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Basic Life Support (Bls) Knowledge and Skill Retention and Increased Self-Efficacy for Rural Health Care Providers

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Disclaimer

Basic Life Support (BLS) Knowledge and Skill Retention and Increased Self-efficacy for Rural Health Care Providers

Victoria Birkeland

Submitted as Partial Fulfillment for the Doctor of Nursing Practice Degree

Regis University

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Executive Summary

Basic Life Support (BLS) Knowledge and Skill Retention and Increased Self-efficacy for Rural Health Care Providers

Problem

Research indicates retention after BLS training is poor (Bukiran, Erdur, Ozen, & Bozkurt, 2012; Hamilton, 2005; Smith, Gilcreast, & Pierce, 2008). Infrequent exposure and no practice can compound the issue (Allen, Currey, & Considine, 2013; Abella et al. 2005; Hamilton, 2005). Rural healthcare workers – defined as registered nurses (RNs), licensed practical nurses (LPNs), certified nursing assistants (CNAs), and emergency medical technicians (EMTs) – in this investigator's area typically do not practice after BLS recertification. Oermann et al. (2011) demonstrated short monthly practice sessions can help. The problem statement for this project was: In (P) rural health care providers, (I) do simulated cardiac arrest practice sessions, (C) when compared with no practice sessions, (O) improve knowledge and skill retention and enhance self-efficacy?

Purpose

This was an evidence-based project conducted to answer the questions do practice sessions help with knowledge and skill retention and do they enhance self-efficacy. The purpose was to provide an opportunity for the rural health care providers to maintain their BLS skills set.

Goal

The goal was to determine the effects of the practice session by measuring knowledge and skill retention and self-efficacy levels at different intervals – initial, 30 days, and 60 days. Yang et al. (2012) indicate finding an optimal interval for review can help facilities balance resource usage with having a prepared workforce.

Objectives

Objectives included providing opportunities for practice using a simulation manikin; evaluating if an extra practice session made a statistically significant difference on retention and self-efficacy; and determining if participants perceived the extra session as beneficial.

Plan

After conducting a needs assessment and literature review, this investigator designed a pre and post intervention study using four instruments to collect data. Following approval from the hospital administration, the area training director for the American Heart Association (AHA), the authors for free use of their self-efficacy survey and the Institutional Review Board at Regis University, the team implemented the plan and collected the data. This investigator then coded the data and analyzed it using the Statistical Package for the Social Sciences (SPSS) version 22.

Outcomes and Results

Results from this study, which included 48 participants, showed mixed results. Written exam scores decreased, but none of these dropped to baseline. This was statistically significant ($p = .000$), indicating some knowledge retention. Confidence ratings for performing six BLS skills increased and two of these – automated external defibrillator (AED) pad placement and operation – were statistically significance ($p = .000$). Manikin feedback indicated participants from the extra practice session maintained chest compression skills, but not ventilation skills. Manikin feedback also indicated EMTs had scores more consistent with AHA recommendations. EMTs reported more practice and exposure which may account for some of this difference. Small rural facilities may not think they have the resources or the ability to investigate issues and promote evidence-based practice, but this study demonstrates they can by networking and forming collaborative partnerships.

Acknowledgements

This project is dedicated to my dad who helped me through my first nursing program by "quizzing" me and editing my papers; he always encouraged me to do more and now I have.

I offer a sincerest thanks to my mentors Angel Johnson, FNP and Nancy LaChapelle, CNM who patiently guided me, my husband who was willing to discover new talents such as wrestling dust bunnies, a dear friend and fellow EMT Kim Pimperton who has been with me on many other journeys, and my faithful prayer warrior Edna.

I also give thanks to coworkers who rearranged their schedules so I could complete assignments and one in particular – Roxeen Olson – who as my top recruiter and cheerleader.

All of my classmates offered support and I learned from each one, but Ophelia Thomas holds a special place. We met at orientation and she became my rock. Her faith and strength kept me from jumping out of the boat many times.

All of the instructors shared their knowledge so I could succeed– especially my capstone chair Dr. Cullen. Dr. Cullen provided the expertise needed to design and implement this project.

A special thanks to Kelly McKeever and his wife Pam. Without their desire to give back to their community, this project would not have been possible. They provided the simulation manikins and the technical support, which brought this project to the next level.

Finally there are the rural health care workers who participated in the project. Many of them – not working in the hospital – drove great distances on more than on occasion.

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Basic Life Support (BLS) Knowledge and Skill Retention and Increased Self-Efficacy for Rural Health Care Providers

Zaccagnini and White (2011) note Doctor of Nursing Practice (DNP) projects often arise from issues individuals observe in practice, which was the case for this project. This project examined whether simulated practice sessions could improve BLS knowledge and skill retention and enhance self-efficacy for rural health care providers. This investigator identified rural health care providers as both licensed and unlicensed hospital personnel (nurses, certified assistants, and physical therapists) and volunteer emergency medical technicians (EMTs). This project took place at a seven-bed critical access hospital (CAH) located in a sparsely populated area which is classified as frontier (Montana Department of Health & Human Services, [MDHHS, 2011]).

Problem Recognition and Definition

BLS is a non-invasive set of skills for sustaining life. Part of this skill set includes cardiopulmonary resuscitation (CPR). With the goal of improving patient outcomes, CPR has undergone many changes over the last 50 years (American Heart Association, [AHA], 2013). This has included moving the resuscitation sequence from airway, breathing, and circulation (ABC) to circulation, airway, and breathing (CAB), increasing compression rates and depth, and utilizing automated external defibrillators (AHA, 2013). Although countless lives have been saved with CPR, the survival rates from in-hospital cardiac arrests (17% discharge alive) and out-of-hospital arrests (6% discharge alive) remain low (Abella at al. 2005; Field, et al., 2010). Research indicates retention after training is poor (Bukiran, Erdur, Ozen, & Bozkurt, 2012; Hamilton, 2005; Smith, Gilcreast, & Pierce, 2008) and that many individuals do not perform effective CPR (Abella et al.). Infrequent exposure and no practice sessions can compound the problem (Allen, Currey, & Considine, 2013; Abella et al.; Hamilton).

Most rural health care providers in this investigator's area do not practice their skills after completing their annual BLS recertification. This is also a low volume area. Available records revealed ambulance crews responded to about 20 calls a month and in-hospital (over the last two years prior to the start of this project) staff treated approximately 100 cardiac related cases and three cardiac arrests. This investigator had observed problems during both events and renewal courses such as inadequate compressions, ineffective communication and difficulty locating equipment. Some of rural health care providers had expressed angst and a desire to feel more "comfortable" with these types of situations.

Statement of Purpose

The purpose of this study was to provide opportunities for rural health care providers to maintain their BLS skills set. To fulfill this purpose the project team assessed the participants' skill, knowledge, and self-efficacy levels. The participants then took a BLS renewal course for health care providers. Four weeks later half of the participants – randomly selected by hat draw – participated in a practice session. At eight weeks (post-renewal course) participants retested. This investigator then analyzed the data to determine if differences existed between the groups and if the differences were significant. The goal was not to develop new knowledge or to make the study generalizable to other facilities.

Problem Statement

Projects such as this utilize the acronym "PICO" rather than stating a formal research hypothesis. The acronym stands for: Population or Disease (P), Intervention or Issue of Interest (I), Comparison Group or Current Practice (C), and Outcome (O) and is usually framed as a question (Melnyk & Fineout-Overholt, 2005, p. 30). The PICO statement for this project –

- The population (P) was rural health care providers

- The intervention (I) was a simulated cardiac arrest practice session
- The comparison (C) was no practice sessions
- The outcome (O) was improved knowledge and skill retention and enhanced self-efficacy of rural health care providers

Study Questions

The study addressed two questions. "Do simulated practice sessions improve knowledge and skill retention for rural health care providers?" and "Do simulated practice sessions enhance self-efficacy for rural health care providers?"

Significance and Scope

This study was significant because patients deserve high quality care during an arrest. Without it the chance of survival is minimal (Fields et al., 2010; Wallace, Abella, & Becker, 2013) and poor retention can negatively impact performance and self-efficacy (Oermann et al., 2011; Delac, Blazier, Daniel, & N-Wilfong, 2013). This project used a convenience sample of rural health care providers to investigate this issue. These rural health care providers are vital links in a patient's chain of survival; these links can be in-hospital, pre-hospital, or out in the community as a bystander.

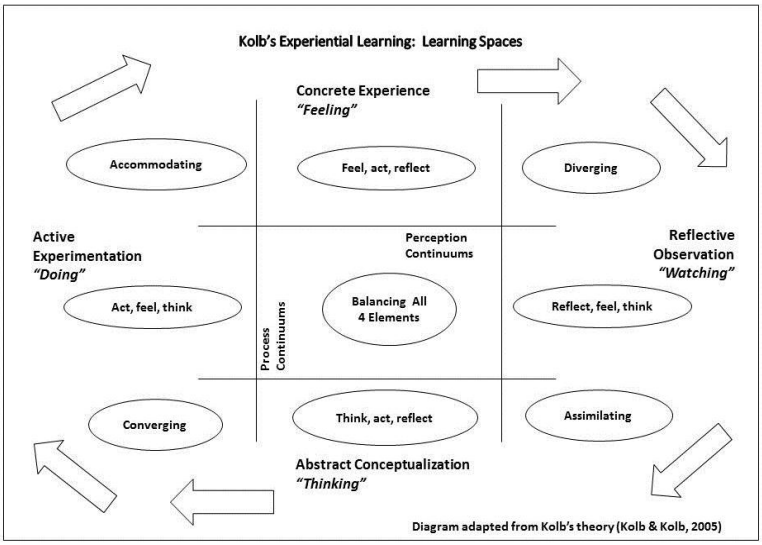
Theoretical Foundations

Two theories formed the foundation for this project – Kolb's Experiential Learning Theory and Covell's Middle-range Theory of Nursing Intellectual Capital. This investigator chose Kolb's Theory as it aligned with the educational interventions in the project. Covell's theory supported investing in staff by building intellectual capital (knowledge and skills).

Kolb proposes the value of using all elements – feeling, thinking, doing, and watching – to learn (Kolb & Kolb, 2005). Two interrelated concepts exist. Learning is a spiral or cycle

where individuals move through different phases such as concrete experience and reflective observation (Kolb & Kolb). The large arrows on the diagram illustrate this concept.

Figure 1 – Kolb's Experiential Learning: Learning Spaces



The other concept is learning spaces (Kolb & Kolb). This is the intersection of two dimensions (perception and process) (Kolb & Kolb). The oval circles on the diagram represent these spaces. Perception is how individuals take information in (feeling or thinking) and process is how they make sense of it (doing or watching). For example, individuals with an accommodating style perceive by feeling and process by doing and prefer hands-on learning. There is balance in the center where all four elements merge. Kolb and Kolb state when learners are within this space enhanced learning occurs, because learners benefit from all of the elements. Using all of these elements, participants in this project could take the knowledge and feedback they received and meld it with their existing knowledge to create change – increased retention and improved skills.

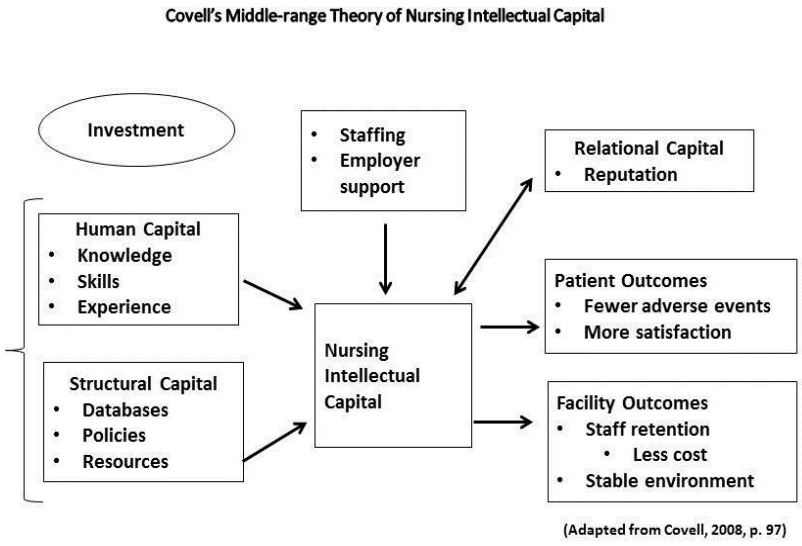
Covell proposes investing in staff through training and development. This investment is important as it contributes to increased satisfaction and decreased turnover (Covell, 2008; Stroth, 2010; Wieck, Dols, & Northam, 2009). That creates stability, which leads to better patient

outcomes (Covell; Stroth). Covell's theory contains several concepts.

The main concept is human capital; this is the knowledge, skills, and experience individuals possess and when they leave an organization this capital leaves with them (Covell). Companies build human capital by investing in training and hiring. Structural capital is the capital within the organization such as policies, resources, and databases (Covell). Relational capital is an organization's reputation (Covell). All three types of capital form intellectual capital, which influences organizational performance (Covell).

When Covell (2008) applies this concept to nursing she uses the two interrelated concepts of human and structural capital and terms it nursing intellectual capital. She further proposes that staffing (supply and mix) and employer support (beliefs and behaviors) exert an influence.

Figure 2 – Covell's Middle-Range Theory of Nursing Intellectual Capital



This theory supported this project because it shows the value in education and the importance of investing in staff even though a facility may need to make financial cuts. Another aspect is relational capital and recruitment. When an organization has an unfavorable reputation, it may be unable to recruit staff and build capital or gain community support.

Review of the Evidence

For the literature review key words used in the search by this investigator included basic life support, BLS, nurs*, retention, simulation, mock code, competence, cardiopulmonary, resuscitation, CPR, and skill. The databases searched include Academic Search Premiere, Cumulative Index for Nursing and Allied Health (CINAHL), MEDLINE, and Cochrane Library. This investigator also viewed a number of websites such as the American Heart Association (AHA), the Centers for Disease Control and Prevention (CDC), Montana Department of Health and Human Services (MDHHS), and Laerdal. The reference lists from a few key articles also provided background (historical) information. After searching through hundreds of abstracts and narrowing searches as outlined in the boxes on the diagram below, the final review included 40 articles and a 2010 consensus statement from the AHA (Fields et al., 2010) (Appendix A).

Figure 3 – Systematic Literature Review Diagram

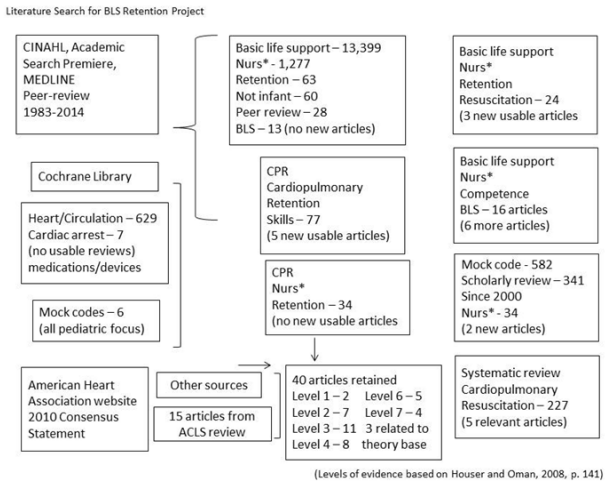


Figure 4 – Levels of Evidence

Seven Levels of Evidence
Level I: Systematic review or meta-analysis
Level II: Well designed randomized control study (RCT)
Level III: Quasi-experimental studies
Level IV: Case control and cohort studies; retrospective
Level V: Systematic review of descriptive or qualitative studies
Level VI: Descriptive or qualitative study; survey
Level VII: Expert or regulatory opinions; reports from expert committees

(Houser & Oman, p. 141, 2011)

Background and Rationale

This investigator found the literature supported what she had experienced in practice. BLS knowledge and skill retention is poor. Bukiran et al. (2012) noted knowledge decreased by six months and even further at 12 months. Hamilton (2005) cited decreases by three months in her review. Also skills decayed faster than knowledge (Smith et al., 2008), but practice and experience (more exposure) could help (Abella, et al., 2005; Delac et al., 2013).

