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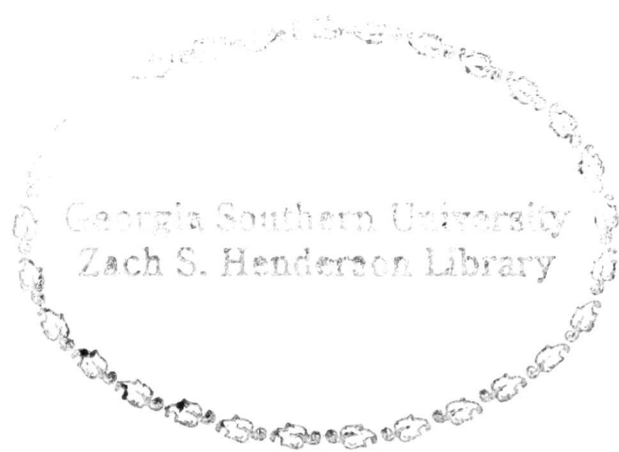
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TRAINING HOSPITAL-EMPLOYED NURSES TO USE
AUTOMATIC EXTERNAL DEFIBRILLATORS:
EVALUATION OF KNOWLEDGE AND SKILLS
IMMEDIATELY POST-TRAINING AND AT SIX MONTHS

Susan Patrice Brown

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Training Hospital-employed Nurses to use
Automatic External Defibrillators: Evaluation of Knowledge
and Skills immediately Post-training and at Six Months

by

Susan Patrice Brown RN, BSN, CCRN

A Thesis Submitted to the Faculty
of the College of Graduate Studies at
Georgia Southern University
in Partial Fulfillment of the
Requirement for the Degree of
Master of Science in Nursing
in the
School of Nursing

Statesboro, Georgia

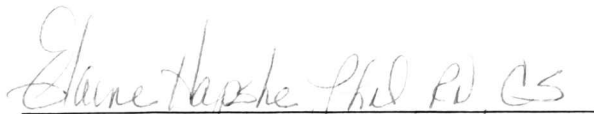
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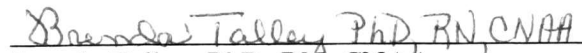
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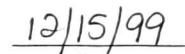
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Dedication

To my husband, Reed, for his patience and support of my furthering my education. A special thanks to our children, Carla, Jason, Kelly, Sara, and Jordan, for the sacrifices they have made as I have worked on this study. Without their love and encouragement this would not have been possible.

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Abstract

Numerous studies have demonstrated the importance of early defibrillation in patients suffering a cardiac arrest. The increased awareness of the importance of early defibrillation and the growing availability of Automatic External Defibrillators (AEDs) has prompted the American Heart Association (AHA) to recommend that AED training be incorporated into Basic Life Support (BLS) programs for all hospital personnel expected to respond to a patient in cardiac arrest.

The purpose of this study was to evaluate the retention of knowledge and skills of hospital-employed nurses in their use of an AED after a training program. A secondary goal was to determine if the training should be repeated in six months. This study reflects research designed to identify the time interval when AED refresher training should be implemented to keep skills high and effective.

A convenience sample of 35 nurses employed at a rural hospital in southeast GA comprised the population. Outcome evaluation using a descriptive repeated measures design was conducted to determine if the level of knowledge and skills necessary to safely use an AED significantly declines after initial training. The 2-hour AED program was incorporated into the nurse's annual Basic Life Support refresher course. Cognitive skills were assessed by administration of a written test prior to training, immediately following training, and six months post-training. Skill performance was tested at the end of the initial training program and six months later. Satisfactory completion of the skill evaluation was

defined as the ability to deliver a shock within 90 seconds of placing an AED on a manikin with simulated ventricular fibrillation. The data were summarized using descriptive and inferential statistics. A significance level of $p < .05$ was set for all statistical tests.

A total of 35 nurses participated in the training. All 35 participants (100 %) demonstrated satisfactory skill performance. After initial training and at six months the mean percentage correct on the follow up written exam was 96.29 % as compared with 97.00 % on the test given on completion of the course, and 88.00 % on the exam given as a pre-test prior to any formal training. A minimum score of 85.00 % on the written test administered at six months implied retention of cognitive knowledge. Further research needs to focus on the evaluation of cognitive knowledge and AED performance skills in an effort to identify when knowledge and skills significantly diminish.

