interval (p = 0.008) • 6-Month Training Interval (p = 0.002) • 12-Month Training Interval (p &lt; 0.001)</td>
<td>By providing regular and frequent CPR training sessions, high-quality CPR is significantly more likely to be achieved and retained. However, a limitation not fully understood is how this might translate from a simulated environment to the practice environment.</td>
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<td>Setting: Health Sciences North Hospital in Sudbury, Ontario, Canada</td>
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<td>A cost analysis of maintaining monthly competency checks for all bedside staff in a hospital is not addressed in this article. This expense could be mitigated by providing regular CPR training for members of the medical emergency response team.</td>
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<td>Beck, S., Doehn, C., Funk, H., Kosan, J., Issleib, M., Daubmann, A., ... &amp; Kubitz, J. C. (2019). Basic life support training using shared mental models improves team performance of first responders on normal wards: A randomised controlled simulation trial. <em>Resuscitation</em>, 144, 33-39. <a href="https://doi.org/10.1016/j.resuscitation.2019.08.040">https://doi.org/10.1016/j.resuscitation.2019.08.040</a></td>
<td>“This study investigated if a training on shared mental models, improves team performance in simulated in-hospital cardiac arrest” (p. 33).</td>
<td>Sample: 183 total teams of 3-4 participants (nurses and physicians) each were randomized with only 95 teams analyzed because of various exclusion reasons. N=95</td>
<td>Design: Randomized Controlled Trial</td>
<td>Variables: Shared Mental Models / Team Performance</td>
<td>At the end of the training session, those trained with the mental model approach achieved significantly less (p = 0.029) time off the chest than those trained with the standard approach. Individual TAS ratings were also significant when compared with time off the chest:</td>
<td>Incorporating simple curriculum adjustments to BLS content can train learners to utilize shared mental models and improve team function while decreasing the time spent not doing CPR. Unfortunately, only half of the teams were able to be analyzed because of various exclusion criteria. Nonetheless, the demographics of both the control and intervention groups were comparable, hopefully eliminating bias concerns.</td>
<td>This simple intervention where training that is already in place was overhauled to meet the needs of learners better is an example of a cost-effective approach to improving team function and CPR quality. It would be reasonable for future life support training to incorporate a model that supports the learners' development of shared mental models.</td>
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<td>3. Brewster, D. J., Barrett, J. A., Gherardin, E., O'Nell, J. A., Sage, D., &amp; Hanlon, G. (2017). Evaluating team-based inter-professional advanced life support training in intensive care—A prospective observational study. <em>Anaesthesia and intensive care, 45</em>(1), 79-87. doi:10.1177/0310057X1704500112 Scopus</td>
<td>“We hoped we could show our new inter-professional team-based simulation ALS [Advanced Life Support] training package would improve our critical care staff performance, understanding and satisfaction with ALS training” (p. 80).</td>
<td>Sample: Critical care nurses (80) and physicians (19) N=99</td>
<td>Design: Pretest/Posttest, Quasi-Experimental</td>
<td>Level of Evidence: Level III</td>
<td>Variables: Enhanced Advanced Life Support Training</td>
<td>By enriching the content, structure, and design of current advanced life support classes, this study demonstrates that participant satisfaction, role understanding, and confidence when responding to a code can all be maintained over some time.</td>
<td>Despite the implications of this article, it does have some limitations. Only 51 of the 99 staff returned all of the questionnaires. Additionally, this study lacks interdisciplinary implications because of the reduced physician response rate. This study also fails to assess the impact on patient outcomes.</td>
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<td>Setting: 508 bed private hospital in metropolitan Australia with a 12-bed intensive care unit</td>
<td>Instruments: Participants were administered Pre, Post and 4-month questionnaires evaluating the stated dependent variables</td>