Oermann et al. (2011) reported in their study, with 606 nursing students, monthly six minute sessions had a positive effect and increased self-confidence. Delac et al. (2013) also noted increased self-confidence in their study. Optimal outcomes depend on individuals doing effective CPR. A consensus statement from AHA, based on 411 scientific reviews and 277 topics, noted the importance of compressions in achieving return of spontaneous circulation (ROSC) (Field et al., 2010). Wallace et al. (2013) found in their review, an association between faster rates and deeper compressions and improved survival.

Project Plan and Evaluation

Market/Risk Analysis

An analysis of strengths, weaknesses, opportunities, and threats (SWOT) revealed:

Figure 5 – SWOT Analysis

Strengths: Longevity of staff Previous certification Culture – some staff desire more education and support efforts Convenience local sessions Applicability of using own environment Cross-training of EMTs and CNAs to assist in ER Practitioner support	Opportunities: Laerdal education manager grew up in Fort Benton and wants to give back to his community by loaning us a simulation manikin and providing technical support Grant funding may be available to purchase a manikin for long term use Community partners
Weaknesses: Low patient numbers requiring BLS Cost – limited funds for educational endeavors Uncontrolled variables (e.g., high unit census) Culture – not all staff motivated; mixed morale Physician with disruptive behaviors Poor ER design Inability to purchase a simulation manikin Not all CNAs cross-trained to help Old equipment Nurses may "memorize" information because of repeated practice, but not internalize the information and critically think	Threats: Resuscitation guidelines evolve challenging retention Inability to issue CE units for practice sessions Certification as a CE source is costly Board of Nursing only grants CE units from certified sources Virtual worlds become less expensive and more popular making sessions obsolete Decline in county population

The strengths included previous certification, convenience, and a familiar environment. All of the rural health care providers had successfully passed a BLS course before so a baseline existed. In a study by Madden (2006) they found even though scores decreased, they remained above what individuals scored before taking a course; this would indicate a benefit to having previous certification.

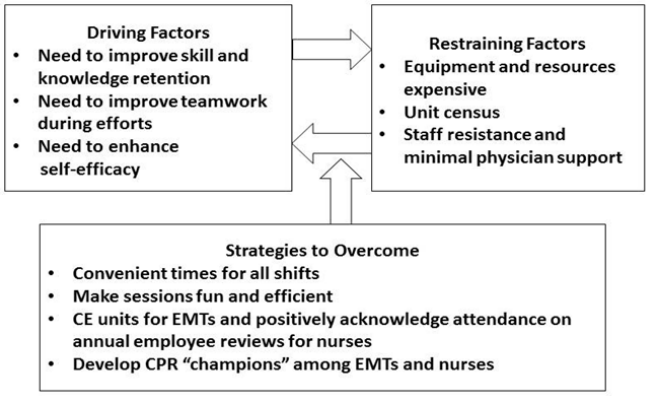
An important opportunity identified in this SWOT analysis was using manikins with feedback. Feedback can help with improving compressions (Yeung et al., 2009; Abella et al., 2005). It is also more precise. Kidd and Kendall (2006) cited this as an advantage as it eliminates observers from having to make difficult judgments on such things as compression depth and ventilation volume. This investigator was able to capitalize on this opportunity, as a Laerdal educator who grew up in the area wanted to give back to his community. He supplied the simulation manikins and technical support for all of the skills testing.

Although the analysis identified the local environment as a weakness if the census was high, this did not occur during the project. This investigator believes conducting the project locally helped minimize attrition as individuals did not have to travel as far. There was some resistance, but the project team took measures to counter it and this is where the driving and restraining forces came into play.

Driving and Restraining Forces

The team used several strategies – timing, efficiency, incentives, and champions – to overcome the restraining forces identified in the diagram below.

Figure 6 – Driving and Restraining Forces



The team offered the renewal courses in the late afternoon and evening so all shifts could attend. These time periods had been well received by staff in the past. Since the practice session and final testing did not take as long as the renewal course, the team tried to schedule participants at times which matched their work schedule, making it easier and more convenient to participate. Scheduled times made the process more efficient as it decreased waiting times and created a more consistent flow of participants for the team to evaluate.

Banks and Trull (2012) developed code blue champions who took responsibility for unit mock codes; these champions helped facilitate enthusiasm and learning among the staff. This study used a related approach by having an LPN and the project team to serve as the champions. They helped generate support by emphasizing CPR skills were not just important for work. What if a spouse or family member collapsed? A participant's knowledge and skills could make a difference in that person's outcome. In addition, the project was about learning a process, which could be used to address other practice issues.

Resources

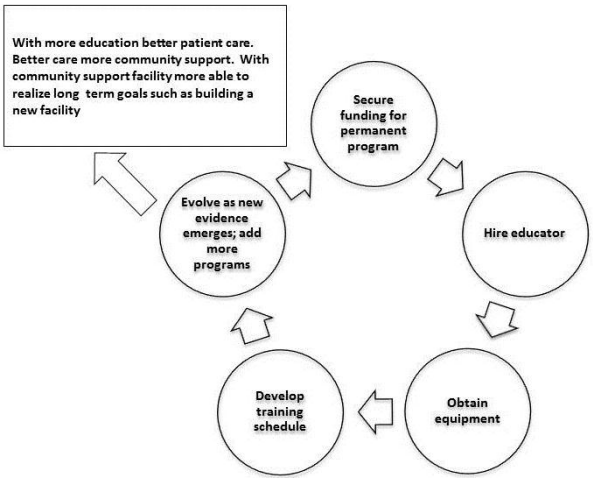
Human resources for this project included this investigator, her mentors, the ambulance manager, Emergency Medical Services (EMS) director, BLS instructors, the Laerdal educator,

and the educator's assistant. All of these individuals donated their time. The educator supplied the simulation manikins and technical support. EMS provided the materials and instructors for the renewal course. Hospital management granted free use of its facility.

Future Sustainability

When deciding whether to invest the time, resources, and energy into a project one must consider sustainability.

Figure 7 – Future Sustainability



This diagram illustrates how the project could become part of a permanent refresher strategy. The director of nursing (DON) can partner with EMS and secure funding through budget adjustments and grants. Once funding is in place they can hire an educator, obtain equipment, develop a training schedule, and build a program. A joint program can strengthen both entities and leads to the next aspect – the stakeholders.

Stakeholders

There were several key stakeholders. The primary ones were the rural health care providers as the project centered on their skill retention and perceived self-efficacy. Patients

were also recognized as key because they would receive the care the rural health care providers delivered. Since both hospital and EMS systems are impacted by the strength of their workforces this made them stakeholders as well. Also there was the community. The hospital is a large employer, exerting an economic influence. Thus it needs to be a stable institution with a good reputation.

Cost/Benefit Analysis

Cardiac arrest is an infrequent, but high stakes event. This requires management strike a balance between having a prepared workforce and the budget (Alspach, 2012; Yang et al., 2012). This investigator proposed the cost to conduct the renewal course at around $3,600 based on the wage rates for staff cited by the United States Department of Labor (2012), the cost for the BLS instructors, and supplies (CPR cards).

The actual cost was less (about $1,400). There were several reasons. Not all of the staff attended the renewal course; the course did not take as many hours as anticipated; the instructors donated their time; and the county issued the CPR cards for free.

Both the estimate and the actual costs included only hospital staff as EMTs serve as unpaid volunteers. The figures also did not include the practice session and the final testing. This investigator did not include these costs because most hospital personnel were scheduled for the sessions at times which matched their work schedule and team members donated their time. This approach aligns with how a facility could conduct practice sessions beyond this project (e.g., at will or by mobile refresher). Niles et al. (2009) brought a cart with a manikin to nurses at the bedside for brief practice sessions in their study and found when nurses participated in these sessions they delivered effective compressions in a shorter time period – 23 seconds versus 67 seconds.

The main benefit is a prepared workforce. This can increase the chances of survival for patients. This investigator believes it is hard to put a price tag on a successful resuscitation; there are a number of variables such as personal beliefs and values, age and quality of life prior to the event, and the neurological outcomes. Another benefit is increased capital – both intellectual and relational and limiting attrition for the facility. Stroth (2010) reports turnover can cost a facility up to two times a nurse's annual salary; this makes the savings from retention substantial.

Rural health care workers are also part of the community, which means they may be bystanders during an arrest and have an opportunity to make a difference. AHA (2013) notes many arrests occur out-of-hospital and in less than half of these cases bystanders initiate CPR. That said the benefits outweigh the cost of the practice sessions.

Mission and Vision

The mission was for the rural health care providers to have the opportunity to retain their BLS knowledge and skills and enhance self-efficacy so that they can deliver high quality care during resuscitations. The vision statement was for the project to serve as a foundation for other educational programs (e.g., ACLS skills refresher or trauma assessments).

Objectives

These were the objectives for the project.

1. Provide practice sessions to enhance skills and retention
2. Provide renewal course
    a. 100% of participants pass course
3. Provide final evaluation sessions at 60 days:
    a. 80% of participants demonstrate skill retention
    b. 90% of participants demonstrate knowledge retention

c. 90% of participants express enhanced self-efficacy

4. Answer both research questions

The team met the objectives and in some cases exceeded them. The objectives are presented in more depth with the findings.

Logic Model

Below is the logic model that guided the project.

Figure 8 – Logic Model

RESOURCES	ACTIVITIES	OUTPUTS	SHORT & LONG-TERM OUTCOMES	IMPACT
What we need to complete the activities:	*These are the activities we will complete to address the problem:*	*Once completed, we expect these activities to produce the following evidence of service delivery:*	*We expect that completed these activities will lead to the following changes: ST (1 year); LT (2-5 years)*	*We expect that completed these activities will lead to the following changes in 5-7 years:*
Secure: IRB approval 4 BLS instructors Participants – Nurses and EMTs (40) Tech support person and manikins; defib trainer; BVMs Written exam, skills check sheet, and survey Statistical software (Excel) Office supplies Meals and hydration BLS instructor pay • 2 practice sessions, 10 minutes long for 40 participants; 2 instructors; 16 hours • 1 practice session, 10 minutes long for 20 participants; 2 instructors; 4 hours • 2 renewal courses for 20 participants; 4 instructors; 40 hours Donations *Counter:* Staff resistance Schedule conflicts *Extraneous variables:* Attrition and "real cases	Acquire BLS test materials Set up the sessions Observers review grading criteria during pre-meeting Step 1 - pre-renewal 40 participants in 10 minute assessment session One observer provides instructions to participant and completes checklist Other observer acts as silent partner. Participants complete BLS multiple choice exam and survey. Step 2 - BLS renewal course; remediation. Participants test, receive card. Half of participants chosen to return in four weeks Step 3 - Randomly chosen participants notified a few days before 4 week practice session;10 minute practice session. Step 4 – At eight weeks 10 minute practice session with all participants; repeat MCE and survey	Three practice sessions for 20 participants; two practice sessions for 40 participants Steps for the participants include • Pre-renewal practice • Renewal course • 4 week practice • 8 week practice All participants possess CPR renewal card Quantitative data on skill and knowledge retention at three different time points • Recertification time to baseline about 1 year • Baseline to 4 weeks • Baseline to 8 weeks 40 self-efficacy surveys before intervention and after CE certificates for EMTs and positive feedback for annual nursing reviews; experiential learning occurs	*Short term:* Facility adopts a skill refresher program Participants increase skill and knowledge retention from baseline levels Participants express enhanced self-efficacy for resuscitative situations CNAs consistently assist nurses in ER *Long term:* Increase patient satisfaction and outcomes More seamless transitions between prehospital, hospital, and regional care Nurses remain at facility CNAs remain at facility Stronger relationships between licensed staff and certified assistants Stronger relationships between hospital staff and prehospital personnel Facility implements other evidenced based practices	Positive impact on facility morale – "team spirit" Positive impact on facility finances – staff retention Positive impact on facility image – good patient care Facility engages in more research projects Facility develops an education department Nursing intellectual capital increases

(Model design from Kellogg, 2004, p. 54)

The project team completed all of the outputs – over 40 individuals participated, four stages completed, and EMTs received continuing education units (CEUs). The next step is for the facility's leadership to adopt a refresher strategy (short term goal), which they can do by using the results of this project. The leadership can then move to some of the long term goals such as

conducting other projects to address practice issues, developing an educational program, and tracking staff satisfaction and retention.

Population

This facility, located in a frontier county, is a 7-bed Critical Access Hospital (CAH) with two emergency room beds and a 45-bed long term care. On average this facility employs 16 licensed nurses (this includes a DON and assistant DON), 25 CNAs, and four individuals in physical therapy. EMS utilizes volunteer EMTs; there are approximately 30 if one includes the Quick Response Unit (QRU) members in the surrounding areas. This resulted in a rural health care provider population of about 75 individuals.

Individuals in this area often function in more than one role. This means they can be a critical link in a patient's chain of survival in the hospital, out in the field as an EMT, or in the community as a bystander. When events occur responses are multidisciplinary and can include anyone working in the facility plus prehospital personnel if the patient arrives by ambulance.

Sample

This investigator recruited a sample of volunteers from the population by disseminating information through word-of-mouth, e-mails, and flyers and by giving a presentation at an EMT refresher course, making this a convenience sample. Out of 53 individuals who signed-up for the study 48 participated (20 prehospital; 28 hospital). The only exclusion was age – no one under age 18. That said, no one working at the facility or in EMS met the exclusion criteria.

Human Subject Implications/Protection

To fully protect participants, this investigator obtained exempt status through the Regis University Institutional Review Board (IRB), as this was a project in a commonly accepted educational setting, involving normal educational practices (Appendix B). All participants

received a detailed information sheet about the study (Appendix C). The hospital DON and the Chouteau County EMS AHA Training Center Coordinator granted permission to conduct the study and use AHA resources (Appendix D & Appendix E). No IRB involvement existed with either of these entities. This investigator completed the CITI course on 11/25/12 – reference number #9202503A (Appendix F). Data remained in sealed envelopes and locked at public health when not in used by this investigator. Although this was an educational intervention and the risk to participants was minimal, testing inherently produces some stress. A critical stress debriefing counselor was available, but she was not needed; none of the participants exhibited or expressed problems.

Benefits for the participants included an opportunity to practice and renew their CPR card. The EMTs received CEUs. Nurses could not receive CEUs (nursing board restrictions), but they did receive an acknowledgment.

Methodology

This study which included a pre-test, intervention, and post-test aligns with what Terry (2012) calls a quasi-experimental study, making it quantitative. This investigator chose this design because it allowed for the type of statistical analysis (t tests and analysis of variance) that could answer the questions posed. This design also supported the theoretical underpinnings of the study – Kolb's Experiential Learning. Kolb's theory proposes the value of using all elements – feeling, thinking, and watching – to learn (Kolb & Kolb, 2005). Participants could experience all of these elements through testing, practice, and participatory feedback (self-efficacy survey).

There were four stages. Stage 1 (initial evaluation) gathered data from the participants on knowledge, skills, self-efficacy, and demographics. Stage 2 was the health care provider BLS renewal course. This brought all of the participants up to an established standard on knowledge

and skills. Stage 3 (30 days post renewal course) was a 10 minute practice session using about half of the participants – randomly selected by hat draw. Stage 4 (60 days post renewal course) was a final evaluation (repeat of Stage 1); this session provided a comparison (Appendix G).

Reliability, Validity, and Data Collection

This investigator used Laerdal resuscitation manikins with computerized feedback and recommendations from the AHA; these are well-established instruments, which have been used in many other studies. The written exam included 25 multiple-choice questions; passing score for the exam was 84%. The participants performed their skills on the manikin using the adult one and two rescuer BLS CPR scenario and an AED. They had a silent partner – BLS instructor – who correctly followed all directions given by the participants. Silent partners did not prompt. Guidelines for the skills included a compression rate of at least 100/min, compression depth of at least 50 mm, and ventilation volumes between 500 ml to 600 ml. Kidd and Kendall (2006) noted simulation manikins allow for more objective evaluations. Yeung et al. (2009) found feedback improved learning and retention.