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Chapter I

Prompt and competent use of automatic external defibrillators (AEDs) is a significant factor in improving the survival of cardiac arrest victims. The American Heart Association (AHA) recommends that all personnel trained in Basic Life Support (BLS) receive instruction in operating an AED (Mancini & Kaye, 1998). Efficient training in the use of AEDs will be an important determinant in the success of in-hospital AED programs. Few articles have been published about the use and training of the devices by nurses since the introduction of AEDs (Mancini & Kaye, 1998). The majority of data on skills retention and training issues regarding AEDs has focused on first responders such as law enforcement personnel and emergency medical technicians as well as lay people in settings outside of the hospital (Stults, Brown, Schug, & Bean, 1984; Eisenberg & Cummins, 1986; Cummins, Eisenberg, & Stelts, 1986; Sedgewick, Watson, Dalziel, Carrington, & Cobb, 1992; White, Vuhor, & Bugliosli, 1994). Furthermore, limited data exist which support the adequacy of teaching strategies in promoting maximal skill retention in health care providers. Few studies were found that examined the retention of cardiopulmonary resuscitation (CPR) skills of hospital-employed personnel after a training program (Fossel, Kiskaddon, & Sternbach, 1983; Gass & Curry, 1983, Mancini & Kaye, 1985). In most studies, the researchers described the effect of various teaching techniques on knowledge and skills performance of basic CPR in the pre-hospital setting (Vandershmidt, Burnap, & Thwaites, 1976; Thompson,

Hallstrom, & Cobb, 1979; Weaver, Ramirez, Dortman, & Raizner, 1979; Tweed, Wilson, & Isfeld, 1980; Cummins, Eisenberg, Bergner, Hallstrom, Hearne, & Murray, 1984; Cummins, 1989; Mancini & Kaye, 1985; Eisenburg & Cummins, 1986; White et al., 1994).

Responding to recommendations by the AHA, Kaye et al. (1995) explained that “Automatic external defibrillation, a BLS skill, should be incorporated into BLS programs for all hospital personnel expected to respond to a patient in cardiac arrest, with rapid defibrillation taking priority over CPR” (p.163). As nurses learn how to use AEDs, the importance of assessing the effectiveness of the new training and the retention rates of the nurses needs to be addressed.

Purpose

A primary goal of this investigation was to evaluate the retention of knowledge and skills of hospital-employed nurses in their use of an AED after receiving a training program. A secondary goal was to determine whether the training program should be repeated six months after the nurses attended the initial AED program.

Significance

Defibrillation is the only treatment that can convert ventricular fibrillation, a lethal and chaotic heart rhythm, to a normal heart rhythm (Aufderheide, Stapleton, Hazinski, & Cummins, 1998, p.1-7). AEDs are safe, easy to use devices that can provide the defibrillation needed to stop ventricular fibrillation and allow a normal heart rhythm to resume. To promote early defibrillation, the AHA developed a course in 1997 to teach lay people and healthcare personnel how to operate AEDs safely and effectively. At present, the AHA recommends a 2-year interval for AED renewal courses, a guideline

consistent with their recommendation for CPR refresher courses. The hospital in which this study was conducted requires all employed nurses to attend CPR courses yearly. The recommended time intervals between refresher courses represent administrative policies and are not based on scientific research.

Previous researchers have predominantly examined knowledge and skill retention in paramedics, first-responders, and lay-persons in a pre-hospital environment. This investigator, however, examined the retention of knowledge and skills in nurses actively working in a hospital setting. To date, limited research exists supporting the adequacy of AED content in CPR courses for healthcare providers. In Chapter I, the significance of the study, purpose, research question, and definitions are presented. Also discussed are definitions of the terms, assumptions, limitations, and delimitations of the study.

Theoretical Framework

The theoretical framework chosen for this study was andragogy, a theory of adult learning first conceived in 1968 by Malcom Knowles (Knowles, 1978, 1980, 1984; Van-Hoozer et al., 1987; Redman, 1993; Zemke & Zemke, 1988). Knowles (1980) defines andragogy as “the art and science of helping adults learn” (p.43). The model emphasizes learning functions and places the student at the center of the learning. This approach to adult education is congruent with AHA’s recent guidelines that recommend a learner-centered program for AED instruction (Chandra, Hazinski, & Stapleton, 1997).

The andragogy model stresses that adults are self-directed and expect to take responsibility for decisions. To accommodate this essential aspect, adult learning programs must take this behavior into consideration. The practice of andragogy produces collaborative relationships among students and between the students and the instructor.

Active participation in the andragogical model is, in part, a result of the maturity and self-directedness of adult learners. Adult learners are usually goal oriented and are interested in learning through problem-solving activities.