<td>Four months after the intervention was applied, the following significant results were noted in the nursing staff:</td>
<td>Results/ Findings:</td>
<td>Implications/ Critique:</td>
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<td>• Significantly improved (p &lt; 0.001) participant satisfaction with course.</td>
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<td>• Significantly improved (p = 0.02) role understanding during a code in the ICU.</td>
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<td>• Significantly improved (p = 0.02) confidence in responding to a code in the ICU.</td>
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<td>4. Cheng, A., Duff, J. P., Kessler, D., Tofil, N. M., Davidson, J., Lin, Y., ... &amp; Hunt, E. A. (2018). Optimizing CPR performance with CPR coaching for pediatric cardiac arrest: A randomized simulation-based clinical trial. <em>Resuscitation, 132, 33-40.</em> doi:10.1016/j.resuscitation.2018.08.021 Scopus</td>
<td>“We aim to determine if integrating a trained CPR Coach into resuscitation teams can improve CC [chest compression] quality during simulated CPA [cardiopulmonary arrest], when a CPR feedback device is in use” (p. 34).</td>
<td>Sample: Teams made up of pediatric intensive care physicians, nurses, advanced practice providers, and respiratory therapists N=41 Teams or 205 Participants *A single team of five participants was excluded because of a technical issue during simulation Setting: Multicenter focus within a simulated environment</td>
<td>Design: Randomized Controlled Trial Level of Evidence: Level II</td>
<td>Variables: CPR Coach Role / CPR Quality Instruments: CPR data extracted from Zoll R-Series Defibrillators</td>
<td>• Significantly improved ($p &lt; 0.001$) percentage of overall excellent CPR in teams with a CPR Coach role • Teams with a CPR Coach also demonstrated a significantly improved percentage of chest compressions meeting guidelines for depth, mean compression depth, and chest compression fraction ($p &lt; 0.001$) • CPR Coached teams also demonstrated significantly shorter pauses in CPR</td>
<td>For decades, resuscitation science has evidenced the need for quality chest compressions. The implementation of a CPR Coach could have a significant impact on patient outcomes during a cardiac arrest. Outcomes demonstrated in the simulated environment support this statement. This article has a broad context for the improvement of resuscitative efforts. Though limited by a simulation environment with a focus on pediatrics, the CPR Coach remains a well-supported role in medical emergency response teams. Future research could address implications for patient outcomes and further assess the impact on the mental workload of the team leader.</td>
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<td>5. Cheng, A., Kessler, D., Lin, Y., Tofil, N. M., Hunt, E. A., Davidson, J., ... &amp; Duff, J. P. (2019). Influence of cardiopulmonary resuscitation coaching and provider role on perception of cardiopulmonary resuscitation quality during simulated pediatric cardiac arrest. <em>Pediatric Critical Care Medicine</em>, 20(4), e191-e198. doi: 10.1097/PCC.0000000000001871</td>
<td>“Our primary objective was to describe the differences in healthcare providers’ perception of CPR quality in resuscitation teams with and without a CPR coach. Our secondary objective was to describe the impact of provider role (i.e., CPR coach, team leader, airway, and CPR provider) on perception of CPR quality.” (p. e192).</td>
<td>Sample: Teams made up of pediatric intensive care physicians, nurses, advanced practice providers, and respiratory therapists N=41 Teams or 205 Participants *A single team of five participants was excluded because of a technical issue during simulation</td>
<td>Design: Randomized Controlled Trial (Secondary Analysis)</td>
<td>Variables: CPR Coach Role / Perception of CPR Quality</td>
<td>Results:</td>
<td>Implications/Critique: This secondary analysis further builds on the significance of utilizing the CPR coach role in resuscitation efforts. The findings of this study enforce the social psychology phenomenon identified as the Dunning-Krueger Effect. Essentially, this effect occurs when a poor performer continues to perform poorly because of their unawareness of their expertise. The finding of this effect also reinforces the need for quality and data-informed debriefing in both simulation and real-life scenarios.</td>