The self-efficacy survey, which used a 5-point Likert scale, was designed by this investigator based on other two other surveys with proven reliability and validity – Schwarzer's General Use Survey and Roh, Issenberg, Chung, and Kim's Resuscitation Self-efficacy Survey (Schwarzer, 2011; Schwarzer & Jerusalem, 1995; Roh, Issenberg, Chung, & Kim, 2012). These types of surveys have shown high internal consistencies (0.85 – .091) (Schwarzer; Roh et al.); they have also been represented as interval level data.

Descriptive and Inferential Statistics

The testing produced nominal level data from the nine question demographics survey (Appendix H), interval level data from the six question and eight question self-efficacy surveys

(initial and post) (Appendix I), and ratio level data from the written exam and the computerized manikin feedback. This investigator used the Statistical Package for the Social Sciences (SPSS) Version 22 to analyze the data. This analysis included both descriptive and inferential statistics – frequencies, central tendency, paired samples t- tests, and analysis of variance (ANOVA).

Project Findings

Out of 53 rural health care providers the project team recruited, 48 participated (90.5%). At the 30 day extra practice session 20 out of 23 randomly chosen participated (86.9%), and at the 60 day final test 41 out of 48 participants returned (85.4%). Out of the 41, 39 completed the skills – two could not for medical reasons. Below are the results from those sessions. Effect size is included with the results if indicated. This investigator set confidence intervals (CI) at 95% and used a p value of < 0.05 for significance, as these are standard parameters.

Tests and Analysis on Demographics

The project team gathered data on the participants from the demographic questionnaire. A descriptive analysis revealed the following –

- Gender: 42.6% male; 57.4% female
- Work environment: 41.3% prehospital; 58.7% hospital
- Age: 70.2% age 40 and older
- Highest education level: 48.9% high school; 51.1% $\geq$ 2 years college
- Years in health care: 80.9% $\geq$ 6 years; out of those 27.7% > 20 years
- Last CPR renewal: 72.9% > 6 months
- Practice since last CPR class: 68.1% none
- Skills used since last CPR class: 72.3% none

Two cross-tabulations offered additional insight – BLS usage and work environment and BLS

practice and work environment. The cross-tabulation for BLS usage and work environment showed 42.1% of EMTs used their skills at least once since their last class versus only 18.5% of hospital workers. This finding may reflect the conditions each group operates under. On the ambulance two EMTs respond and both perform skills whereas in the hospital there is more staff. Not all workers may need to use their skills. Although interesting, this did not reach significance ($p = .159$ and chi square = 6.586). The cross-tabulation on BLS practice and work environment did ($p = .031$ and chi square = 6.963). These findings revealed 52.6% of the EMTs practiced at least once since their last class versus 18.5% of the hospital personnel. These results may also reflect environment. EMTs participate in annual refreshers and assist with scenarios that train new EMTs. The hospital typically does not hold practice sessions. That said overall rural health care providers do not have much exposure, which aligns with a basic premise of the study.

Tests and Analysis on Self-Efficacy Survey

Participants completed self-efficacy surveys at the beginning and at the end of the study. The surveys asked participants to rate how confident they were in their ability to perform six BLS skills (e.g., apply automatic external defibrillator [AED] pads) on a 5-point Likert scale. The final survey contained the same six questions plus two others for those who had participated in the 30 day extra practice.

Descriptive statistics on the first survey showed the highest frequencies for extremely confident were on recognizing unresponsiveness (46.8%) and absence of breathing or abnormal breathing (42.6%); the areas with the lowest frequencies of extremely confident were AED pad placement (23.4%) and AED operation (17.0%).

A paired-samples t-test which compared the two surveys (pre and post intervention) reached significance on two of the questions – correct AED pad placement and AED operation.

The final survey mean on AED pad placement was higher (4.0526) than the first survey mean (3.4737). Mean difference was -.57895; t = -3.883; p = .000; CI is -.88108 to -.27681; Cohen's d = .541 (moderate effect). The final survey mean on AED operation was higher (4.0526) than the first survey mean (3.4474). The mean difference was -.60526; t = -4.209; p = .000; Cohen's d = .638 (moderate effect). .

A one way ANOVA on the initial self-efficacy survey revealed no statistical significance between the two work environments. On the final survey significant differences existed. EMTs rated themselves more confident on four skills (Table 1.1)

Skill	Mean	Std. Deviation	CI	Mean Square		F	Sig.
Ventilations							
Prehospital 16	4.3750	.80623	3.9454 to 4.8046	Between group	5.054	5.899	.020
Hospital 22	3.6364	1.00216	3.1920 to 4.0807	Within group	.857		
Compressions							
Prehospital 16	4.5000	.89443	4.0234 to 4.9766	Between group	6.909	8.000	.008
Hospital 22	3.6364	.95346	3.2136 to 4.0591	Within group	.864		
AED pad							
Prehospital 16	4.4375	.81394	4.0038 to 4.8712	Between group	4.094	6.192	.018
Hospital 22	3.7727	.81251	3.4125 to 4.1330	Within group	.661		
AED operation							
Prehospital 16	4.4375	.81394	4.0038 to 4.8712	Between group	4.094	5.712	.022
Hospital 22	3.7727	.86914	3.3874 to 4.1581	Within group	.717		
Retention	Mean	Std. Deviation	CI	Mean Square		F	Sig.
Skill							
Prehospital 12	4.3333	.77850	3.8387 to 4.8280	Between group	6.761	7.436	.011
Hospital 17	3.3529	1.05719	2.8094 to 3.8965	Within group	.909		
Knowledge							
Prehospital 12	4.1667	.83485	3.6362 to 4.6971	Between group	4.658	4.922	.035
Hospital 17	3.3529	1.05719	2.8094 to 3.8965	Within group	.946		

(Table 1.1 – One way ANOVA results for work environment and post self-efficacy survey)

EMTs also rated the practice session as more beneficial and that the session helped more with skill retention than knowledge retention. Hospital workers did not perceive a difference. It is critical to note the results from the two extra questions were skewed as 29 individuals responded, but only 20 participated. Thus, conclusions are not valid. This investigator believes the results are not without merit. They would seem to indicate – at least on some level – participants viewed the experience as positive though not specific to an extra practice session. This was a design

flaw by this investigator. A better design, which may have eliminated confusion, would have been for this investigator to only provide a survey with the extra questions to the 30 day group. All of the rural health care providers reported enhanced self-efficacy on the final survey meeting Objective 3c (90% of participants would express enhanced self-efficacy).

Tests and Analysis on Written Exam (Knowledge)

Participants took the written exam in Stage 1 (initial) and Stage 4 (post-intervention). The descriptive analysis revealed 10% of participants scored ≥84% on the initial exam and the scores ranged from 28% to 88% with a mode of 68%. AHA designates 84% as passing. Results on the final exam (post-intervention) showed 29% of participants scored ≥84% and the scores ranged from 56% to 92% with a mode of 80%. A paired t-test revealed this difference reached significance. The final exam mean was higher 76.9756) than the initial mean (67.0244); mean difference was -9.95122; t = -6.583; p = .000; CI -13.00653 to -6.89591; correlation .555; Cohen's d = .995 (large effect). These results show even with a drop from course scores, final scores remained above initial scores and this was true for all participants, indicating knowledge retention. This met Objective 3b (90% of participants would demonstrate knowledge retention.

Tests and Analysis on Computerized Manikin Feedback (Skills)

The manikins provided computerized feedback on the compressions and ventilations participants delivered at the three time periods – initial evaluation, 30 day randomized extra practice, and 60 day final evaluation. According to the AHA 2010 CPR guidelines for adults, providers should deliver at least 100 compressions per minute at least two inches deep (50 mm) and ventilate at 500 ml to 600 ml per breath – visual chest rise (Fields et al., 2010). The means reveal the participants only met the guidelines for rate. Means decreased at 30 days on all three variables. At 60 days all three means showed some rebound. That said one must consider the

variability with ventilations and interpret this finding with caution.

Table 1.2 shows the descriptive statistics for the three variables – at the three time points.

	Avg. Compress Base	Avg. Compress 30 day	Avg. Compress 60 day	Avg. Depth Base	Avg. Depth 30 day	Avg. Depth 60 day	Avg. Vent Volume Base	Avg. Vent Volume 30 day	Avg. Vent Volume 60 day
N	48	20	39	48	20	39	46	20	39
Mean	110.333	108.300	124.512	47.062	40.800	45.564	411.913	295.500	299.641
Median	111.500	112.500	124.000	48.000	44.000	46.00	399.500	341.000	280.000
Mode	102.00	122.00	126.00	37.00	36.00	46.00	.00	.00	.00
Std. Deviation	20.527	26.456	17.930	9.746	10.013	8.872	221.706	250.091	201.993

(Table 1.2 – Descriptive statistics for skills)

Table 1.3 shows a series of paired sample t-tests, which offers more insight into the differences.

Baseline to 30 day	Mean	Std. Deviation	CI	t	df	Sig.
Avg. Compress Base Avg. Compress 30 d	-2.8000	23.36574	-13.73550 to 8.13550	-.536	19	.598
Avg. Depth Base Avg. Depth 30 d	3.40000	9.31552	-.95980 to 7.75980	1.632	19	.119
Avg. Vent Volume Base Avg. Vent Volume 30 d	92.50000	187.70259	4.65248 to 180.34752	2.204	19	.040
30 day to 60 day	Mean	Std. Deviation	CI	t	df	Sig.
Avg. Compress 30 d Avg. Compress 60 d	-18.0000	24.74537	-29.926689 to -6.07311	-3.171	18	.005
Avg. Depth 30 d Avg. Depth 60 d	-5.26316	7.34728	-8.80443 to -1.72188	-3.122	18	.006
Avg. Vent Volume 30 d Avg. Vent Volume 60 d	21.26316	211.49832	-80.67577 to 123.20208	.438	18	.666
Baseline to 60 day	Mean	Std. Deviation	CI	t	df	Sig.
Avg. Compress Base Avg. Compress 60 d	-13.35897	19.66628	-19.73404 to -6.98390	-4.242	38	.000
Avg. Depth Base Avg. Depth 60 d	1.89744	9.05769	-1.03873 to 4.83360	1.308	38	.199
Avg. Vent Volume Base Avg. Vent Volume 60 d	109.83784	207.16493	4076561 to 178.91006	3.225	36	.003

(Table 1.3 – Paired samples t-test for skills)

On the initial to 30 day results only ventilation volume showed significance. The initial mean was higher (388.000) than the 30 day mean (295.500); the mean difference was 92.500; t =

2.204; p = .040; CI is 4.65248 to 180.34752; correlation .664; Cohen's d = .434 which shows a small to medium effect. Although the other two variables did not reach significance, the initial means were closer to the recommendations, indicating skills decayed in this sample of providers.

The 30 day to 60 day results showed significance for both compression rate and depth. The rate mean was higher (126.4737) at 60 days than at 30 days (108.4737); the mean difference was -18.00; t = -3.171; p = .005; CI is -29.926689 to -6.07311; correlation .474; Cohen's d = .611 (moderate effect). The depth mean was also higher (46.3158) at 60 days than at 30 days (41.0526). Mean difference -5.26316; t = -3.122; CI is -8.80443 to -1.72188; p = .006; correlation .729; Cohen's d = .542 (moderate effect). Although ventilations decreased slightly, this finding did not show significance indicating perhaps a "leveling off" or maintenance. Overall findings show the extra practice session was associated with retention in this sample.

The initial to 60 day data reflects the whole group and showed significance for two variables – compression rate and ventilation volume. The compression rate mean was higher (124.5128) at 60 days than at baseline (111.1538). Mean difference was -13.35897; t = -4.242; p = .000; CI is -19.73404 to -6.98390; correlation .423; Cohen's d = .739 (moderate effect); ventilation volume mean was lower (278.2973) at 60 days than at baseline (388.1351). Mean difference 109.83784; t = 3.225; p = .003; CI is 40.76561 to 178.91006; correlation .492; Cohen's d = .542 (moderate effect).

Results indicate the participants had an increase in their rate of compressions, but had a slight decrease with compression depth. Intuitively this makes sense as fatigue could be a factor. Ventilation volume also reached significance, but for a decrease as it had with the randomized group at 30 days. Although it is optimal for individuals to perform all CPR skills according to AHA's standards, studies indicate compression rates and depth are key in ROSC and this reflects

AHA's shift to emphasizing harder and faster compressions and compression only CPR for lay responders (Fields et al., 2010). That said results from this study indicate practice was associated with retention on these two key skills meeting Objective 3a.

This investigator explored the differences between practice environments in more depth as the demographic survey revealed EMTs practiced more , the self-efficacy survey indicated they perceived themselves as more confident, and these differences relate to the questions the study addressed. Table 1.4 shows the means for the two groups on the three variables at the three time points.

	Initial		30 day		60 day	
Avg. Compress	EMS 19	116.36	EMS 5	121.60	EMS 16	126.00
	Hospital 27	106.11	Hospital 15	103.86	Hospital 22	123.63
Avg. Depth	EMS 19	52.78	EMS 5	44.20	EMS 16	50.06
	Hospital 27	43.18	Hospital 15	39.66	Hospital 22	43.31
Avg. Vent Volume	EMS 17	502.70	EMS 5	485.80	EMS 16	390.25
	Hospital 27	345.77	Hospital 15	232.06	Hospital 22	217.72

(Table 1.4 – Mean comparisons between prehospital [EMS] and hospital)

An independent t-test revealed significance at a number of points. On the initial evaluations the differences between compression depth and ventilation volume reached significance – $p = .001$ for depth and $p = .022$ for ventilation. At 30 days only ventilation volume reached significance and $p = .046$. Then at 60 days differences between compression depth and ventilation volume again reached significance ($p = .010$ for depth and $p = .008$ for ventilation). These differences could reflect training as noted earlier. Another factor could be gender. When this investigator examined the results relative to gender findings were similar. EMS has more males than the hospital. The effect of gender has been noted in the literature. Verplancke et al. (2008) surmised it might relate to more body weight and muscle mass.

Summary of Interpretations

The rural health care providers in this study did not have much exposure to actual cases

(72.3%) and many did not participate in practice sessions (68.1%) since their last renewal course which was greater than six months for most. This confirmed a basic premise of the study. EMTs experienced more actual cases, but this did not reach significance. It did for practicing and $p = .031$. Differences in policies may account for this. EMTs attend a refresher course in addition to their BLS recertification and often help train new EMTs; the hospital does not hold refreshers.

The initial self-efficacy survey did not reveal any statistical differences between the two work environments. On the final survey EMTs rated themselves as more confident on four skills – compression, ventilations, AED pad placement, and AED operation and this difference reached statistical significance. This is an important consideration as confidence can influence actions. EMTs also rated the extra practice as more beneficial, but as noted earlier this result was skewed. Nonetheless, it is worth noting as it indicates – at least on some level – participants viewed the experience as positive and were eager to respond.

On the written exam, which reflected knowledge retention only 29.3% of the participants maintained a passing score (≥ 84%) 60 days after the renewal course. That said the post mean was significantly higher ($p = .000$) than the initial; it showed a strong effect (Cohen's $d = .995$) indicating knowledge retention. Another interesting finding was the mode; it moved from 68% to 80% indicating even if individuals did not meet the passing mark many were close.

The manikin feedback indicated the 30 day extra practice session was associated with maintaining compression skills for these rural health care providers. A consensus statement from AHA, based on 411 scientific reviews and 277 topics, notes the importance of compressions in achieving ROSC (Field et al., 2010). Wallace et al. (2013) found in their review, an association between faster rates and deeper compressions and improved survival. EMTs also demonstrated skill levels closer to the AHA recommendations and this reach significance.

The results from this study support findings from other studies which note a positive association with practice sessions, increased self-confidence, and skill retention (Abella, et al., 2005; Oermann et al. 2011; Delac et al., 2013). This study also answered the PICO questions – do practice sessions help with knowledge and skill retention and do they increase self-efficacy.