In the past, elements of the andragogy model have been shown to be effective in designing effective learning experiences for adults. Additionally, the model has been used extensively in the development of organizational training programs (Knowles, 1984). According to Merriam & Caffarella (1991), Knowles' andragogy has been the most widely applied theory in practice since its debut in the 1960s. Knowles (1984) asserted that adults need to focus more on the process and less on the content being taught. The author recommended that instructors adapt a role of facilitator or resource person rather than lecturer. According to Knowles, the primary responsibility of the instructor is to facilitate the learning process by selecting appropriate learning activities and encouraging application of the content.

Andragogy makes the following assumptions, all of which are characteristics of adult learners (Knowles, 1984):

1. Need to Know: Adults need to know why they need to learn the information before they begin the experience.
2. Self-Concept: Adults need to protect the facets of their self-concept, which reflect their ability to take responsibility for their own decisions.
3. Life Experience: Adults have accumulated life experiences, which differs in quantity and quality from children.
4. Readiness to Learn: Adults become ready to learn when they decide they need to know in order to meet the challenges of real-life situations.

5. Orientation to Learning: Adults' orientation comes from the need to use information meaningfully for they are task-centered as compared to children who tend to be subject-centered.
6. Motivation: Adults' motivation comes from internal forces.

Each of these assumptions has potential implications in the planning and implementation of learning activities with adults. For this reason, Knowles' andragogy principles were used in this study involving the design and execution of an educational program for hospital-employed nurses. Further research of Knowles' theory of andragogy has revealed four fundamental principles: (a) adults need to be involved in the planning and evaluation of their instruction, (b) their experience provides the basis for learning activities, (c) adults are most interested in learning subjects that have immediate relevance to their job or personal life, and (d) their learning is problem-centered (Knowles, 1984). Although some skeptics say andragogy is not so much a theory of education as it is a way of looking at the learning of adults, andragogy offers a practical approach to adult education (Merriam & Caffarella, 1991). The principles of andragogy guided this training program as self-directed students were taught in such a manner to facilitate their learning.

Research Question

This study was designed to answer the following question: Do the levels of skill and knowledge of hospital-employed nurses following a training program on AEDs significantly decrease six months after initial training?

Definition of Terms

The theoretical definitions utilized in the study are presented. The operational definitions used to complete the study are identified.

AED

Conceptual: A device that incorporates micro-processor-based systems to detect ventricular fibrillation (Dickey, Dalzell, Anderson, & Adgey, 1992, p. 608). The device “evaluates the patient’s heart rhythm, generates and delivers an electric charge, and reevaluates the heart rhythm” Aufderheide et al., 1998, p. 1-4).

Operational: A portable shock-advisory automatic device with a monitor screen. The AED automatically charges and signals the operator with a voice prompt when defibrillation is indicated.

Hospital-Employed Nurses

Conceptual: Persons currently licensed to practice as professional registered nurses (RN) or licensed practical nurses (LPN).

Operational: RNs or LPNs employed by hospital during length of study.

Knowledge

Conceptual: “...process or state of knowing; cognition” (Geiss, 1997, (p. 541).

Operational: Based on a passing score of 85% or above on the 20-question multiple choice AED written exam (AHA, 1997).

Skill

Conceptual: Knowledge of any science or art, as demonstrated by “dexterity in execution or performance, or in its application to practical purposes” (Guiss, 1997, p. 905).

Operational: Based on the participants’ ability to deliver a first shock to a manikin with simulated ventricular fibrillation in < 90 seconds.

Training session

Conceptual: an educational meeting using systematic instruction and drill to convey information.

Operational: a two-hour AED-provider course consisting of videos, lecture, practice, and evaluation with a faculty-to-student ratio of 1:4 (Chandra & Hazinski, 1994). This course was specifically designed for health care providers who were already trained in Basic Life Support.

Assumptions

Polit & Hungler (1995) defined assumptions as “basic principles that are accepted as being true on the basis of logic or reason, without proof or verification” (p.637). The following assumptions were identified in this study:

1. Acquisition of knowledge and skills to operate an automatic external defibrillator is a desirable goal.
2. Participants in the study will respond in a truthful manner.

Limitations

Awareness of major weaknesses in a study is essential in research, particularly during interpretation of the findings (Polit & Hungler, 1995, p.565). Limitations identified prior to initiation of this study were as follows:

1. Generalizability of this study is limited, since the study was conducted with one hospital.
2. Due to time constraints, participants were only re-tested once at six months. Further research is needed to include different intervals, such as between initial training and follow up evaluation.
3. Due to convenience sampling, findings cannot be generalized to nurses outside of of the hospital where the study was conducted.