<td>Comments/Themes: Through the leveraging of the CPR Coach role, teams not only perform better CPR, but also have a more accurate perception of the quality of CPR performed. Specifically, the CPR coach provides the medical emergency response team with the needed focus on CPR quality. A more aware team can not only perform better during the situation, but is also likely to benefit in similar situations in the future.</td>
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<td>Cheng, A., Overly, F., Kessler, D., Nadkami, V. M., Lin, Y., Doan, Q., ... &amp; Charnovich, A. (2015).</td>
<td>&quot;The primary objective was to describe the difference between healthcare providers’ perception of CPR quality versus measured CPR quality. Our secondary objectives were to determine how often healthcare providers’ are accurate in their visual perception of CPR quality and to describe the impact of provider role, JIT training and real-time CPR feedback on healthcare providers’ ability to accurately assess the quality of CPR.&quot; (p. 45).</td>
<td>Sample: Teams made up of pediatric intensive care physicians, nurses, medical students, and residents N=108 Teams or 324 Participants</td>
<td>Design: Randomized Controlled Trial</td>
<td>Variables: Just-In-Time Training &amp; Real-Time Feedback / CPR Quality &amp; Perception of CPR Quality in Relation to Role</td>
<td>Results:</td>
<td>Implications: The findings of this study are consistent with the literature and further reinforce the challenges of accurately gauging the quality of CPR provided, especially in situations lacking a CPR feedback device or a CPR coach. The addition of a CPR feedback device improves the accurate perception of compression depth. Without an accurate understanding of the quality of CPR being delivered, highly trained healthcare professionals will remain at a disadvantage. This study is limited by the simulation environment. Additionally, the study is designed around the pediatric population, but likely holds validity amongst the adult population given the crossover in the provision of CPR.</td>
<td>Comments: Introducing CPR feedback devices into both training and actual CPR events could assist in reducing provider misperceptions. Without an accurate understanding of the quality of CPR being delivered, highly trained healthcare professionals will remain at a disadvantage. This study is limited by the simulation environment. Additionally, the study is designed around the pediatric population, but likely holds validity amongst the adult population given the crossover in the provision of CPR.</td>
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<td>7. Hunt, E. A., Cruz-Eng, H., Bradshaw, J. H., Hodge, M., Bortner, T., Mulvey, C. L., ... &amp; Shilkofski, N. A. (2015). A novel approach to life support training using “action-linked phrases”. <em>Resuscitation</em>, 86, 1-5. <a href="https://doi.org/10.1016/j.resuscitation.2014.10.007">https://doi.org/10.1016/j.resuscitation.2014.10.007</a></td>
<td>“The objectives of this project were to: (1) review existing data to measure whether the intuitive use of Action-Linked Phrases was associated with shorter times to initiation of chest compressions in simulated cardiac arrest scenarios and (2) measure whether a brief educational intervention can increase the likelihood that participants of AHA, BLS or Advanced Cardiovascular Life Support (ACLS) courses will utilize specific Action-Linked Phrases” (p. 2).</td>
<td>Sample: A convenience sample was utilized Phase 1: 68 residents Phase 2: 155 BLS participants and 98 ACLS participants N=321</td>
<td>Design: Mixed Methods: Phase 1: Retrospective Observational Review Phase 2: Quasi-Experimental</td>
<td>Level of Evidence: Phase 1: Level IV Phase 2: Level III</td>
<td>Variables: Brief Training Intervention / Use of Action-Linked Phrases and Initiation of CPR</td>
<td>Instruments: Phase 1: Action-linked phrase use scoring sheets and timing metrics Phase 2: Action-linked phrase use scoring sheets</td>
<td>Through the use of a brief training on action-linked phrases, learners were more likely to use those phrases than those without training. Future studies should examine the decay of learnings over time and seek to validate this finding in clinical practice.</td>