- In this sample of rural health care providers data indicates practice was associated with retaining knowledge and compression skills, but not with delivering ventilations.
- In this sample of rural health care providers data indicates practice was associated with an increase in self-efficacy though not specific to the 30 day extra session. This effect was more statistically significant for EMTs. Self-efficacy levels for AED pad placement and AED operation saw the most change and this reached significance.

Limitations

This was a convenience sample, which according to Polit (2010) means bias can exist, making the study not generalizable. According to the results from an online statistical calculator (Al-Therapy, 2014) this sample achieved adequate power (.80) for a paired-samples t-test with more than 34 participants on the self-efficacy survey and written exam, but was under powered (.05 – .06) with the 30 day skill comparison (20 participants).

Another limitation could be the Hawthorne effect on the self-efficacy survey as this is a small area where individuals are well acquainted. To counter this effect, this investigator had her mentor and assistants provide participants their testing packets. She does not believe this effect occurred, but it should be noted. There is also a possibility participants became test wise since the study used repeated measures; this would skew results. Inadvertent practice through work exposure could also exert an influence, but this investigator is not aware of any resuscitation situations during the study.

There is one event worth noting. Shortly after the participants completed the initial testing, took the renewal course, and recertified, state inspectors surveyed the facility – nursing home section. One of the first requests by the survey team was documentation showing current CPR certification. This reinforced the value of having a prepared workforce.

Recommendations

Facilities can set up manikins so individuals can practice at will or have rolling refreshers similar to what Niles and colleagues (2009) noted in their study. Approaches like this can minimize time and money as they require fewer resources and they are incorporated into the work day, making them convenient. Grants exist for purchasing the manikins and this investigator would recommend the DON partner with EMS and pursue this option. Partnerships can increase buying power, strengthen both work forces, and extend resources (flexibility with cross-training).

Another important aspect is the process. Rural health care workers may not think they have the resources or ability to investigate issues and promote evidence-based practice, but this study demonstrates they can. This investigator views this project as a starting point rather than an end point and would encourage the DON to build on this experience and establish a practice committee to investigate and address other issues.

Implications for Practice

This project was significant because patients deserve high quality care during a cardiac arrest. Without it the chance of survival is minimal (Fields et al., 2010; Wallace et al., 2013). Delivering high quality care requires skill and knowledge. When individuals have poor skill retention it can negatively impact performance and self-efficacy (Oermann et al., 2011; Delac et al., 2013).

Yang et al. (2012) note finding an optimal interval for review is important as it allows facilities to balance resource usage, while having a prepared workforce. This is important for facilities when facing budget constraints.

Skill maintenance and enhanced self-efficacy can build human and relational capital. This capital can influence a facility's turnover rate and impact how a community perceives the facility. If this perception is unfavorable the community may not want to invest in a facility and this can have economic ramifications. The cost to replicate this study will depend on a number of factors such as what resources a facility has and whether they pay staff to attend. Appendix J (Budget and Resources) provides an outline on the cost.

Summary

Findings from this study hold importance for this investigator's practice area as resources are limited, but the workforce must be prepared; patients deserve optimal care. This study added to the body of knowledge available, confirmed findings from previous studies, and answered the research questions posed. Results indicated practice sessions can be beneficial and this is an important consideration as research reveals knowledge and skills decay shortly after training and good CPR skills are essential for optimal outcomes. Although there were limitations, this study demonstrates a small rural facility can conduct a study to address practice issues with minimal expense. Additional studies in this population would be beneficial to compare and explore various methods for increasing retention and maintaining skill levels.

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Appendix A

Article/Journal (1 & 2)	Annual resuscitation competency assessments: A review of the evidence. *Australian Critical Care, 26,* 12-17	Resuscitating competence in advanced life support. *Critical Care Nurse, 32*(3), 10-12
Author/Year	Allen, J. A., Currey, J., & Considine, J. (2013)	Alspach, J. G. (2012)
Database/Keywords	Discovered while looking for another article	CINAHL; Academic Search Premier Advance* cardiac life support; ACLS
Research Design	Literature review	Editorial
Level of Evidence	Level IV	Level VII
Study Aim/Purpose	Review evidence for annual assessment of resuscitation knowledge and skills and efficacy of training practices	Discussion highlighting the persistent problem of retaining resuscitation skills and knowledge and the lack of improving outcomes (survival to discharge rates)
Population/Sample Size Criteria/Power	Not stated but the reference table includes 57 listings	Not applicable
Methods/Study Appraisal Synthesis Methods	Researchers conducted a search of MEDLINE and CINAHL using the key words resuscitation, advanced life support, assessment, cardiac arrest, in-hospital cardiac arrest, competence, training, ALS, ACLS, course, and competency. They limited the search to full test articles in English, within the last 10 years. Further, they used the International Liaison Committee on Resuscitation (ILCOR worksheets to identify additional literature not reveal in the search.	Author discusses the issue within the context of a systematic review performed by Yang et al. (2012). Highlights key points from the Yang et al. review.
Primary Outcome Measures/Results	Written exam performance correlates poorly with resuscitation skills. Knowledge declines between 6 to 12 months. The 2010 guidelines recommend regular retraining but do not indicate a time frame. Online or multi-media methods may provide a cost-effective method for delivering refreshers. Regular short practice sessions in a simulation setting have resulted in competence at 6 months. There is a lack of evidence to support one type of simulation method over another. Simulation does provide an opportunity to practice some non-technical skills such as leadership, communication, and teamwork.	Key points noted include – Most studies used multiple choice exam and cardiac arrest simulation to assess retention. Interval to assess retention ranged from 6 weeks to 2 years, although most occurred at 6 months or 1 year. Skills decayed faster than knowledge. Erosion appeared steepest within the 6 month to 12 month window. The degree of decay varied – 3% in knowledge at 6 months to 86% in performance at 12 months. None of the studies viewed as good – most rated fair.

Conclusions/Implications	In the search, researchers found little evidence that supports the usefulness of annual competency assessments. This would then suggest the process represents a poor use of time and resources with no clear indication of improved patient outcomes. Frequent and regular review and practice sessions are more strongly supported in the literature. This approach needs to be explored more. Clinical experience is helpful, but is an unreliable method for maintaining competency.	Author believes that if adding detailed algorithms, computer-based learning, and high tech simulation has not improved retention implement other approaches. She advocates developing muscle memory – the automaticity. Rethink volume and complexity – concentrate on what contributes to survival. Consider more frequent, smaller practice segments versus all every two years and different alternatives (e.g., online and simulation). Recertify skills more often than knowledge to address the different rates. Focus remediation on the problem areas. Design studies to discern the time frames for skill and knowledge decay.
Strengths/Limitations	Did not discuss the specifics of the review. Search limits may have excluded relevant evidence.	Author has conducted her own research on the topic. Article discusses a key systematic review. Even though a good discussion, it is still a discussion versus an actual study.
Funding Source	None noted	None noted
Comments	Although the review is conducted within the context of Australian critical care nurses, the articles are relevant to the topic. Further, it offers some additional points to consider for long term planning after the project.	Although not a study, the author raises some good points. Further, the article served as part of the impetus for my project as it highlighted problems observed in practice.
Article/Journal (3 & 4)	Optimizing patient resuscitation outcomes with simulation. *Nursing2012, 42*,60-61	CPR performance counts: Quality improves survival. *Journal of Emergency Medical Services*
Author/Year	Banks, D., & Trull, K. (2012)	Bobrow, B., Leary, M., Heightman, A. J. (2011)
Database/Keywords	CINAHL; Academic Search Premier Advance* cardiac life support, ACLS	Found from a reference in another paper
Research Design	Not stated – descriptive?	Monograph of several articles that cite a number of studies
Level of Evidence	Level VI	Unsure – varying levels of evidence within document
Study Aim/Purpose	Optimize outcomes with simulation	Optimize CPR
Population/Sample Size Criteria/Power	214 cardiopulmonary arrests	Varied
Methods/Study Appraisal Synthesis Methods	Through informal interview the code blue team identified a need to improve the response to events –	Full range of methods– surveys to control studies

	early activation, AED use, communication, coordination, and teamwork. They developed code blue simulation classes and used Kolb's experiential learning as a framework.	
Primary Outcome Measures/Results	68 code blue "champions" have been educated and 22 out of 40 units doing mock codes. During 2010 the units conducted 236 mock codes and experienced 214 actual arrests. Of these patients, 74% had ROSC compared to national level of 44% and 33% survived to discharge (national rate of 17%).	Quality CPR key; quality CPR equals correct depth and rate with minimal interruptions. This improves the odds of survival; better cerebral perfusion; better response to defibrillation. Perception of responders differs from reality. Ways to ensure congruency include frequent practice and training; concurrent monitoring; and retrospective review/debriefings. Need collaborative effort and strong medical director involvement.
Conclusions/Implications	The numbers would indicate improvements.	Improvement possible; need strong program.
Strengths/Limitations	Although the numbers indicate improvements, there are no specifics or statistical analysis presented. Further the rates are compared to national levels versus what they were prior to implementing the training.	Multiple studies included in this monograph. Although some of the articles cite rural areas, not sure how well some of the information translates to a frontier setting.
Funding Source	None noted	Different studies supported through different entities – Laerdal, CPR improvement association
Comments	Although the facility in this report opted not to teach ACLS and focus on patient management prior to the code team arrival, it provides good background. Further, the program sounds similar to one by Brown, Latimer-Heeter, Marinelli, Rex, and Reynolds in 1995. Also some of the points such as inefficient code management and limited exposure correlate to the facility in my project and the theoretical underpinnings are the same – Kolb. This program also aligns with points Alspach (2012) makes and it offers a possible long term approach (post project).	Some of this is "expert opinion" but overall good background or foundation for the project, as it concurs with the major aspects – Frequent training Knowledge and skill retention Self-efficacy
Article/Journal (5 & 6)	The first 3 minutes: Code preparation for the staff nurse. *Orthopaedic Nursing, 14*(3), 35-40	Retention of nurses' knowledge after BLS/ACLS training at immediate, 6-month, and 12-month post-

		training intervals: A longitudinal study of nurses in Turkey. *Journal of Emergency Nursing* (online)
Author/Year	Brown, J., Latimer-Heeter, M., Marinelli, A., Rex, E., & Reynolds, L. (1995)	Bukiran, A., Erdur, B., Ozen, M., & Bozkurt, A. I. (2012)
Database/Keywords	CINAHL; Academic Search Premier; Advance* cardiac life support, ACLS	MEDLINE; ACLS retention
Research Design	Pre and post survey	Longitudinal quasi-interventional study
Level of Evidence	Level IV	Level III
Study Aim/Purpose	Identify the learning needs for staff, design a program, and evaluate the effectiveness of the program.	Examine knowledge retention for nurses after BLS/ACLS training.
Population/Sample Size Criteria/Power	134 RNs, 65 LVNs, and 50 CNs medical-surgical nursing staff.	225 nurses (pretest and immediate posttest) 160 (78%) nurses (6 months) 149 (73%) nurses (12 months)
Methods/Study Appraisal Synthesis Methods	Survey developed and sent out to staff. From the survey, educators developed an educational program on managing the first few of a codes which included such things as compressions, setting up oxygen and suction, finding items in a crash cart, establishing IV access, and communicating with code team. Prep classes provided to all the staff. From here, the researchers conducted mock codes and then a follow-up survey. On average each unit had a total of 23 mock codes before the second survey; 9 to 12 months elapsed since the initial survey.	25 question multiple choice pre-test given followed by 8 hours of training (4 hour didactic/4 hour simulation) on BLS/ACLS, immediate posttest evaluation, and then repeat evaluations at 6 months and at 12 months; successful passing equaled 18 correct answers. Data analyzed w/SPSS 10.0; $p < .05$ consider statistically significant. Sample *t* tests and Friedman test used to compare data.
Primary Outcome Measures/Results	All staff attended the classes. Follow-up survey done with a similar response rate to the first survey – RNs 39.5%, 55% LVNs, and 42% CNAs. Results for the RNs showed in the initial survey 13% uncomfortable with mask, 11% with room set-up, 26% with finding equipment, 45% with code charting, and 25% with communication; in the follow-up 6% uncomfortable with mask, 4.5% room, 13.6% equipment, 33% chart, and 1.5% communication. LVNs showed a similar pattern. CNAs only evaluated in three areas because of their role limits. Pre-survey they rated discomfort with the mask at 43%, room prep at 14%, and	Pretest mean equaled 13.1 correct answers and immediate posttest mean 21.9 ($p = .001$). 15.6% passed pretest, 90.7% passed immediately after intervention. Passing rates at 6 months 18.8% and at 12 months 16.7% ($p < .0001$). Although low, still higher than pretest. Nurses who had taken a similar course received high scores in each of the four tests ($p < .001$).

	equipment at 62%. The post findings showed 18% for the mask, room 12.5%, and the crash cart equipment at 43.7%.	
Conclusions/Implications	Results indicate a positive impact from the intervention.	Demonstrates that knowledge declines over time. Further, experience or exposure positively affects retention.
Strengths/Limitations	The number of participants and the pre and post design exist as strengths. Limitations include the response rates, an unproven measurement tool, and an unpaired analysis – not generalizable.	Number of nurses; some attrition occurred but still had 73% at the end; standardized tool used. Only knowledge tested in the 6 month and 12 month follow-ups; know data about skill retention.
Funding Source	None noted	None noted
Comments	As an early study it provided a starting point. Further, it is one of the few studies that focus solely on nursing. Interesting that the process of preparing nurses has come somewhat full circle if one looks at this study within the context of Alspach (2012) and Banks and Trull (2012).	The knowledge testing aspect applies directly to project; strong reference as it aligns with part of project.
Article/Journal (7 & 8)	Confidence vs competence: basic life support skills of health professionals. *British Journal of Nursing, 16,* 664	The middle-range theory of nursing intellectual capital. *Journal of Advanced Nursing, 63*(1), 94-103
Author/Year	Castle, N., Garton, H., Kenward, G. (2007)	Covell, C. L. (2008)
Database/Keywords	CINAHL; Academic Search Premiere, MEDLINE; Basic life support, nurs*, competence, BLS	CINHAL; Academic Search Premiere Middle range theory nursing
Research Design	2 part – observational and survey; convenience sample	Literature review with synthesis of the evidence to support theory propositions
Level of Evidence	VI	Not applicable
Study Aim/Purpose	Compare BLS competency to confidence levels	This paper outlines the development of a middle-range theory of nursing intellectual capital.
Population/Sample Size Criteria/Power	60 participants; no attrition 20 doctors, 20 RNs, and 20 HCAs	132 papers reviewed and from these 61 retained.
Methods/Study Appraisal Synthesis Methods	Structured questionnaire provided descriptive data; tables showed – number of cardiac arrests among the three groups; performance comparison on five points between those who attended events and those who did not; observed competence levels for the five points for	Author conducted an extensive search of nursing and health related literature to identify the use of intellectual capital (IC). Key terms included human capital, IC, structural capital, and knowledge. This produced four articles related to IC in health care, which the author

	each groups; competence assessed for those who expressed confidence	reviewed to clarify the meaning. Next the analysis resulted in the development of parallel concepts; the concepts were redefined and propositions applied. Another literature review provided evidence to support the propositions. Relationships between human capital, structural capital, and outcomes identified.
Primary Outcome Measures/Results	Number of cardiac arrests – doctor with highest mean at 7.7, nurses 1.2, HCAs 0.4. Those who experienced event to those who did not – correct ratio of compressions show significance; 96% of those who attended an event did this correctly versus 64% who had not. Overall those who attended events scored higher. Doctors showed highest number of confident (15) along with highest % actually doing correctly. Especially concerning compression aspect – out of nurses and HCAs who expressed confidence 40 to 50% performed incorrectly	Development of a new theory from intellectual capital theory that is relevant to nursing – specifically deals with continuing professional development. The theory proposes that staffing and employer support for development influences human capital and that this capital influences outcomes. Also structural capital makes an impact. Human capital = knowledge, skills, and experience. Structural capital = resources that support the work of nurses. The two work together.
Conclusions/Implications	Doctors demonstrated highest level of competence; confidence for the most part matched their skill. Not so for nurses. HCAs did not express confidence and had the weakest performance. Combination of training and clinical exposure helpful. Confidence does not always reflect competence.	The theory proposes that nursing knowledge available in health care organizations is influenced by variables within the work environment and that this knowledge impacts patient and organizational outcomes.
Strengths/Limitations	Three different groups. Appears to be a convenience sample.	A new theory that is untested.
Funding Source	None noted.	None noted.
Comments	Supports the self-efficacy component of project. Supports the framework of having different levels of personnel involved. Will be interesting to see if this project produces similar results with regard to the CNAs – especially since many have worked for more than 10 years	This theory supports the project as it demonstrates to management the value of building capital within the organization. Further, it is important to maintain these resources because when folks leave they take their "capital with them"; this relates to employee satisfaction and whether individuals feel like they have the tools to perform in their job – a goal for this project.
Article/Journal	An exploratory study of factors influencing	Adding emotional stressors to training in simulated