Delimitations

In Webster's Revised Unabridged Dictionary, Geiss (1997) defined a delimitation as "...the process of fixing limits or boundaries"(p.47). Specific limits were imposed to define the population under study. The delimitations of this study were as follows:

1. Subjects were instructed not to participate in the study if they had any co-existing medical problems that could influence their ability to demonstrate correct use of an AED.
2. Only full-time nurses were included in the study to insure availability of the study participants for retesting at 6 months.
3. All study participants had previous BLS training.

Summary

The importance of early defibrillation has emerged as a result of extensive research. However, little research has specifically addressed the training of hospital staff in AED skills and the retention of these skills. This study was an examination of the retention of cognitive knowledge and AED performance skills of hospital-employed nurses six months after a training program. The nurses involved in the study were already skilled in BLS and were attending their annual CPR refresher course in which instruction of AED use was incorporated. The answers to the research question will contribute to the knowledge base concerning AED relative to training of health care providers. Knowles' Theory of Andragogy was chosen as the theoretical framework and a synopsis of Knowles' philosophy was presented.

Chapter II - Review of the Literature

Literature Related to AEDs

Automatic External Defibrillators

Any thorough study demands a basic understanding of previous scholarship on the topic of inquiry. This literature review summarizes the available research involving learning retention of cardiopulmonary resuscitation (CPR) and automatic external defibrillator (AED) skills of first-responders, lay persons, medical students, physicians, and nurses. The review of literature for this study will provide documentation of previously completed studies in order to provide a factual foundation to address the proposed research question. The history, mechanics, and implications of automatic external defibrillators are addressed. Literature related to the use of Knowles' Theory of Andragogy as the theoretical basis for adult learning is also discussed. An initial understanding of the general history of AED and CPR practices is essential to this study, and several articles provide this basic framework.

In 1989, Joseph J. Bocka, MD, examined the history, mechanics and implications of AEDs in an article printed in the Annals of Emergency Medicine. Bocka described a series of early electric shock experiments, dating as far back as 1775, which eventually led to the development of practical defibrillators in the 1920s. The device went through numerous trials and transformations before the U.S. Food and Drug Administration approved it in 1982. Following the brief history of the defibrillator, Bocka discussed the

current mechanics of the device, which required the placement of pads at the right sternal border and the cardiac apex. In earlier AED models, an oral-epigastric electrode with a second electrode placed on the chest was required. Bocka then compared fully automatic AEDs to semiautomatic models, and discussed the AEDs efficacy in the detection of ventricular fibrillation. A detailed comparison of the models produced by various manufacturers is followed by cautions against improper usage and suggestions for future use of the device. Bocka observed that AEDs represent medical technology comparable to vaccines and antibiotics in their ability to save lives, but admitted that further research and trials are necessary to determine the exact role of AEDs in emergency medical care. Although Bocka's study, written when AEDs were still in an evolutionary stage of development, still serves as a valuable overview of the AED.

History of CPR and Defibrillation

In a more recent Annals of Emergency Medicine article, the history of CPR and the role of the National Conference in creating guidelines for adult, advanced, pediatric, and neonatal life support was examined (Paraskos, 1993). The author summarized the proceedings of the most recent National Conference on CPR. Paraskos began with a description of mythological accounts of resuscitation from ancient European, Near Eastern, and Middle Eastern cultures, followed by a discussion of similar accounts from the Bible. Paraskos continued to describe some of the numerous sporadic, and later, more deliberate attempts at resuscitation which preceded the "discovery" of "closed-chest cardiac massage" by Kouwenhoven, and Knickerbocker in 1960. Paraskos then examined the role of the national conferences by describing the guidelines set forth in the

proceedings of 1966, 1973, 1979, 1985, and 1992, respectively. Paraskos distinguished the most recent conference from its predecessors in that it achieved unprecedented international participation, established criteria for reviewing scientific literature, and graded recommendations according to the weight of supporting evidence. Paraskos' article not only provided a useful history of resuscitation, but also established CPR as an internationally regulated emergency medical practice.

Before undertaking any serious medical study, it is necessary to define and justify the concept being examined. In Advanced Cardiac Life Support, defibrillation is defined as "the therapeutic use of electric current delivered in large amounts over very brief periods of time" which "temporarily depolarizes an irregularly beating heart and thus allows more coordinated contractile activity to resume" (Cummins et al., 1997, p. 4-1). The same work outlines the importance of early defibrillation as the only effective means of treating ventricular fibrillation (VF), which is the most frequent initial rhythm in sudden cardiac arrest. The need for early treatment is evidenced by the fact that the probability of success declines rapidly with time. Also, defibrillation can be successful when performed as late as six to ten minutes after cardiac arrest, when CPR is performed in the interim period.