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<td>Hunt, E. A., Duval-Arnould, J. M., Chime, N. O., Jones, K., Rosen, M., Hollingsworth, M., ... &amp; Jung, J. (2017). Integration of in-hospital cardiac arrest contextual curriculum into a basic life support course: A randomized, controlled simulation study. Resuscitation, 114, 127-132. doi:10.1016/j.resuscitation.2017.03.014</td>
<td>“Evaluate learning outcomes of the TradBLS [Traditional Basic Life Support] course compared with a revised course (HospBLS [Hospital Basic Life Support]) amended to include contextually relevant curriculum specific to the hospital environment” (p. 128).</td>
<td>Sample: Teams made up of first-year medical students N=59 Teams or 122 Participants</td>
<td>Design: Randomized Controlled Trial</td>
<td>Variables: Hospital BLS Course / Response to Simulated Cardiac Arrest</td>
<td>Results/ Findings: • In both of the provided scenarios, teams that had taken the hospital-specific BLS course initiated chest compressions faster ($p &lt; 0.001$)</td>
<td>Implications/ Critique: This research demonstrates that although learners in a traditional BLS class are deemed competent to handle an in-hospital cardiac arrest (IHCA), they demonstrate little differentiation in skill from the layperson. Adapting the BLS course to meet the needs of hospital providers may prove to be beneficial. This enhanced course also gave learners a better understanding of teamwork functions during an IHCA.</td>
<td>Comments/ Themes: This article lacks implications regarding direct patient outcomes, the study sample composition is weak, and it lacks additional representation from other healthcare professions. Perhaps findings would look different amongst nurses? Nonetheless, this research seems to support the adaptation of a traditional BLS course to meet the needs of those regularly working in the hospital setting.</td>
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| 9. Hunt, E. A., Duval-Arnould, J. M., Nelson-McMillan, K. L., Bradshaw, J. H., Diener-West, M., Perretta, J. S., & Shilkofski, N. A. (2014). Pediatric resident resuscitation skills improve after “rapid cycle deliberate practice” training. *Resuscitation, 85*(7), 945-951. [https://doi.org/10.1016/j.resuscitation.2014.02.025](https://doi.org/10.1016/j.resuscitation.2014.02.025) | “The objective of this study was to measure if implementation of an intervention, i.e. RCDP [Rapid Cycle Deliberate Practice] curriculum, was associated with: (1) improved performance on key resuscitation quality markers when compared to a baseline cohort from our initial pre-intervention study and (2) a measurable improvement between first and third-year pediatric residents” (p. 946). | Sample: Convenience sample of pediatric residents N=121 | Design: Pretest/Posttest, Quasi-Experimental | Level of Evidence: Level III | Variables: Rapid Cycle Deliberate Practice Simulated Training / BLS Metrics | Results: RCDP learners saw significant improvements in their BLS metrics over those that did not receive the same training:  
- Significantly more likely to administer respirations ($p = 0.004$)  
- Significantly faster at starting chest compressions ($p < 0.002$)  
- Significantly less time spent not performing compressions ($p < 0.001$)  
- Significantly faster to defibrillate ($p = 0.03$)  
- Significantly less pre-shock pause time ($p < 0.001$) | Implications: Through the use of RCDP training methods, significant improvements in BLS quality can be made. However, it remains challenging to determine the decay of learning from this study. Future research should address this concern and incorporate the use of multiple facilities to increase the generalizability of these findings. | Comments: The lack of randomization amongst the sample poses a concern for bias. The pre and post-intervention groups also identify significant differences that may contribute to the successes of those in the post-intervention group. Nonetheless, the contributions of RCDP training seem promising for the improvement of foundational resuscitation skills. |
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<th>Implications/ Critique</th>
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<tr>
<td>10. Lin, Y., Cheng, A., Grant, V. J., Currie, G. R., &amp; Hecker, K. G. (2018). Improving CPR quality with distributed practice and real-time feedback in pediatric healthcare providers – A randomized controlled trial. <em>Resuscitation</em>, 130, 6-12. <a href="https://doi.org/10.1016/j.resuscitation.2018.06.025">https://doi.org/10.1016/j.resuscitation.2018.06.025</a></td>