(9 & 10)	resuscitation skills retention & performance among health providers. *Journal of Continuing Education in the Health Professions, 32*(2), 126-133	cardiopulmonary arrest enhances participant performance. *Medical Education 2010, 44*, 1006-1015
Author/Year	Curran, V., Fleet, L., & Greene, M. (2012)	DeMaria, S., Bryson, E.O., Mooney, T. J., Siverstein, J. H., Reich, D. L., Bodian, C., & Levine, A. I. (2010)
Database/Keywords	CINHAL; Academic Search Premiere Resuscitation, skills, retention, rural	CINAHL; Academic Search Premier Advance* cardiac life support, ACLS
Research Design	Mixed methods, explanatory design using focus groups and an online questionnaire	Randomized-control study
Level of Evidence	Level VI	Level II
Study Aim/Purpose	Explore the perceptions and attitudes of certified resuscitation providers on skill retention, skill updates, and preferences for skill updates.	Determine if a high-frequency simulation with added emotional stress provokes anxiety and examine where the anxiety promotes more retention.
Population/Sample Size Criteria/Power	A total of 28 participants from the four focus groups; online survey completed by 909 respondents – majority nurses and women.	First 25 respondents to a mass email – first and second year medical students randomized into a group.
Methods/Study Appraisal Synthesis Methods	Investigators conducted focus groups by teleconference that were recorded, and transcribed. Investigators used NVivo to code the data. Data reviewed by 3 investigators. Responses analyzed using a constant comparative method. Common themes emerged such as insufficient chances to practice concerned individuals; they wondered about responding appropriately. Results from the focus groups formulated the basis of the survey. Survey contained both closed and open-ended questions.	All participants completed a 50 item pre-test and a 20 item State-Trait Anxiety Inventory. Study then divided into three phases – didactic, code management, and assessment. During phase one all participants attended a four hour didactic session using ACLS guidelines. Participants then returned 1 to 2 weeks later (individually) for a 60 minute code management segment. Control group experienced the simulation without any deliberately scripted stressors. The anxiety group experienced several planned stressors and had their heart rates monitored. After the skill sessions all participants took a 32 item posttest, the 'state' portion of the stress survey, and a debriefing. Assessment phase occurred 6 months later; all participants returned to the simulator for a mega-code and a written test. No emotional stressors inserted into the final scenario. After the session participants completed a final test. Participants asked to assess their perceived ability to manage a code and their perception of realism with the testing. Statistical analysis conducted using t-tests for

		group characteristics and scores; two-rater's performance scores evaluated with correlation coefficient; internal consistency determined.
Primary Outcome Measures/Results	Rural providers reported less code experience and lower abilities across a variety of resuscitation areas. Popular methods for updating included the computer, mock codes, team practice, and self-practice with a manikin. Barriers to participating in updates included staff shortages, timing of updates, and availability. Lack of communication, team leaders not current, and discrepancies in skill levels had a negative influence. Confidence greatest after practice, update, or debriefing session; lowest confidence when team does not work well together, no clear leader, and poor communication.	Groups well matched – resting heart rates and trait anxiety scores comparable. No significant differences between groups for the written examination at any of the three testing points. High correlation between faculty raters – 0.97. The experimental group scored significantly higher on performance assessment at 6 months (32.5 versus 25.0; $p < 0.05$); the testing evoked significant changes in the heart rates between the groups; self-efficacy scores for managing a code and realism rates did not differ significantly.
Conclusions/Implications	Skill deterioration is a concern; regular updates viewed as important for retention; dysfunctional teamwork reduces self-efficacy; focusing on teamwork and creating more opportunities are key strategies; individuals prefer active learning methods such as mock codes, low or high fidelity simulation, or instructor monitored practice. A broad approach may be the most useful.	Simulation with emotional stressor led to greater anxiety during the instruction and correlated with enhanced performance after the course.
Strengths/Limitations	Large number for survey; survey offers a number of strategies. However, the data is self-reported and from self-selected respondents.	Reviewers blinded to group assignments; two independent raters; established tools. However, it was a small voluntary study – selection bias possible. Also did not account for other factors such as extra prep, study, or actual cases between testing times that may have increased retention.
Funding Source	Funded through the Medical Research Foundation, Faculty of Medicine, Memorial University.	Intramural funding from Mount Sinai School of Medicine, Department of Anesthesiology.
Comments	This study includes data from the rural setting. This is important because many studies do not. Further, this is the environment where this project will take place; the article provides useful insight.	Adds another element to consider when doing a project that includes simulation.

Article/Journal (11 & 12)	Five alive: Using mock code simulation to improve responder performance during the first 5 minutes of a code. *Critical Care Nursing, 36*, 244-250	Basic life support refresher training of nurses: Individual training &group training are equally effective. *Resuscitation, 79*, 283-287
Author/Year	Delac, K., Blazier, D., Daniel, L., & N-Wilfong, D. (2013)	De Regge, M., Calle, P. A., De Paepe, P., & Monsieurs, K. G. (2008)
Database/Keywords	CINAHL, Academic Search Premiere, MEDLINE; Mock code, nurse*	CINAHL, Academic Search Premiere, MEDLINE; Basic life support, CPR, nurs*
Research Design	Not stated; quasi experimental?	RCT
Level of Evidence	III	II
Study Aim/Purpose	Improve the RNs performance in responding to code situations; increase confidence; improve communication	Compare BLS refreshers strategies – individual versus group instruction
Population/Sample Size Criteria/Power	250 participants; data collected from the first 103 reported in this article	103 nurses from non-critical units – IT 56; GT 47 (median size 5) 80% for compression; 95% for ventilation – assuming 50% improvement of IT versus GT at second check point (10 months)
Methods/Study Appraisal Synthesis Methods	One hour in-situ mock codes; randomly picked units; participants complete pre-survey, do two scenarios with debriefing, evaluation, and complete a post-survey	Randomized to either IT or GT; skills assessed using 3 min BLS test on computerized manikin; given intervention; retested immediately after; retested again at 10 months
Primary Outcome Measures/Results	65% improvement in 1 minute to CPR; 67% improvement in 3 minutes to defibrillation; increased confidence initiating interventions and in handoff communication.	No significant demographic differences between groups or in each group's performance. However, training time for IT nurses less. IT time 20% of GT spent in class; GT (90 min class) with 19 min per trainee. No differences in retention
Conclusions/Implications	Performance improved.	Groups not significantly different. Hospitals could use individual programs versus small group programs –
Strengths/Limitations	Number of nurses, randomly chosen; study looked at response times – but does this fully address performance? What about the quality of compressions? Also increased confidence cited, but it is not correlated with the competence; variables reported separately.	Good power; randomization Interesting that they placed manikin in bed, but then did not provide board – stated this has not been shown to help? If this is so this raises the question about doing CPR in a hospital bed?
Funding Source	None noted	None noted
Comments	Supports project – would be stronger study if it had	Skills noted poor – for example, with ventilation [IT at

	included information on quality. Contains a self-confidence element which is helpful; also the observed challenges during actual events aligns with what this investigator sees in practice.	second time point only 4 out 16 ventilations correct, 54 out of 119 compressions right depth; showing retention issues with the nurses' skills although this was not focus of study
Article/Journal (13 & 14)	Nurses' behavior regarding CPR & the theories of reasoned action & planned behavior. *Resuscitation, 52,* 85-90	Part 1: Executive summary: 2010 American Heart Association guidelines for cardiopulmonary resuscitation & emergency cardiovascular care. *Circulation, 2010, s640-s656*
Author/Year	Dwyer, T., & Williams, L. M. (2002)	Field, J. M., Hazinski, M. F., Sayre, M. R., Chameides, L., Schexnayder, S. M., Hemphill, R… Vanden Hoek, T. L. (2010)
Database/Keywords	CINAHL, Academic Search Premiere, MEDLINE; Basic life support, CPR, nurs*	CINAHL, Academic Search Premiere, MEDLINE; Systematic review, cardiopulmonary resuscitation
Research Design	Not a study; theory proposal	Systematic Review; Meta-analysis
Level of Evidence	Not applicable	Mixed many different studies – 1, 11
Study Aim/Purpose	Examine behavioral issues associated with CPR	To provide recommendations for cardiac care
Population/Sample Size Criteria/Power	Not applicable	Varying dependent on the individuals studies within the guidance – 356 resuscitation experts from 29 countries over a 36 month period
Methods/Study Appraisal Synthesis Methods	Not applicable	By committee who's systematically reviewed the evidence to form a consensus; 411 scientific reviews on 277 topics
Primary Outcome Measures/Results	Authors offer the theory of reasoned action and planned behavior to address the reason nurses hesitate in response to resuscitation situations They propose programs have not examined attitudes and this could influence retention Attitude can serve as a restraining force thus educators need to identify whether staff will embrace training or not Authors acknowledge arrest situations are stressful and frequently nurses fear them; this stress can adversely affect retention – especially in older nurses; some factors causing stress include knowing the	Recommendations published for healthcare workers and the public on emergency cardiac care Emphasis on rate, depth, and uninterrupted cardiac compressions Early defibrillation Early activation of 911 Encourage bystander CPR Do not over ventilate Sequence now CAB versus ABC No longer three shocks in a row– just one

	patient, fear of missing something, problems with doctor or equipment, disorganization, and a negative outcome; this then fuels the cycle – poor self-efficacy – lack of retention – poor performance	
Conclusions/Implications	Education should not only focus on procedure but address staff attitudes, past experiences, and perceived control issues; need to motivate nurses to attend sessions with a positive attitude	Considered the gold standard Outlines changes to BLS for 2010 update which is the most current
Strengths/Limitations	Intuitively it makes sense; no studies proving the proposal	Consensus from many studies – on an international level
Funding Source	None noted	Varied
Comments	Offers insight; need to consider when looking at SWOT & driving/restraining factors for project	Provides the foundation for this project and the standards by which to test individuals
Article/Journal (15 & 16)	In-hospital cardiac resuscitation outside the ICU by nursing staff equipped with automated external defibrillators – the first 500 cases. *Resuscitation, 70,*416-422	Basic life support skill acquisition & retention in student nurses undertaking a pre-registration diploma in higher education/nursing course. *Nurse Education Today, 16,* 28-31
Author/Year	Gombotz, H., Weh, B., Mitterndorfer, W., & Rehak, P. (2006)	Greig, M., Elliott, D., Parboteeah, S., & Wilks, L. (1996)
Database/Keywords	CINAHL, Academic Search Premiere, MEDLINE; Cardiopulmonary resuscitation, nurs* , defibrillator	CINAHL, Academic Search Premiere, MEDLINE; Basic life support, nurs*, retention
Research Design	Retrospective study	Randomized control trial
Level of Evidence	Level IV	Level II
Study Aim/Purpose	Increase survival rates by instituting an AED program within a large hospital/clinic facility	Determine if poor skill performance is an acquisition or retention issue
Population/Sample Size Criteria/Power	439 cardiac arrest cases in non-monitored areas of a hospital	72 nursing students
Methods/Study Appraisal Synthesis Methods	Chart review of the cases using the Utstein style of collection. Study examined response times and time to defib within the context of survival and what type of event over several years	72 randomized into 12 for 6:1 instruction; the remaining 60 placed in the 15 to 20 instruction group size.
Primary Outcome Measures/Results	500 cases examined 439 used [61 false arrests]. ROSC 58%, 28% discharged, 22% alive at 6 months; 73 patients had VF; out of these 86% had ROSC, 47% discharged, 38% alive at 6 months; slightly higher	First phase of the study in this report. On the written pretest it showed the students had some knowledge of BLS, but overall poor scores on the practical – assess breathing and circulation only two items >50% and this

	survival if MD in-house responder (0.078); review did not find survival rate influenced by time team called to first shock. Risk of dying significantly higher in patients with non-VF/VT ($p<0.001$). The study did include a survey of nurses regarding confidence levels; these increased with CPR training from one session to the next.	was for the control group. After instruction the study group scored greater on all nine skill points; calling for help low for both groups (33% study; 17% control).
Conclusions/Implications	Supports house-wide first responder resuscitation before "team" arrives; survival rates higher in VF/VT events. Also supports the idea that training helps with confidence levels.	Only first phase, but indicates value in small group instruction.
Strengths/Limitations	Large numbers of cases. However, I question if the time on phone in sync with the monitor. Also the study does not state the difference in rates before training and placing AEDs throughout the facility/clinic; it just provides the numbers as a whole for the time period.	Randomization and group size are strengths. Only percentages provided; no correlation or other statistics supplied.
Funding Source	None noted	Laerdal supplied manikins; grant from University of Portsmouth, School of Health Studies
Comments	Supports the practice of having nurses trained to use an AED in non-monitored areas – which is FB for the most part. This will be an interesting piece because we have an AED at MRMC but how many will go get it during the training?	Good background; referenced in other studies. However, is outdated in the sense that instruction methods have evolved from even the 6:1proposed in this study.
Article/Journal (17& 18)	Nurses' knowledge & skill retention following cardiopulmonary resuscitation training: a review of the literature. *Journal of Advanced Nursing, 51*, 288-297	Improving code blue response through the use of simulation. *Journal for Nurses in Staff Development, 28,* 120-124
Author/Year	Hamilton, R. (2005)	Huseman, K. (2012)
Database/Keywords	CINAHL; Academic Search Premier Advance* cardiac life support, knowledge, retention, skill	CINAHL, Academic Search Premiere, MEDLINE; Mock code, nurs*,
Research Design	Literature review	Quasi-experimental; descriptive
Level of Evidence	Level IV	Level III
Study Aim/Purpose	Examine factors that enhance knowledge and skill	Measure whether mock code practice drills improved

	retention during and after training; make suggestions for improving the process.	responses
Population/Sample Size Criteria/Power	24 articles	Not stated
Methods/Study Appraisal Synthesis Methods	Literature search done using CINAHL, MEDLINE, British Nursing Index databases; key word search included cardiopulmonary resuscitation, basic life support, advanced life support and training. Researchers focused on studies published in English from 1992 to 2002. Reviewed the reference lists for additional studies.	Retrospective examine of codes – response time, initial compressions, defib, and first epi dose; training done using surprise drills with debriefing over 3 month time period; reevaluation done looking at same variables over this period; researcher then examined after another 3 months (post training).
Primary Outcome Measures/Results	105 primary and 157 secondary studies identified. From these 24 met the criteria and researchers included them in the literature review.	Initial improvement in compressions and epi; results not sustained.
Conclusions/Implications	Research suggests that skills and knowledge decline 3 to 6 months after lecture-style training. Ways to improve the skills and retention include video self-instruction, computer based teaching tools, and peer tutors. Base education on evidence-based guidelines; use scenarios that correlate to practice areas; use formal assessments to ensure individuals retain skills. Conduct further research to verify strategies that improve retention. Research proposes that the best approach may entail using more than one technique.	Educators need to recognize deterioration of skills post training; design program appropriate to their facility.
Strengths/Limitations	Review initially looked at over 200 studies. Restricting the dates and language (English only) may have eliminated some pertinent studies. Also the researcher notes a number of unobtainable, unpublished theses that could have provided valuable data.	Limitation – study size not stated, thus no indication of power. Does provide evidence for project – value of practice.
Funding Source	None noted	None noted.
Comments	Examines nurses as the population which aligns with project. Although some of the studies included in the review examined ACLS, many focused on basic CPR. However, still relevant as basic CPR serves as the base for ACLS – especially with new guidelines that	Would have been better if power stated.