Importance of Early Defibrillation

The common acceptance of the importance of early defibrillation emerged as a result of extensive research. In a 1996 Resuscitation article, suggestions were given for improving the outcome of cardiac arrest occurring in the hospital (Kaye & Mancini, 1996). The authors observed the need for guidelines for predicting poor outcome of

cardiac arrest patients in order to make more informed decisions about resuscitation, and implementing early defibrillation when resuscitation was deemed appropriate.

Furthermore, Kaye and Mancini (1996) suggested that in a hospital setting, early defibrillation should always take priority over CPR because of the immediate availability of the necessary equipment. According to the authors, medical and surgical nurses can easily learn and retain the skills needed to properly operate AEDs. The authors concluded that providing early defibrillation can eliminate the need for interim CPR, resulting in a better outcome for the patient.

As a result of a 1991 study, Kaye and Mancini's conclusion was supported with scientific evidence. Dickey and Adgey (1991) had set out to determine the factors related to mortality within the hospital after patients had been resuscitated with an AED by a mobile coronary unit manned by a physician. The researchers employed a retrospective design, using records of resuscitated patients admitted to a Belfast hospital over a 21-year period to determine survival rates and causes of death. A result of the study revealed that early defibrillation was a major factor in determining the survival of the patients once admitted to the hospital. The study findings indicated that defibrillation delayed by more than five minutes significantly decreased survival rates. Although Dickey and Adgey's study consisted of only 281 subjects, it is sufficient evidence of the significance of early defibrillation.

The use of AEDs has clear advantages over CPR alone. One early study examined the neurologic recovery and survival of 87 patients who had suffered cardiac arrests outside of the hospital and had received defibrillating shocks delivered by minimally

trained first responders before paramedics arrived (Weaver, Ramirez, Dortman, & Raizner, 1979). Researchers found that, in cases where there was a delay in CPR initiation and in which paramedics arrived later than nine minutes after the arrest occurred, there was a 62 % survival rate after early defibrillation by first responders, as compared to only 27 % when only CPR was administered. The study also indicated improved neurologic recovery after early defibrillation. Weaver, Copass, Bufi, Ray, Halstrom, & Cobb (1984) concluded that, even in cities with rapidly responding emergency care personnel, early defibrillation could decrease mortality and morbidity in cardiac arrest victims.

Richard E. Kerber, MD, mirrors this sentiment in an online synopsis of a recent speech made before the AHA. Kerber (1998) advocated the implementation of public access defibrillation (Kerber, 1998). The trend toward the extension of automated defibrillation into the public service sector illustrates the general recognition of the need for early AED response to cardiac arrest. Kerber concluded that "the deployment of easy-to-use, automated monitoring and defibrillation units operated by non-traditional responders should dramatically decrease time to defibrillation and increase success in the treatment of sudden cardiac death" (Kerber, 1998). Kerber recommends more AHA clinical trials to establish the feasibility and cost of public access defibrillation, as well as legislative strategies to encourage AED use. Kerber's recommendations, because they would entail the instruction of lay-persons in AED use if implemented, imply a definite need for studies examining the comprehension and retention of defibrillation skills.

Public Access Defibrillation

A 1989 study conducted by Cummins, indicated that public access defibrillation could be a feasible means of saving lives outside the hospital environment. Results from previous controlled clinical studies have demonstrated increased survival rates seen in communities before and after the implementation of an early defibrillation program (Eisenberg et al., 1980; Stults et al., 1984; Bachman, McDonald, & Obrien, 1986; Vukov, White, & Backman, 1988; Olson, Larochelle, & Fark, 1988). In four of the studies, emergency medical technicians (EMTs) received instruction in rhythm recognition and device operation and then utilized conventional defibrillators. In the fifth study, EMTs from 15 fire departments were studied before and after switching from non-shocking AEDs to those that could deliver a shock. The results of these studies showed dramatic degrees of improvement in the survival rates for ventricular fibrillation. Primary results from these studies suggested that AEDs increase survival when used soon after cardiac arrest by relatively untrained emergency medical service personnel.