<td>“In our study, we aim to compare the effect of distributed CPR training with real-time feedback to conventional BLS training in pediatric healthcare providers, and assess retention of CPR over 1 year by mapping the CPR metrics over time for both training methods.” (p. 7).</td>
<td>Sample: Participants were made up of pediatric healthcare providers including: nurses, residents, and respiratory therapists N=87</td>
<td>Design: Randomized Controlled Trial</td>
<td>Level of Evidence: Level II</td>
<td>Variables: CPR Training Method / Retention of CPR quality over one year</td>
<td>Results: • Baseline measurements of CPR quality showed no significant differences between the group receiving standard BLS training and those receiving distributed CPR training with real-time feedback. • At 3 months, the intervention group significantly improved CPR depth (p &lt; 0.001), rate (p &lt; 0.001), and recoil (p &lt; 0.001) with no significant future decay. • At 12 months, the intervention group demonstrated significantly improved guideline compliant CPR depth (p = 0.003), rate (p = 0.003), and recoil (p = 0.002). The proportion of those providing excellent CPR was also significant (p &lt; 0.001).</td>
<td>The provision of distributed CPR trainings over the course of time, and with the addition of real-time feedback, significantly enhances CPR performance when compared with standardized BLS training methods. Furthermore, this study demonstrates not only the ability to improve CPR performance, but to sustain CPR performance. With other literature findings demonstrating rapid skill decay, a method that sustains quality of CPR, potentially having a positive impact on patient outcomes. Future research could look to validate these findings at additional sites and beyond the pediatric simulation environment.</td>
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<td>Setting: Emergency department of Alberta Children’s Hospital</td>
<td>Instruments: CPR data extracted from simulation mannequin</td>
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Despite similar limitations to much of the literature in resuscitation science, this evidence demonstrates the potential to train healthcare professionals in a way that protects against skill decay. This could enhance their performance and delivery of quality CPR, potentially having a positive impact on patient outcomes. Future research could look to validate these findings at additional sites and beyond the pediatric simulation environment.
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<tr>
<td>Mahramus, T. L., Penoyer, D. A., Waterval, E. M., Sole, M. L., &amp; Bowe, E. M. (2016). Two hours of teamwork training improves teamwork in simulated cardiopulmonary arrest events. <em>Clinical Nurse Specialist, 30</em>(5), 284-291. doi:10.1097/NUR.000000000000237</td>
<td>“Assess the effectiveness of a 2-hour multidisciplinary teamwork training program on perceptions of teamwork during simulated codes events for all members of the code team” (p. 285).</td>
<td>A convenience sample of physicians (18), nurses (23) and respiratory therapists (30) regularly responding to cardiac arrest situations N=71</td>
<td>Pretest/Posttest, Quasi-Experimental</td>
<td>Teamwork Training Program / Perceived Teamwork Rating</td>
<td>• Significantly improved ($p &lt; 0.001$) mean TEAM scores and global rating by participants • Significantly improved ($p &lt; 0.001$) mean TEAM scores and global rating by observers</td>
<td>Through the use of brief simulated education focused on teamwork and debriefing, team members involved in various clinical scenarios can be better prepared to function as an interdisciplinary team.</td>
<td>This article not only demonstrates the need for teamwork training for those regularly responding to codes but also identifies that a brief and focused curriculum can be quite useful. A significant limitation to note is how this training impacts patient outcomes.</td>
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Sample: The simulation training center at a large teaching hospital in the southeastern United States