	emphasize compressions and defib. In addition, the review addresses the issue of nurses as "first on scene" which is important because in this project the providers are generally not in-house.	
Article/Journal (19 & 20)	Basic life support knowledge of undergraduate nursing & chiropractic students. *Australian Journal of Advanced Nursing, 26,* 58-63	Research on ACLS training – which methods improve skill & knowledge retention? *Respiratory Care, 40*(5), 538-543
Author/Year	Josipovic, P., Webb, M., & McGrath, I. (2009)	Kaye, W. (1995)
Database/Keywords	CINAHL, Academic Search Premiere, MEDLINE; Basic life support, CPR, nurs*	CINAHL, Academic Search Premier; Advance* cardiac life support; ACLS
Research Design	Non-experimental, exploratory	Not specifically stated (appears quasi-experimental)
Level of Evidence	Level VI	Level III
Study Aim/Purpose	Examine knowledge retention and self-rated ability to perform CPR/BLS	Explores the issue of training and retention.
Population/Sample Size Criteria/Power	Convenience sample of 3rd year nursing students and 4th year chiropractic students	140 nurses from three medical/surgical units
Methods/Study Appraisal Synthesis Methods	Questionnaire distributed to both sets of students – 35 questions Data analyzed with SPSS 15.0 Data unevenly distributed; Spearman's rho correlation used.	Nurses taught how to use an AED in a two hour class that emphasized hands-on practice of the BLS-AED algorithm on a computerized manikin. Post-test given. Participants then retested at 1 to 3 months, 4 to 6 months, and 7 to 9 months through convenience sampling (total of 77). In addition, Kaye (1995) also discusses a literature review that included 38 articles on skill and knowledge retention and two large reviews on in-hospital arrests.
Primary Outcome Measures/Results	Both had instruction prior to completing questionnaire. 220 questionnaires distributed. 130 completed = 59% response rate 48% unable to correctly identify compression rate [95% chiropractic; 25% nursing] p .001 34% unable to correctly identify ventilation rate [69% chiropractic; 17% nursing] p .001 Number of initial breaths 90% nursing, 53% of chiropractic answered correctly Compression depth answered poorly by both– 65%	On the immediate post-test 139/140 nurses showed satisfactory performance. For retention at 1 to 3 months 31/32 showed competence, at 4 to 6 months 18/18, and at 7 to 9 months 24/27. In the discussion part of the article, Kaye notes a review of 38 studies found poor retention of CPR skills by all groups; decline occurred as early as two weeks. Further, Kay notes the poor retention may occur because of inadequate practice and instruction. Similar findings found for ACLS. With the two large in-hospital arrest

	chiropractic; 57% nursing did not know Last time practiced – 76.9% reported within the last 3 months; 13.2% (17) had actual real experience with CPR – 14 of these student nurses Self-rating nurses scored themselves higher, but not statistically significant	reviews, researchers found no improvement in survival to discharge rates.
Conclusions/Implications	If initial premise is that all healthcare professionals should have sound CPR/BLS differences exist; also gaps in knowledge exist even though participants felt confident and ready to perform CPR. Participants also indicated they did not read guidelines.	The training showed that individuals can easily learn and utilize the AED. With regard to the reviews, findings suggested learning did not occur. Kaye reports the need to examine student, curriculum, and instructor. Also advocates for refreshers.
Strengths/Limitations	Response rate fair for survey 59%. However, participants received different training. Also the data on skills is self-reported, which has been shown to correlate poorly to actual performance Correlates with Dwyer et al (2004) study that individuals are reluctant to use AED	The article does not supply many specifics on the AED training (e.g., statistical analysis, demographics, or measurement tools) or information on how the literature reviews were conducted. However, the number of articles reviewed (38) and the number of arrests (14,765) examined are substantial.
Funding Source	None noted	None noted
Comments	Limited value – but supports the self-efficacy or confidence component gap with actual skill level	Although this article is from 1995, issues that Kaye addresses remain relevant. Further, some of things Kaye advocated for such as AED training and standardized training have occurred. This article is mentioned in many other articles, making it useful to review. One gains a good perspective on how the training has evolved and what problems remain.
Article/Journal (21 & 22)	Strengthening the in-hospital chain of survival with rapid defibrillation by first responders using automated external defibrillators: Training & retention issues. *Annals of Emergency Medicine*, *25*, 163-168	Revisiting CPR knowledge & skills among registered nurses. *The Journal of Continuing Education in Nursing*, *24*(4), 174-179
Author/Year	Kaye, W., Mancini, M., Giuliano, K. K., Richards, N., Nagid, D. M., Marker, C. A., & Sawyer-Silva, S. (1995)	Lewis, F. H., Kee, C. C., & Minick, M. P. (1993)
Database/Keywords	CINAHL, Academic Search Premiere, MEDLINE;	From reference list in Hammond, F., Saba, M., Simes,

	Basic life support, nurs*, CPR	T., & Cross, R. (2000) article
Research Design	Prospective, longitudinal cohort	Not stated (appears quasi-experimental)
Level of Evidence	Level IV	Level III
Study Aim/Purpose	Determine whether staff outside critical care who were proficient with BLS could be easily trained to use AED and retain these skills	Examine knowledge and skill retention to answer question if annual recertification is adequate.
Population/Sample Size Criteria/Power	140 nurses who had previously learned BLS	73 RNs, three hospitals, and a purposive sample.
Methods/Study Appraisal Synthesis Methods	Nurses trained (2 hour class, 1:5 ratio) evaluated with computerized manikin. All nurses tested immediately after training; retested at different time intervals 1 to 3, 4 to 6, and 7 to 9 months using convenience samples. Satisfactory score defined as the delivery of the first shock within 2 minutes of recognizing arrest.	Various specialty and general care areas used to obtain broad range of subjects for study. RNs recruited on the spot. Given written exam and asked to show skills without review/practice. Result compared to the participants previously recalled scores; ACLS materials used to measure – 25 point written exam and ACLS skills sheet. However, instead of a pass/fail for skills the researcher assigned a point to each item to analyze. Correlation coefficients computed to examine variables (age, years as nurse, time spent in direct care, number of CPR courses, number of times CPR done, number of certification years and days since last certification).
Primary Outcome Measures/Results	139 passed the immediate post-test. 77 nurses evaluated in the retesting process – 31/32 at 1 to 3 months, 18/18 at 4 to 6 months, and 24/27 at 7 to 9 months met the standards.	Knowledge retained (means scores decreased by three points; 90% passed). Skills not retained – mean score 71with 21% scoring below 60 and only three scoring a passing score of 100. However, on what was missed two of the items unlikely to be missed in a real situation – call for help and continuing CPR. Positive correlation between number of CPR courses taken, certification as an instructor, and time since last certification – less time higher scores. Number of times CPR actually used did not impact score. Skill and cognitive test scores showed significant relationship; moderate in strength ($r = .47$; $p = .000$); also with an increase in age and years in nursing cognitive scores decreased.
Conclusions/Implications	As demonstrated with prehospital personnel nurses outside critical care can learn the AED and retain the skill.	Cognitive knowledge retained over time; reinforcement required to maintain skills. Study raises further questions – training lacks realism, so does poor testing

		performance reflect real situations. This brings into question certification procedures.
Strengths/Limitations	Number of participants fair; I do question how long to actually recognize the arrest? This time interval not given.	More than one setting and institution; number of RNs; examined both knowledge and skills; used AHA measurement tools. The study relied on recall for prior cognitive scores.
Funding Source	No noted	None noted
Comments	Outdated as AED is now part of BLS. However, it is interesting about the retention levels with skills as this seems to contradict other studies; so is it because they only looked at AED and this is easier to do than compressions? Study is helpful as the framework is similar to what I plan to use.	Study notes the likelihood of an RN first responder in hospital arrests – need for competency; aligns with project; study also references and summarizes a lot of the early work done in this area.
Article/Journal (23 & 24)	Integration of theory & practice: Experiential learning theory & nursing education. *Nursing Education Perspectives, 31*(2)	Undergraduate nursing students' acquisition & retention of CPR knowledge & skills. *Nurse Education Today, 26,* 218-227
Author/Year	Lisko, S. A., & O'Dell, V. (2010).	Madden, C. (2006)
Database/Keywords	CINAHL; Academic Search Premier Nursing education, simulation, learning style, Kolb	CINAHL, Academic Search Premiere, MEDLINE; Cardiopulmonary resuscitation, retention, nurs*
Research Design	Not stated – survey?	Quasi-experimental time series
Level of Evidence	Level VII	Level III
Study Aim/Purpose	Integrate scenario based learning to facilitate critical thinking and accommodate individual learning styles	Determine if student nurses acquire the knowledge and skill to do CPR and do they retain it?
Population/Sample Size Criteria/Power	Not stated – author only reports the population as a curriculum change in a junior medical-surgical course	18 student nurses in Ireland, randomly selected out of 55; tested at three time points
Methods/Study Appraisal Synthesis Methods	Integration of the technology based on Kolb's learning theory; the process occurred over the 15-week semester, with testing at the end. For the evaluation students were scheduled a one-hour individual session with their assigned clinical faculty. Each faculty developed a scenario incorporating all the skills presented during the first two weeks of the semester.	CPR knowledge assessed with 21 multiple choice exam; evidence-based; AHA, validated by expert consensus. Pass standard 85.7% (18 points). Psychomotor skills evaluated with structured observation using Laerdal resuci-anne manikin/data for Laerdal skill meter; AHA checklist. Data analysis with SPSS 10.0; descriptive and inferential statistics used; t-test compared the mean scores; statistical significance set at <0.05
Primary Outcome	Objectives for the integration were met – students	Pre-test mean knowledge score 15.2, 6% achieved a pass

Measures/Results	assessed critical health incidents; planned appropriate steps; intervened correctly to stabilize situation and evaluated the situations and took additional steps or altered the care plan. Although the article states both faculty and students evaluated the learning as positive, there are no statistics. Also the faculty noted other benefits – ability to control variables, allow failure, maximize learning time, promote self-evaluation, and learn effective decision making.	before taking course; mean score after 18.1, 72% passed; retest 44% passed. All time points showed significance. Although scores dropped at the 10 week mark they did remain higher than pretest scores. For the skills none passed on the pretest evaluation, posttest or 10 week mark. These scores showed a similar pattern. Initial increase and then a drop at the 10 week mark. The 10 week score higher than the initial score.
Conclusions/Implications	Experience viewed as positive; faculty planned to expand this type of learning within the curriculum.	Although decay exhibited; knowledge at 10 weeks higher than pretest. Somewhat supports the issue of acquisition in that none of the students performed correctly in any of the time points.
Strengths/Limitations	Established validity and reliability with Kolb's model. However, this report provided few details on how the staff or students evaluated the process. In addition, with each instructor creating their own scenarios, a lack of consistency exists. Also are instruments valid?	Small group, limiting power. Design good; valid instruments; effect of skills practice and study preparation between post-testing and re-testing outside the control of the study; as a result retention effect may be increased.
Funding Source	None noted.	None noted.
Comments	Can apply the theory to a wider group of situations, making it useful for this project.	Although larger studies that are more recent exist, this offers a framework and design similar to this project making it useful. Congruent with other retention studies; it also lends credence to the issue of acquisition, leading me to wonder if it is not a combination of the two?
Article/Journal (25 & 26)	Methods of assessing cardiopulmonary resuscitation skills: A systematic review. *European Journal of Emergency Medicine, 14*, 108-114	Student satisfaction & self-report of CPR Competency: HeartCode™ BLS courses, instructor-led CPR course, & monthly voice advisory manikin practice for CPR skill maintenance. *International Journal of Nursing Education Scholarship, 9*, Article 10
Author/Year	Makinen, M., Niemi-Murola, L., Makela, M. & Castren, M. (2007).	Montgomery, C., Kardong-Edgren, S. E., Oermann, M. H., & Maryon-Odom, T. (2012)
Database/Keywords	CINAHL, Academic Search Premiere, MEDLINE;	CINAHL, Academic Search Premiere, MEDLINE;

	Systematic review, cardiopulmonary, resuscitation	Basic life support, CPR, nurs*
Research Design	Systematic Review	Large randomized study – 10 schools
Level of Evidence	Level I	Level II
Study Aim/Purpose	Compare assessment methods	Evaluate effects of brief monthly refreshers on skill retention, confidence, & satisfaction; determine confidence, satisfaction with initial course type
Population/Sample Size Criteria/Power	25 studies included; 19 assessed CPR, 4 CPR and defib, and 2 only defib; mean number of participants = 107 (range 36 – 495)	10 schools – 606 students; 303 instructor led initial course; 303 web-based course; each of these groups further divided into practice or no practice groups
Methods/Study Appraisal Synthesis Methods	Used Best Evidence Medical Education Coding sheet to rate educational quality of the studies. Group consensus.	Bandura's theory served as the framework; The practice groups were further randomized into 3, 6, 9, or 12 month practice. Assigned group was the exit time for the participant; practice sessions were 6 minutes a month. When participants exited they completed the satisfaction/confidence survey
Primary Outcome Measures/Results	Wide variety of methods used; most with methodological shortcomings; many compared participants to each other versus a standard. 11 evaluated teaching method; 9 focused on skills retention; 4 on assess; 1usability of guidelines – mean follow-up time 6.5 months range 2 weeks to 13 months. Many studies done with lay responders.	Significant testing 0.05 level (two-sided) using SAS software. No significant association between students' confidence to perform CPR and teaching method (HC 81%; IL 85%, p=0.35). More of the monthly practice students reported higher confidence levels in performing CPR (95%; 78% no practice, p=0.003). Those reporting not confident or somewhat 22% of no practice versus 10% with practices. Differences in the initial training noted. Dissatisfaction greater with HeartCode training (p=0.01) 13% rated not satisfied or somewhat versus 6% with IL. Also students commented not getting enough feedback during initial training; with design study unable to correlate this with which type of initial training
Conclusions/Implications	Although Cardiff test recommended by ILCOR statement this review did not find a superior method. Another aspect is that most evaluated the students against one another versus a set standard or passing level.	Although both groups expressed confidence, HC training led to better skills according to a corresponding study with this one. Researchers note because those in the monthly practice group reported training frequency and length as just right, employers may want to adopt similar design.
Strengths/Limitations	Strength is the type of study; however, AHA	Size of study in the beginning, but ending results not as

	guidelines have evolved since this review.	much power because of the number of groups the participants were divided into. Also could not track initial training to practices.
Funding Source	None noted.	Laerdal; AHA
Comments	Identifies many weaknesses, which is helpful. Can work to correct any of these present in this project such as compare results to a set standard – not just the participant themselves	Good study; aligns well with this project and addresses the self-efficacy component.
Article/Journal (27 & 28)	Simulation technology for resuscitation training: A systematic review & meta-analysis. *Resuscitation, 84,* 1174-1183	Practice makes perfect: Simulation in rural emergency medicine. *Canadian Journal of Rural Medicine, 17*(2)
Author/Year	Mundell, W. C., Kennedy, C. C., Szostek, J. H., & Cook, D. A. (2013)	Nagji, A., & Sadiq, A. (2012).
Database/Keywords	CINAHL, Academic Search Premiere, MEDLINE; Systematic review, cardiopulmonary, resuscitation	CINAHL; Academic Search Premier Advance* cardiac life support; ACLS
Research Design	Systematic review	Anecdotal – editorial piece
Level of Evidence	Level I	Level VII
Study Aim/Purpose	Summarize current data on simulation training in resuscitation for health care professionals.	Not directly stated, but author discusses the importance of enhancing communication and teamwork.
Population/Sample Size Criteria/Power	182 studies involving 16,636 participants	Not applicable
Methods/Study Appraisal Synthesis Methods	Comprehensive literature search, plus they used the entire reference lists from several previous reviews; all articles in two key publications on simulation; started with over 10,000 articles. Exclusion process applied – no original research, did not use technology-enhance simulation, no health professions, no group comparison or time point, duplicates, no relevant outcomes, insufficient data to extract effect size – final review included 182; reviewed and divided into 3 themes; comparison with no intervention, comparison with non-enhanced technology, and other technology. Applied coding and statistical analysis; standardized mean, plotted on quartiles, 95% confidence interval.	The author expressed how his first code experience in a rural facility was unpleasant and that prior training would have been beneficial. Further, discussions with nursing staff revealed a desire to become more prepared. This lead to the development of some mock scenarios using an ACLS computer-based simulator. The author along with another physician conducted eight mock cardiac sessions with doctors, nurses, and paramedics. These sessions included debriefings.