AED Training and Retention Studies

The training of hospital staff in AED related skills and the retention of the skills has previously been examined. Kaye et al. (1995) attempted to determine if non-critical care staff previously trained in basic life support (BLS) could be easily trained to use AEDs and whether they could retain what they learned. Participating in the study were 140 nurses who constituted three nursing units in two university teaching hospitals and were proficient in BLS. The nurses attended a two-hour class in which they were taught how to use AEDs on computerized manikins. The study participants were evaluated

immediately after the training and at intervals of 1 to 3, 4 to 6, and 7 to 9 months. Overall, 95 % of the study participants evaluated performed satisfactorily. While these results are promising, the study does present several limitations. The scope of the study was relatively narrow. Of the 140 participants, only 77 were ever evaluated beyond the initial posttest period. In the group of 77, only small groups were tested at each interval. Furthermore, the study did not evaluate the performance of the participants in actual emergency situations. However, the study findings suggested that AED skills can easily be taught to and retained by medical/surgical nurses.

Another study conducted by Cummins et al. (1989) revealed findings that suggested similar implications for lay persons. Since AEDs do not require training in rhythm recognition and interpretation by the operator, non-medical personnel can be trained to use them properly. The 1989 study was conducted to determine the possibility of recruiting lay persons to use AEDs and the effectiveness of initial training and the need for retraining (Cummins et al., 1989). One hundred and forty six volunteers, recruited from various business and service sectors, attended a two-hour training session and were evaluated one or more times during the year following training. The researchers discovered that all age groups and both sexes showed satisfactory performance, although participants over 60 years of age received slightly lower scores. Unlike the nurses, however, lay persons' skills declined significantly after initial training but increased with training sessions. While the results indicated that AED training for lay persons is feasible, the ability of trained lay persons to successfully use AEDs on patients actually experiencing cardiac arrest cannot be predicted.

AEDs and CPR are inextricably linked because the skills and knowledge required to use AEDs are based on existing CPR skills. However, results of previous studies have shown that retention of CPR skills by all persons trained, especially lay persons, is generally poor. The trend was recognized following a 1979 study in which 61 lay persons trained in CPR. The participants were randomly selected from a group of 280 and were evaluated six months after completion of a four-hour BLS course to determine the degree of retention according to AHA standards (Weaver et al., 1979). The researchers discovered significant declines in performance six months after initial training.

Retention of CPR Skills

A study of retention of CPR skills by medical students showed similar results. Fossel et. al (1983) found that preclinical medical students who had received CPR certification one or two years prior to the study showed significantly lower retention rates than students who had received training two or three weeks before. The recently certified group showed better skill performance, fewer errors, and higher test scores. The entire study actually consisted of 61 students, but in light of previous research it is likely that similar results would be seen in a larger population. The authors concluded that even one year might be too long a certification period for individuals who are not actively engaged in frequent CPR administration. A further study conducted by Gass & Curry (1983) that focused on physicians' and nurses' retention of knowledge and skill after CPR training revealed comparable results. The researchers noted a significant decrease in knowledge and skill 6 months following training and a further decrease 12 months later.

Another study conducted using EMTs, indicated that deterioration of CPR skills extended to other trained professionals. The study evaluated the degree of retention of 71 ambulance attendants and 60 fire-rescue squad men and found a significant decline in skill performance over time (Deliere & Schneider, 1987). The researchers observed a significant association between CPR skill retention and the length of time since a training program was completed. Participants who had completed a training program within one to six months prior to the study showed better performance when evaluated. While acknowledging the need for further study, the researchers concluded that retraining programs should be conducted no less than once a year and, preferably, every six months.

Study findings have emphasized the need for CPR educators and researchers to reexamine current teaching techniques in order to provide better comprehension and maximize the likelihood of successful resuscitation in the event of a cardiac arrest. In a Critical Care Medicine article, Kaye et al. (1985) addressed this need by advocating changes in life support instruction. The authors suggested the following improvements: simplification of basic life support (BLS) and advanced cardiac life support (ACLS) procedures and curricula, and teaching and testing strategies; definition of objective criteria for knowledge acquisition and performance; development of a resuscitation record; development of retraining courses based on specific deficiencies; and new approaches to improving retention, formation of an international consortium to investigate BLS and ACLS, and development of a tool to measure skill performance during actual resuscitation. Since the article's publication in 1985, the suggestions have been useful in studying and improving CPR training.

The tendency toward deterioration of CPR skills over time is recognized by the authors of one article in which skill acquisition and retention issues related to AED training were discussed (Cummins et. al, 1985). Utilizing Knowles' Theory, the authors observed the potential problems associated with teaching CPR in combination with AED skills because of the limitations of adult learning capabilities. To combat these problems, the authors suggested an individualized, multi-media approach, which employed verbal explanation, visual aids, demonstrations, role-playing and coaching. As a result of prior evidence regarding deterioration of CPR skills, the authors considered periodic retraining necessary to enhance skill retention. Again, the authors stressed the limitation of AED research in that its findings may not correlate with actual emergency use.