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| 12. Majer, J., Jaguszewski, M. J., Frass, M., Leskiewicz, M., Smereka, J., Ladny, J. R., ... & Szarpak, L. (2019). Does the use of cardiopulmonary resuscitation feedback devices improve the quality of chest compressions performed by doctors? A prospective, randomized, cross-over simulation study. *Cardiology Journal, 26*(5), 529-535. doi: 10.5603/CJ.a2018.0091 | “The aim of this study was to compare the quality of CCs [Chest Compressions] performed unmanaged and using the TrueCPR device during simulated cardiopulmonary resuscitation conducted by trainee doctors” (p. 530). | Sample: A convenience sample of emergency medicine trainee doctors N=65 | Setting: The simulation training center at the Medical University of Warsaw | Design: Prospective, Randomized, Cross-Over Trial | Level of Evidence: Level II | Variables: CPR Feedback Device / Quality of CPR Performed and Confidence | Results/ Findings: 
- Significantly improved ($p < 0.001$) chest compression depth with use of CPR feedback device 
- Significantly improved ($p = 0.002$) chest compression rate with use of CPR feedback device 
- Significantly improved ($p < 0.001$) chest recoil with use of CPR feedback device 
- Significantly improved ($p = 0.024$) confidence in delivery of correct CPR | Implications/ Critique: Through simulation and the use of a CPR feedback device amongst the training of inexperienced physicians, a CPR feedback device proves to be effective in improving chest compression performance. Unfortunately, this study is limited by the use of “trainee doctors” only, limiting generalizability. Furthermore, this occurred in a simulated environment, allowing for control of confounding variables, but limiting generalizability to real cardiac arrest scenarios. The participants were also asked to perform CPR for longer than recommended by the AHA guidelines. | Comments/ Themes: This study demonstrates the viability of a CPR feedback device in improving CPR performance quickly. The trainee doctors in this study had no prior exposure to CPR feedback devices, excluding the ten minutes of time they were provided to read about the device. The simulated environment allows for protection from confounding variables, but limits generalizability in real cardiac arrest scenarios. |
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<td>13. Wagner, M., Bibl, K., Hrdliczka, E., Steinbauer, P., Stiller, M., Grüpel, P., ... &amp; Olischar, M. (2019). Effects of feedback on chest compression quality: A randomized simulation study. <em>Pediatrics</em>, 143(2), 1-9. <a href="https://doi.org/10.1542/peds.2018-2441">https://doi.org/10.1542/peds.2018-2441</a></td>
<td>“We aimed to assess whether visual or verbal feedback by using a feedback device compared with instructor-led feedback would improve CPR performance and quality in an infant and an adolescent manikin during CPR training.” (p. 2).</td>
<td>Sample: A convenience sample of third-year medical students N=653</td>
<td>Design: Randomized Controlled Trial</td>
<td>Variables: Instructor Feedback &amp; Real-Time Visual Feedback / Total Compression Score (Manikin calculated score of CPR quality)</td>
<td>Participants receiving only the instructor feedback performed significantly worse than groups receiving visual feedback or a combination of both visual feedback and instructor feedback (p &lt; 0.001)</td>
<td>In both the training and assessment phases of this study, those receiving visual feedback or a combination of visual and instructor feedback performed significantly higher quality CPR. This study is limited by the recruitment of only third-year medical students, but this also mitigates the bias of experience or expertise. Furthermore, these findings are limited to infant and adolescent manikins. It would be beneficial to validate these findings with an adult manikin, though perhaps not necessary. Still, this study remains limited by the simulation environment.</td>
<td>This study introduces a few interesting ideas for training and skill retention. This study poses an opportunity for daily CPR training with a feedback device to maximize CPR delivery quality. A short training session at the beginning of a shift could enhance the performance of CPR provision later in the shift. This would be an interesting future study opportunity.</td>
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The objective of this study was to evaluate the impact of a targeted training program combined with real-time CPR feedback on chest compression performance in an international cohort of health care providers. 