Primary Outcome Measures/Results	Simulation based training effective when compared to no intervention 78 studies – magnitude of effect varied, but not direction of benefit; 44 studies reported knowledge outcomes, not statistically significant; 1 assessed time in relation to real patient – performance slower, but better; Moderate to large effect for satisfaction using simulation versus non. Self-regulated versus instructor courses, the instructor slightly more favorable outcome – p =0.46; less cost for self-regulated in one study; one study indicated computer manikins with a cost 3.4 times higher. 114 studies indicate simulation highly effective when compared with no-intervention; 21 studies indicate it may be more effective than other non- simulated interventions for skill – but not speed or knowledge.	From the practice sessions, Nagji reports increased confidence with such devices as the King airway, and the laryngeal mask airway. Further, the sessions helped build rapport among different disciplines and increase familiarity with the trauma room. However, the mock scenarios were voluntary, so this limited participation as individuals participated as able. This impacted the continuity from week to week.
Conclusions/Implications	Simulation improves outcomes compared with no interventions; comparison to other approaches less clear; effective for skills and satisfaction. One must consider cost, but unfortunately a paucity of research exists for this factor. Several important themes exist for simulation – incorporating team, leadership, feedback, distraction, and booster sessions can be beneficial. Further studies to look at realistic distractors and how the sessions translate to actual outcomes are needed.	Nagji acknowledges the benefits from the practices and identifies a number of challenges in the rural setting – such as low volume and limited resources. This highlights the need for adequate preparation, so that individuals can respond effectively.
Strengths/Limitations	Focused on resuscitation; included studies that looked at a variety of learners and methodologies. This scope can also be viewed as a limitation as it contributes to heterogeneity, but the researchers not this may not be so much that this type of training does not help, but rather the degree that it helps. Study quality has an effect on the overall review. Volume and methods used are strengths.	Although this report does not constitute a study, it does provide some useful anecdotal information. This is important as there is not much evidence for this practice setting. Nagji accurately describes what I have seen and experienced in the rural setting.
Funding Source	None noted	None noted
Comments	Excellent resource – given the level; it addresses many aspects associated with simulation; also it aligns	It provides useful insight into how rural settings operate and discusses challenges these settings face.

	with project as this project will use different levels and type of responders	
Article/Journal (29 & 30)	"Rolling refreshers": A novel approach to maintain CPR psychomotor skill competence. *Resuscitation, 80,* 909-912	Competence in CPR. *American Journal of Nursing, 112,* 43-46
Author/Year	Niles, D., Sutton, R. M., Donoghue, A., Mandip, S. K., Roberts, K., Boyle, L…Nadkarni, V. (2009)	Oermann, M. H., Kardon-Edgren, S. E., & Odom-Maryon, T. (2012)
Database/Keywords	CINAHL, Academic Search Premiere, MEDLINE; Cardiopulmonary, resuscitation, nurs*, competence, defibrillator	CINAHL, Academic Search Premiere, MEDLINE; CPR, nurs*, competence
Research Design	Prospective, observational	Commentary regarding research conducted using VAM and monthly refreshers with student nurses
Level of Evidence	Level IV	VII
Study Aim/Purpose	Recognize CPR skill retention is poor. Test hypothesis that just-in-time or in-place training are effective and accepted by staff.	N/A
Population/Sample Size Criteria/Power	420 individuals "refreshed" – sample of 20 consecutively chosen individuals divided into two groups – 10/10 to assess skill; also 9 individuals surveyed post actual resuscitations during the 15 week sessions	Reports on study published – 606 students – 303 divided into two groups
Methods/Study Appraisal Synthesis Methods	Two groups – infrequent refreshers < 2/mo. and frequent refreshers ≥2/mo. to compare how much time it took to achieve adequate compression skill defined as <3 prompts in 30 seconds; the manikin was set to AHA guidelines for depth and rate; study used a Resusci-Annie manikin brought to the beside for staff to refresh; sessions <5 min. Q-CPR review program Laerdal version 2.1.0.0 used; data analysis with STATA 8.0. p value less than 0.05 considered significant.	Described in the two other studies – Used different time points VAM for intervention Intervention monthly 6 minute practice sessions
Primary Outcome Measures/Results	Infrequent group took longer to reach competent level for compressions; p=<0.001; 21 sec median versus 67 sec median; those who refreshed and experienced an actual arrest rated the experience as helpful (4.2 on	Although they maintained skills to a certain degree they fell short with adequate compression depth and ventilation amounts – 4% met compression depth ≥51 mm/5cm/2 in

	Likert 1-5 scale).	72% met rate guidance ≥ 100/min 19% ventilation volume 500-600 ml 21% ventilation rate 8-10/min For those not meeting guidance: 96% under the 51mm; 28% under the rate; 57% under volume and 24% over volume; 37% too slow rate and 42% too fast
Conclusions/Implications	Refreshers helped.	Noted from past studies that instructors able to better asses ventilations than compressions; students unable to adequately perform some skills – especially compressions
Strengths/Limitations	Small consecutive sample to determine effectiveness although a large number refreshed; However, this started as QI check.	Size – however it would have been nice to know some variables on the 4% who could adequately perform compression because another study mentioned males performing better compressions
Funding Source	Laerdal foundation; Children's Hospital of Philadelphia	N/A – for this commentary
Comments	Adds some evidence to the idea that frequent practice helps with retention. Also the approach may help with long-term sustainability of a program as it would represent minimal cost, disruption, and time commitment from staff.	Adds more insight into the study that they conducted – especially about the quality of the skills; this is important because individuals need to not only remember what to do, but be able to meet the standards so patients receive optimal care.
Article/Journal (31 & 32)	Deliberate practice of motor skills in Nursing Education: CPR as exemplar	Evaluation of nurses' & doctors' knowledge of basic & advanced life support resuscitation guidelines. *Nurse Education in Practice*, *11*, 365-369
Author/Year	Oermann, M. H., Kardon-Edgren, S. E., Odom-Maryon, T., Hallmark, B. F., Hurd, D., Rodgers, N…Smart, D. A. (2011)	Passali, C., Pantazopoulos, I, Dontas, I., Patsaki, A., Troupis, G., & Xanthos, T. (2011).
Database/Keywords	CINAHL, Academic Search Premiere, MEDLINE; CPR, nurs*, competence	CINAHL, Academic Search Premiere, MEDLINE; Basic life support, nurs*
Research Design	Randomized control	Descriptive quantitative design; randomized
Level of Evidence	Level II	Level VI
Study Aim/Purpose	Determine effect of deliberate practice on CPR skills using VAM	Determine if knowledge reflected professional profile
Population/Sample Size	606 nursing students randomized into two groups –	10% from 2200 randomized – 5 hospitals in Greece

Criteria/Power	these groups further randomized into different time points	470 asked – 214 agreed (45.5% response); 82 nurses, 70 trainees/ 64 specialized doc = 134
Methods/Study Appraisal Synthesis Methods	Students taught BLS, then at 3, 6, 9, 12 mos. retested. Data analysis completed with SAS 9.1	Completed a test/questionnaire with 30 questions; BLS and ALS assessed independently. Analyzed using SPSS 13.0. z-test, t-test, chi-square used to examine relationships; $p<0.05$ set as significant
Primary Outcome Measures/Results	Control group at times performed more compressions but intervention group had more with adequate depth ($p=0.005$). In addition, the intervention group saw improvement over time (3mos. mean 144.2 correct/12 mos. 176.4); control group (3mos. 139.9/12 mos. 116.3) – each time point and each skill showed difference	Overall BLS score nurses scored significantly better than physicians – higher on all questions; doctors scored better on the ALS – but surprising not all questions (PEA rhythms). More nurses had attended BLS than doctors; more doctors attended ALS than nurses and those who attended the courses score better than those who had not; those working in high-risk areas higher frequency to correct answers and higher level of confidence $p<0.001$); also if they encountered more than 5 arrests ($p=0.0072$ BLS; $p=0.0001$ALS).
Conclusions/Implications	Students who practiced a few minutes a month retained their CPR skills and for some skills they improved; however not with depth; see other commentary from Oermann on competency	Knowledge is suboptimal and that both groups failed to meet recommendations.
Strengths/Limitations	Students volunteered thus may have been more motivated to learn the skill. Some students withdrew from study – researchers used an imputing technique to account for missing data.	Only one of a couple studies conducted thus far. Resuscitation training in early stages. Good start. Adequate size.
Funding Source	AHA; Laerdal Medical	None noted
Comments	Aligns well with project goals	Not all that helpful. Does offer insight on another area; reiterates many other studies on some basics
Article/Journal (33 & 34)	Evaluation of staff's retention of ACLS & BLS skills. *Resuscitation, 78,* 59-65	Determinants of the quality of basic life support by hospital nurses. *Resuscitation, 77,* 75-80
Author/Year	Smith, K. K., Gilcreast, D., & Pierce, K. (2008)	Verplancke, T., DePaepe, P., Calle, P. A., DeReggae, M., VanMaele, G., & Monsieurs, K. G. (2008)
Database/Keywords	CINAHL; Academic Search Premier Advance* cardiac life support; ACLS	CINAHL, Academic Search Premier, MEDLINE, Mock code, nurs*
Research Design	Repeated measures, quasi-experimental	Observational and a self-confidence survey

Level of Evidence	Level III	Level IV
Study Aim/Purpose	Evaluate knowledge and skill retention for ACLS and BLS to determine the point at which RN skills and/or knowledge of ACLS and/or BLS degrade to where they do not meet the standards.	Understand reasons for the variations in BLS quality among a group of nurses
Population/Sample Size Criteria/Power	Convenience sample of 133 RNs; criteria included: hospital employment, current ACLS or BLS certification within 10.5 months, and expected to remain for one year	292 nurses (296; 4 excluded/ no previous BLS) from non-critical wards
Methods/Study Appraisal Synthesis Methods	Initial testing done to assure all participants met the standards. Score of 86% required for written and a pass/fail for skills. In addition, data for a number or variables such as primary work unit, time since last course, and number of times performed ACLS/BLS in the past two years was gathered. Participants then randomized into one of four groups for final testing – 3 months, 6 months, 9 months, or 12 months. All testing used the same scenario and the AHA checklist.	Completed a questionnaire with demographics (gender, age, experience, last training, and last CPR experience) and self-confidence survey on performing BLS. Participants then completed 2 min test on using pocket mask and a skill reporter Resusci-Anne manikin version 1.3.0. Seven variables recorded: number of ventilation, volume, compression/min, rate, and depth. Considered good = $\geq$ 4 resp/min,700-800 ml, $\geq$40 compression/min, rate 80-120, and 40-50mm depth; analysis with SPSS 12.0
Primary Outcome Measures/Results	Nurses retained knowledge but skills decayed quickly. In addition, two variables influenced written scores – RNs who had performed ACLS one or more times in the past 2 years and RNs who maintained certification for 5 or more years scored significantly higher. ACLS skills declined faster than BLS. For BLS skills, 63% passed at 3 months and 58% at 12 months, but for ACLS only 30% passed at 3 months and 14% at 12 months. Similar findings in other studies.	Low confidence and longer training interval associated with poor ventilation. Male gender Experience positive impact. Percentages for meeting standard or "good" – 58% ventilation rate, volume 21%, compression rate 35%, compressions/min 37%, depth 24%,
Conclusions/Implications	Nurses unable to meet the standards for ACLS and BLS during the certification period. This indicates a need for more frequent refresher training. In addition, allow more time for hands-on practice, and consider reducing the recertification time.	Large variation in skill level. Male gender, recent BLS training, self-confidence, and recent CPR associated with good quality CPR. Male gender may relate more to body weight and muscle strength; ideal time between refreshers not established. Increasing frequency may help.

Strengths/Limitations	Study design – over time; the use of established tools (AHA) to evaluate the nurses.	Study size is strength; did not assess immediate impact of training, which could shed light on the issue of whether individuals actually acquire the skills.
Funding Source	Sponsored by the TriService Nursing Research Program, and the Uniformed Services University of the Health Sciences	None noted.
Comments	Aligns well with project – population and design. Offers a good template for variables and methodology.	Supports project.
Article/Journal (35 & 36)	Quantifying the effect of cardiopulmonary resuscitation quality on cardiac arrest outcome: A systematic review & meta-analysis. *Circulation: Cardiovascular Quality & Outcomes, 6,* 148-156	Optimal refresher training intervals for AED & CPR skills: A randomized controlled trial. *Resuscitation, 71,* 237-247
Author/Year	Wallace, S.K., Abella, B. S., & Becker, L. B., (2013)	Woollard, M., Whitfield, R., Newcombe, R. G., Colquhoun, M., Vetter, N., & Chamberlain, D. (2006),
Database/Keywords	CINAHL, Academic Search Premier, MEDLINE; Systematic review, cardiopulmonary, resuscitation	Reference list in Oermann (2012) article – Competence in CPR
Research Design	Systematic review, meta-analysis but not on RCT	Randomized control
Level of Evidence	? how to rate level of evidence	Level II
Study Aim/Purpose	Measure relationship between key CPR parameters and outcomes	Examine retention levels for AED use among laypersons
Population/Sample Size Criteria/Power	Initially 603 articles identified; based on reviews and criteria – final number 10. 8 prospective studies; 2 post hoc analyses of clinical trials	Using statistical software with a power of 85% and an alpha of 0.05, researchers determined they needed at least 28 participants; 57 participants
Methods/Study Appraisal Synthesis Methods	Used consensus meta-analysis methodology of Stroup et al in conjunction with PRISMA guidelines; looked at both OHCA and IHCA	Subjects randomized using SPSS 10.0 to attend a single second refresher 12 mo. after first fresher – (6 mos.) or a second and third refresher at 7 and 12 mos. Participants test before after each refresher course. Cardiff test of basic life support& AED version 3.1
Primary Outcome Measures/Results	4 variables assessed – rate, depth, no-flow fraction (% of time no compressions done), and ventilation rate; mean age 67.3, 65% male; ROSC 34.3% , survival to discharge 5.9%; mean rate 107, depth 39.9mm, 39.3% no flow, vent rate 13.6.	Circulation checks performed incorrectly by over 2/3; breaths incorrect by over 1/2; compression depth inadequate for 1/2; rate too fast for over 3/4; ideal pad placement achieved by only 3% - hands off or stand clear not made before all four shocks by over 1/2.