Another method of maximizing skill retention is increasing the level at which study participants are trained. This method evolved from a 1980 Canadian study in which researchers evaluated skill retention in a police force initially trained to meet instructor level skills as defined in the 1977 American Heart Association Instructor Manual (Tweed et al., 1980). The 900 personnel of the Winnipeg Police Force were trained in basic CPR and tested according to instructor standards. A total of 116 police officers were randomly selected for retesting 12 to 18 months later. Researchers found high retention scores for knowledge, assessment skills, call for help, numbers of adequate ventilations and compressions, which led them to conclude that deliberate over training of highly motivated and mature nonmedical basic rescuers results in satisfactory retention for at least one year. While the sample evaluated was relatively small, the size of the original population and the random selection of participants for re-evaluation suggested a high

level of accuracy. Although the results of this study cannot necessarily be applied to laypersons, the study findings suggested that training individuals at instructor levels could be a viable way to increase retention.

The principle of early defibrillation has been established by extensive research. Many emergency care systems and family members of high-risk patients across the country have utilized AEDs to deliver early shocks for cardiac arrest. Previous research findings have established that use of AEDs by EMTs and paramedics can save lives from out-of-hospital cardiac arrest. In one study, results revealed that AED implementation could be cost-effective. Ornato, Craren, Gonzolez, Garrett, McCluns, & Newman (1988) found that EMTs or paramedics who are equipped to defibrillate could save more lives than those who could not defibrillate. The researchers collected data from all 50 states and the District of Columbia to determine the length and cost of training for the three types of EMTs in the U.S. in 1986. Whether in urban, rural, and suburban settings, the initial cost per life was more than three times greater in emergency medical systems with basic EMTs than in those trained to use AEDs.

AED Devices

Although the benefits of using AEDs for early defibrillation are clear, the devices are not always foolproof. As illustrated in several journals, proper training does not always insure that the devices will be operated correctly. In one article, a dozen incidents of AEDs failing to discharge occurring at nine different hospitals during 1986 were reported (Anonymous, 1986). However, at least seven of these cases were due to user error, and the patients suffered no serious injuries. Authors of a 1992 Annals of

Emergency Medicine article described a similar incident in which a 79-year-old man who was in normal sinus rhythm was erroneously shocked two times by a Heartstart ® 1000 AED (Ornato, Shipley, Powell, & Racht, 1992). After the second shock caused ventricular tachycardia, the device countershocked a third time to restore normal sinus rhythm. Again, the incident occurred because the EMTs failed to follow the device's instructions against applying the device in analysis mode to a patient with a detectable pulse. More recently, two cases of AED malfunction in 1994 led FDA agents to view AEDs as a public health hazard (Cummins et. al, 1995). One error occurred when a Heartstart 1000 AED did not shock ventricular fibrillation (VF), and the second case took place when an AED of the same brand shocked a non-VF rhythm. The FDA used these two cases as evidence that this particular brand was "misabeled" because its instruction manual was interpreted by the FDA as indicating that it would shock VF when VF was present, not when detected, which was what the manual actually stated. The FDA censured the manufacturer in spite of the fact that these two cases alone-represented small percentages of malfunction considering the devices' extensive use in emergency care. Although AEDs like any medical device or technology are not perfect, they have saved thousands of lives from cardiac arrest. Early defibrillation programs implemented in emergency care systems across the country have been widely successful. Although adequate training cannot guarantee perfect use, improvement of teaching methods and recertification intervals can decrease the already small number of AED errors.

In spite of the few cases of AED malfunction which have occurred, results of one study offered evidence that defibrillators are safe and effective (Dickey et al., 1992)

assessed the accuracy of decision-making of a semi-automatic defibrillator at 57 cardiac arrests in 55 patients. Thirty-seven of 40 initial VF rhythms were correctly identified, and 16 of 17 non-VF rhythms were also correctly identified. The results indicated that the defibrillator has a high sensitivity (efficacy) for VF and specificity (safety) for non-ventricular fibrillation. The researchers concluded that the particular defibrillator in question, the Lifepak automatic brand, is suitable for use by relatively unskilled operators outside the hospital. Recent clinical trials of AEDs have resulted in similar findings. In an online version of Cardiac Science, Ybarra (1999) described the clinical results of the prototype AED Powerheart bedside model, which has completed both Phase I and II human clinical trials on 141 patients. Researchers collected data from four clinical centers from May 1993 to October 1996. In the 93 shockable events experienced by the patients, the sensitivity of the Powerheart model was 100 percent, and the specificity was 99.4 percent, with an average response time of 20.9 seconds. Although these findings represent the performance of a single model on a small scale, they indicate that current AEDs are highly accurate and effective.