Setting: Standardized six hour seminar on resuscitation science and optimal CPR performance

Design: Pretest/Posttest, Observational Cohort Study

Level of Evidence: Level IV

Variables: CPR Training Course & CPR Feedback Device / Pre and Post Intervention CPR Quality

Instruments: CPR data extracted from Zoll R-Series Defibrillators

- Percentage of compressions less than 100 per minute decreased significantly ($p = 0.048$)
- Percentage of compressions greater than 120 per minute decreased significantly ($p < 0.001$)
- Percentage of compressions in target range increased significantly ($p < 0.001$)
- Percentage of compressions meeting adequate depth target increased significantly ($p < 0.001$)
- Percentage of compressions meeting both depth and range targets increased significantly ($p < 0.001$)

Though this study fails to control for the testing threat, it gains some strength from the inclusion of multiple hospitals amongst multiple countries. It also remains important to note that the performance of both the pre intervention and post intervention compressions only lasted for a minute each. This brief simulated event is not reflective of the longevity of most resuscitation events. Nonetheless, this study demonstrates that both a CPR focused training and the use of a CPR feedback device can have a significant impact on the quality of compressions delivered.

This study finds strength in the multicultural inclusion of healthcare providers, bringing something to the literature that is not well understood. The use of randomization and a control group could further validate these findings. Future research should seek to address these gaps. Furthermore, this study is reflective of individualized performance. Resuscitation in the hospital setting often incorporates a team. It would be helpful to understand these findings in the context of team performance.
## Literature Theme Identification

### Background
- Poor Outcomes
- Current Training Lacking
- Chaotic Codes
- Meager Teamwork
- Nonadherence to Guidelines

### Methods
- Level II
- Level III or IV
- Superior Teamwork

### Outcomes
- Improved CPR Quality
- Enhanced Satisfaction & Confidence
- Improved CPR Quality

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Appendix C

Triggering Clinical Issue:
Ineffective code team function leading to decreased CPR quality

Is this topic a priority for the organization?  
No  Consider another issue or opportunity
Yes: Increasing code team effectiveness is a priority
Form a Team

Assemble, Appraise, and Synthesize Body of Evidence  
See Appendix A & Pages 8-32

Pilot the Change in Practice:
1. Select outcomes to be achieved:
   Primary: Increase code team effectiveness
   Secondary: Increase CPR quality
2. Collect baseline data: 6-month pre-
   implementation period code team effectiveness
   survey and defibrillator CPR data
3. Design EBP guideline: Appendix D
4. Implement EBP pilot: Inpatient Code Team
5. Evaluate the process and outcomes: 6-month post-implementation period code team
   effectiveness survey and defibrillator CPR data
6. Modify the practice guidelines: To Be
   Determined

Is there a sufficient research base?  
No
Yes

Base Practice on Other
Types of Evidence:  
Conduct Research
1. Case reports
2. Expert opinion
3. Scientific principles
4. Theory

Is change appropriate for adoption in practice?  
No  Yes

Consider alternatives
and redesign

To Be Determined

Integrate and Sustain the Practice Change:
☐ Identify and engage key personnel
☐ Hardwire change into system
☐ Monitor key indicators through quality
   improvement
☐ Reinforce as needed

: A question to make a decision

Figure 2. Iowa model of evidence-based practice applied to the CPR coach role (Iowa
Model Collaborative, 2017)
Appendix D

**CPR Coach Role Description:**
The CPR coach is an assigned member of the cardiac medical emergency response team that provides just-in-time feedback on the provision of CPR by other members of the medical emergency response team. This coach utilizes action-linked phrases to assure that the quality of CPR depth, recoil, and rate are maintained throughout the resuscitation efforts. The coach is also charged with keeping track of the CPR cycle and delivering defibrillation when appropriate.

**CPR Coach Training Objectives:**
1. All members of the medical emergency response team will be trained in the CPR coach role to ensure all members of the team understand the importance of the role.
2. Training will be designed to engrain the shared mental model that the detection and delivery of quality CPR is the role of each team member, despite a focus on the CPR coach role. The utilization of this shared mental model will enhance the culture of feedback.
3. The CPR coach is already proficient in the use of the defibrillator; therefore, training will be focused on understanding the CPR feedback provided by the defibrillator. This training will be provided through a brief video developed by the defibrillator manufacturer.
4. The didactic portion of the training will incorporate the shared mental model, teaching on interpretation of the CPR feedback provided by the defibrillator, and teaching on the use of action-linked phrases developed for the CPR coach role.
5. The simulated training portion will focus on executing these learnings in a team setting through the rapid cycle deliberate practice approach. This training will allow each member of the medical emergency response team to function in the CPR coach role during a simulated cardiac arrest scenario. At the end of each scenario, a short debrief lead by the Nursing Education Specialist will provide the team with feedback on the effectiveness of the CPR coach.

**CPR Coach Action-Linked Phrases:**
3. Situation: *Compression Rate Fast* - say, "Compressions are too fast, slow down.”
4. Situation: *Compression Rate Slow* - say, "Compressions are too slow, speed up.”
5. Situation: *Compression Cycle Ending* – say, “Pause compressions and exchange compressor.”
Figure 3. Team Emergency Assessment Measure (TEAM) survey tool used for the assessment of teamwork and effectiveness (Cooper et al., 2010).
Figure 4. Team Assessment Scale (TAS) survey tool used for the assessment of teamwork (Kiesewetter & Fischer, 2015).