Conclusions/Implications	Deeper chest compressions and chest compression rates closer to the range of 85 to 100 per minute associated with improved survival. No significant difference for ventilation rate or no flow fraction between survivors and nonsurvivors IHCA survival more sensitive to compression rate than OHCA, but authors believe this may stem from differences between the two conditions – e.g., 40% of OHCA shockable rhythm; thus time to defibrillate more important predicator of survival. Although no flow did not show significance authors not the variability with this factor and note a need for a standard definition and measurement guide; survival rate low, but several of the studies published before new guidelines	Frequency of retraining must be based on a balance of need and practicality – long intervals may lead to decay and short may lead to volunteer fatigue or employers not wanting to release staff for practice – increasing dropout rates for a program – also the issue of cost. Also there is the issue of training. In this study researchers suspected this an issue. If skills are not acquired adequately and refresher training is similar no improvement will occur; on completion of refresher training all maintained the ability to deliver counter shocks with a reduction in time to first shock of at least 17s in both groups and ability to perform most skills increased; however the execution of several important skills were poor. This suggests that the refresher training should not be longer than the 7 mos.
Strengths/Limitations	No RCT for obvious ethical reasons, but researchers report high quality for 6/10 studies.	Sample size; number of dropout from original training and refresher.
Funding Source	This work was supported by a grant from the Doris Duke Charitable Foundation to the University of Pennsylvania to fund Clinical Research Fellow S.K. Wallace.	Department of Health, England
Comments	Adds support to why good CPR skills are important.	Adds to the body of support for the project. Also addresses a self-confidence component.
Article/Journal (37 & 38)	Evaluation of nurse's theoretical knowledge in basic life support: A study in a district Greek hospital. *International Emergency Nursing, 20,* 28-32	Chest compression rates during cardiopulmonary resuscitation are suboptimal: A prospective study during in-hospital cardiac arrest. *Circulation, 11,* 428-434
Author/Year	Xanthos, T., Akrivopoulou, A., Pantazopoulos, I., Aroni, F., Datsis, A., & Iacovidou, N. (2012)	Abella, B. S., Sandbo, N. Vassilatos, P., Alvarado, B. A., O'Hearn, N., Widger, H. N…Becker, L. B. (2005)
Database/Keywords	CINAHL, Academic Search Premiere, MEDLINE; Basic life support, nurs*, competence, BLS	Reference list in several other articles
Research Design		Prospective observational study
Level of Evidence		IV
Study Aim/Purpose		Measure in-hospital chest compression rates and determine compliance to published international guidelines.

Population/Sample Size Criteria/Power	Decided not to evaluate –	97 cardiac arrest events
Methods/Study Appraisal Synthesis Methods		Researchers trained individuals to count rates using a hand-held electronic device; given pagers; responded to events and gathered data. Data then compared to whether patients had ROSC or not.
Primary Outcome Measures/Results		Initial survival or ROSC attained in 61 of 97 (63%). Considered ROSC if patient maintain status for 5 minutes or more. Recorded 813 min/97 events. 55% of events in ICU; HR 95.5-138.7 75% ROSC; HR 87.4-94.8 76% ROSC; HR 72.4-87.1 58% ROSC; HR 40.3-72.0 42% ROSC. P<0.0083. Also average code times for no ROSC longer – 595 ± 390 versus 450 ± 403.
Conclusions/Implications		Effectiveness depends on several components, but this study indicates rate plays a role.
Strengths/Limitations		Generalizability and instrument.
Funding Source		Laerdal, Alsius Corp. and Philips Medical Systems

Appendix B

IRB Approval Letter Regis University

REGIS UNIVERSITY
Academic Grants
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IRB – REGIS UNIVERSITY

January 14, 2014

Victoria Birekland
P.O. Box 1317
Fort Benton, MT 59442

RE: IRB #: 14-011

Dear Ms. Birekland:

Your application to the Regis IRB for your project, "Basic Life Support (BLS) Knowledge and Skill Retention and Self-Efficacy in Rural Health Care Providers," was approved as an exempt study on January 13, 2014. This study was approved per exempt study category 45CFR46.101.b(#1).

The designation of "exempt" means no further IRB review of this project, as it is currently designed, is needed.

If changes are made in the research plan that significantly alter the involvement of human subjects from that which was approved in the named application, the new research plan must be resubmitted to the Regis IRB for approval.

Sincerely,

Patsy Cullen

Patsy McGuire Cullen, PhD, PNP-BC
Chair, Institutional Review Board
Professor & Director
Doctor of Nursing Practice & Nurse Practitioner Programs
Loretto Heights School of Nursing
Regis University

cc: Dr. Patsy Cullen

Appendix C

Information Sheet for Participants in BLS Retention Project 2014

My name is Victoria Birkeland. I am a Doctor of Nursing Practice (DNP) student at Regis University. My contact information is P.O. Box 1317, Fort Benton, MT or 406-868-9380. I am conducting a research study where individuals will participate in Basic Life Support (BLS) cardiopulmonary (CPR) simulation. The purpose of the study is to provide rural health care workers with an opportunity to practice their resuscitation skills, to determine knowledge and skill retention and self-efficacy levels.

I am asking you to participate in this study because you work in an area where you may be the first one to find or respond to an individual in cardiac arrest. Your participation is strictly voluntary. Choosing not to participate will not affect your access to any goods or services. There are no direct benefits to participating in the study.

I will be conducting the study by having you complete a survey with some general questions such as how long you have worked in your current role, how many times you have done CPR in a real situation, and how confident you feel performing CPR. I will then have you complete a multiple-choice test and a 10 minute CPR skill simulation session (Step 1). You will the then take the BLS support for healthcare provider's renewal course (CPR course) (Step 2). After the CPR course, you will be asked to participate in either Step 3 *and* Step 4 *or just* Step 4. Step 3 will be held approximately four weeks after the course. For this step individuals will participate in a 10 minute CPR practice session. Step 4 will be held approximately eight weeks after the CPR course. In this session individuals will take a survey, complete a multiple-choice question test, and participate a 10 minute CPR skill simulation session. Participation in this study will take 5 hours to 5 ½ hours depending on if you participate in Step 3 and Step 4 or just Step 4.

I will not be collecting any data that can link you to the answers you provide. Your anonymity and the confidentiality of your responses will be protected as much as possible. If you are uncomfortable answering any question, you may choose to not answer that question or to stop your participation and have any notes, recordings, or hard copy answers destroyed. To further protect the confidentiality of your responses, I will not be collecting a signed consent form but will instead consider your participation in the study as consent permitting me to collect the data you provide.

Should you have any questions or concerns about participation in this study, you may contact me using the information in the first paragraph. My capstone advisor is Dr. Patsy McGuire Cullen email: pcullen@regis.edu; phone: 303-964-5132. You may also contact the Chair of the Regis University Institutional Review Board for human subjects participation by telephone at 303-346-4206; by mail at Regis University, Office of Academic Grants, 447 Main, Mail Code H-4, 3333 Regis Blvd., Denver, CO, 80221; or by e-mail at irb@regis.edu with questions or concerns, or if you feel that participation in this study has resulted in some harm.

Sincerely,

Victoria Birkeland, RN, EMT-B, MSN

Appendix D

Approval Letter Missouri River Medical Center

Missouri River
Medical Center

Missouri River Medical Center (MRMC)

Letter of Agreement

11/11/2013

To Regis University Institutional Review Board (IRB):

I am familiar with Victoria Birkeland's research project entitled BLS Knowledge and Skill Retention for Rural Health Care Providers. I understand MRMC's involvement to be allowing nursing staff to participate in three or four steps of the study. Step 1 is a 10 minute simulated CPR skills test, a multiple-choice question exam, and a self-efficacy survey; Step 2 is a BLS health care provider course; Step 3 (approximately four weeks after the BLS health care provider course and with half of the participants randomly selected) is a 10 minute simulated CPR practice session; and Step 4 (approximately eight weeks after the BLS health care provider course and with all of the participants) is a 10 minute simulated CPR skills test, a multiple-choice question exam, and a self-efficacy survey.

I understand that this research will be carried out following sound ethical principles and that participant involvement in this research project is strictly voluntary and provides confidentiality of research data, as described in the proposal.

Therefore, as a representative of MRMC, I agree that Victoria Birkeland's research project may be conducted at our agency/institution.

Sincerely,
Janice Woodhouse R.N., D.O.N.
Janice Woodhouse R.N., D.O.N.
Director of Nursing

Instructions: (Select one)

- Fax with original signature to (303) 964-5528
- Email as pdf file with original signature to irb@regis.edu from an official agency email address.
- Adobe electronic signature to irb@regis.edu

1501 St. Charles Street, P.O. Box 249, Fort Benton, Montana 59442 (406) 622-3331

Appendix E

Approval Letter Chouteau County EMS AHA Training Center

Chouteau County
Disaster & Emergency Management

Linda Williams, Coordinator
Phone (406-622-3751)
lwilliams@montana.edu

PO Box 459
Fort Benton, MT 59442

Chouteau County EMS

Letter of Agreement

11/11/2013

To Regis University Institutional Review Board (IRB):

I am familiar with Victoria Birkeland's research project entitled BLS Knowledge and Skill Retention for Rural Health Care Providers. I understand that Chouteau County EMS AHA Training Center involvement is to assist in all four steps of the study by supplying the BLS instructors and materials. Step 1 is a 10 minute simulated CPR skills test, a multiple-choice question exam, and a self-efficacy survey; Step 2 is the BLS health care provider course; Step 3 (approximately four weeks after the BLS health care provider course and with half of the participants randomly selected) is a 10 minute simulated CPR practice session; and Step 4 (approximately eight weeks after the BLS health care provider course and with all of the participants) is a 10 minute simulated CPR skills test, a multiple-choice question exam, and a self-efficacy survey.

I understand that this research will be carried out following sound ethical principles and that participant involvement in this research project is strictly voluntary and provides protection of all testing materials and confidentiality of research data, as described in the proposal.

Therefore, as the center's training coordinator, I agree that Victoria Birkeland's research project may be conducted with our agency/institution.

Sincerely,

Linda D Williams

Linda Williams
Chouteau County DES/EMS
American Heart Association Training Center

Appendix F

CITI Certification

CITI Collaborative Institutional Training Initiative

Human Research Curriculum Completion Report
Printed on 11/25/2012

Learner: Victoria Birkeland (username: birke057)
Institution: Regis University
Contact Information Department: LHSON DNP student
Email: birke057@regis.edu

Social Behavioral Research Investigators and Key Personnel:

Stage 1. Basic Course Passed on 11/25/12 (Ref # 9202503)

Required Modules	Date Completed	
Introduction	11/25/12	no quiz
History and Ethical Principles - SBR	11/25/12	5/5 (100%)
The Regulations and The Social and Behavioral Sciences - SBR	11/25/12	5/5 (100%)
Assessing Risk in Social and Behavioral Sciences - SBR	11/25/12	5/5 (100%)
Informed Consent - SBR	11/25/12	5/5 (100%)
Privacy and Confidentiality - SBR	11/25/12	5/5 (100%)
Regis University	11/25/12	no quiz

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI participating institution. Falsified information and unauthorized use of the CITI course site is unethical, and may be considered scientific misconduct by your institution.

Paul Braunschweiger Ph.D.

Appendix G

Testing Timeframe/Stages

Testing Stages:

Stage 1 – Assess current levels for knowledge, skill, and self-efficacy:
Participants completed:
1. BLS Healthcare Provider 25 question multiple-choice question exam
2. BLS Healthcare Provider Adult BLS 1 and 2 rescuer with AED skill exam.
3. Self-efficacy survey - 6 questions
4. Demographics questionnaire - 9 questions

Stage 2 – Renewal course:
1. Participants participated in a BLS renewal course
2. Complete the course testing and received CPR cards

Stage 3 – Educational intervention four weeks after renewal course:
Half of the participants (randomly selected by hat draw)
1. Practiced for 10 minutes with simulation manikin using the skill scenario

Stage 4 – Evaluation eight weeks after renewal course:
All of the participants completed:
1. BLS Healthcare Provider 25 question multiple-choice question exam
2. BLS Healthcare Provider Adult BLS 1 and 2 rescuer with AED skill exam
3. Self-efficacy survey - 6 or 8 questions reflecting extra practice session

November 2013: Proposal presentation and approval
December 2013: IRB submission and approval
January 2014: Pre-BLS project instructors training First stage: Testing Second stage: CPR renewal course
February 2014: Third stage – 4 weeks from renewal course: Practice for half of participants
March 2014: Fourth stage – 8 weeks from renewal course: Repeat testing all participants
April – May 2014: Analyze data
June 2014: Formulate final report and prepare PowerPoint presentation
July – August 2014: Project defense

Appendix H

General Demographics Questionnaire

For each question please circle one of the choices.

1. Gender: Male Female

2. Work environment: Prehospital Hospital Clinic

3. Age: 18-19 20-29 30-39 40-49 50-59 60-69 70-79

4. Highest level of education: High school/GED College 2yr College 4yr College >4yr

5. Years in health care: 0-5 6-10 11-15 16-20 Over 20

6. Years with BLS card: 0-5 6-10 11-15 16-20 Over 20

7. Months since last BLS class: 0-6 7-12 13-18 19-24 Over 24

8. Times BLS used since last renewal: None 1-5 6-10 11-20 Over 20

9. Times BLS practiced since last renewal: None 1-5 6-10 11-20 Over 20

Appendix I

BLS Self-Efficacy Survey

How confident are you that can you perform the following BLS skills:

(Please circle the number that best corresponds to your confidence level)

	Extremely Confident	Very Confident	Confident	Somewhat Confident	Not Confident
Recognize that a person is unresponsive	5	4	3	2	1
Recognize that a person is not breathing or not breathing normally	5	4	3	2	1
Provide ventilations that make the chest rise	5	4	3	2	1
Provide chest compressions that are at least 2 inches deep	5	4	3	2	1
Place the AED pads in the correct location	5	4	3	2	1
Know how to operate the AED	5	4	3	2	1

(Adapted from Schwarzer, 2011; Schwarzer & Jerusalem, 1995; Rohs, Issenberg, Chung, & Kim, 2012)

Note: These are the two extra questions on the post-survey; instructions stated "Only answer the questions below if you participated in the extra practice session in February

	Extremely Beneficial	Very Beneficial	Beneficial	Somewhat Beneficial	Not Beneficial
Did the session help with skill retention?	5	4	3	2	1
Did the session help with knowledge retention?	5	4	3	2	1

Appendix J

Budget and Resources

Practice Sessions		
Three 10 minute practice sessions – Two sessions with 40 participants One session with 20 participants	20 hours Two BLS instructors $12.50/hour/EMT Two BLS instructors $25.00/hour/RN	$500 to $1,000 wage dependent
Renewal Course		
20 participant capacity Two sessions Student/instructor ration 5:1	4 instructors for 5 hours each session 40 hours BLS instructors versus RN	$500 to $1,000 wage dependent
Pre-intervention planning		
Two hour session	4 individuals for 2 hours 8 hours	$100 to $200 wage dependent
Manikins		
Static manikins on Amazon set of 5	Need 4 sets for 20 class capacity $400 to $500 per set	$1,600 to $2,000
Low or High-fidelity simulation manikin	Price dependent on the type and number of features; extra costs for software & tech support	$3,000 to over $200,000
Facility and supplies		
Facility rental	1 full day $250 3 part days $200	$450
CPR cards	$5 per card for 40 individuals	$200
Total Costs		$6,350 to over $200,000

(Rogers, 2007; United States Department of Labor, 2012)

Appendix K

Permission for Self-Efficacy Surveys

Permission to use RSES tool: Received through Regis email – birke057@regis.edu on Saturday, November 30, 2013 3:35 PM

Dear Victoria,
Thank you for your email, and your interest in the RSES tool. I'm very happy for you to use it for your research. Please just remember to cite us as appropriate and let us know how it goes.
all the best with your research
kind regards
Thank you.
Young Sook

Young Sook Roh, PhD, RN
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Fachbereich Erziehungs-
wissenschaft und Psychologie
- Gesundheitspsychologie -
Professor Dr. Ralf Schwarzer
Habelschwerdter Allee 45
14195 Berlin, Germany

Fax +49 30 838 55634
health@zedat.fu-berlin.de
www.fu-berlin.de/gesund

Permission granted

to use the General Self-Efficacy Scale for non-commercial reseach and development purposes. The scale may be shortened and/or modified to meet the particular requirements of the research context.

http://userpage.fu-berlin.de/~health/selfscal.htm

You may print an unlimited number of copies on paper for distribution to research participants. Or the scale may be used in online survey research if the user group is limited to certified users who enter the website with a password.

There is no permission to publish the scale in the Internet, or to print it in publications (except 1 sample item).

The source needs to be cited, the URL mentioned above as well as the book publication:

Schwarzer, R., & Jerusalem, M. (1995). Generalized Self-Efficacy scale. In J. Weinman, S. Wright, & M. Johnston, *Measures in health psychology: A user's portfolio. Causal and control beliefs* (pp.35-37). Windsor, UK: NFER-NELSON.

Professor Dr. Ralf Schwarzer
www.ralfschwarzer.de