Although clinical trials have proven the effectiveness of AEDs, further improvements must be made to insure the success of public access defibrillation. Kerber et. al (1997) stressed the high potential for misuse of AEDs by minimally trained personnel. The elevated risk is due to the fact that AEDs are inappropriate for victims who are conscious and breathing, as well as those in cardiac arrest who are receiving artifact-generating CPR during rhythm analysis. To conquer these potential complications, the AHA Task Force on Automatic External Defibrillation recommended

that new features be designed to minimize injury in the event of misuse. AED features might include voice chips to prompt a rescuer in proper techniques, a low frequency “wake-up shock” to arouse an unconscious patient not actually in cardiac arrest, or a mechanism to automatically alert local emergency medical services when the device is put into use. The features, in combination with improved training techniques, should maximize the possibility of successfully implementing public access defibrillation.

However, additional research must be conducted to determine appropriate certification periods and training techniques, especially if public access defibrillation is to be implemented on a large scale. The AHA has recommended that the National Heart, Lung, and Blood Institute initiate and fund large clinical trials to evaluate AED use by first responders and the lay public. The trials should also document the safety, efficacy, and cost-effectiveness of the device and attempt to determine which training methods achieve satisfactory outcomes (Weisfeldt et. al., 1995). Successful early defibrillation programs require not only clinical trials, but also a level of commitment from hospital and emergency care staff. Public access defibrillation clearly poses numerous challenges. Even the establishment of an in-hospital automated external defibrillator program demands commitment from administration, physicians, and nursing personnel. Mancini & Kaye (1998) also recognized the role that critical care nurses can play in implementing AED programs, by evaluating an institution’s need for such programs, gaining support from hospital staff, developing the training programs, serving as BLS and ACLS instructors, and modifying policies to incorporate first-responder automated external defibrillation.

As evidenced by all the studies discussed, early defibrillation has been proven as an effective means of saving lives from cardiac arrest. In order to maximize the benefits of defibrillation, however, AED programs must be implemented in every community, hospital and emergency care system across the country. The Advanced Cardiac Life Support Subcommittee and the Emergency Cardiac Care Committee of the AHA has made several specific recommendations concerning early defibrillation (Cummins et al., 1997). First, all communities should adopt the principle of early defibrillation. All personnel who are expected to perform CPR should be required to carry an AED. Second, all medical professionals who are expected to respond to cardiac arrest should have either immediate or prompt (1-2 minutes) access to a defibrillator. Last, the widespread use of AEDs by community responders should be authorized and implemented by responsible personnel. Furthermore, the AHA emphasizes the “Chain of Survival” concept which consists of early recognition and access, early CPR, early defibrillation, and early advanced life support. The “Chain of Survival” should be constantly stressed as more emergency medical systems attempt to incorporate early defibrillation programs (Weisfeldt et. al, 1995). Embracing the concept is important because it emphasizes that early defibrillation is only one aspect of a larger process. In a special report from the American Heart Association, Weisfeldt et al. (1995) stated the position of the AHA’s AED task force:

Strengthening the single link of early defibrillation in a system that is weak in the other links is not sufficient. Such programs are a waste of time, economically

irrational, and deceptive to both the emergency personnel and the citizens who are being treated. (p. 93).

The key to building this strong link lies in a CPR training program that enables citizens to quickly recognize cardiac arrest and respond by summoning medical assistance so that defibrillator units can be dispatched immediately (Cummins, Thies, & Pepe, 1991). Furthermore, trained bystanders will recognize that while CPR alone is not an effective means of resuscitating a patient in cardiac arrest, it can help to prolong VF rhythms until the arrival of a defibrillator. Lastly, advanced life support systems serve to stabilize patients after resuscitation and insure a consistent rhythm. As Weisfeldt et. al (1995) stated, “without strong links in these other portions of the Chain of Survival, implementation of an early defibrillation program is essentially a waste of time and resources” (p.2763).

Summary

AEDs are just one example of how the advent of modern medical technology has saved hundreds of thousands of lives in the U.S. The review of literature on this important device has established the significance of the principle of early defibrillation, highlighted the skills necessary to utilize this principle, as well as the difficulties which have occurred with past methods of instruction. The rapid deterioration of skills over time and the benefits of overtraining at the instructor level have been examined. The benefits of AEDs have been emphasized, as well as the flaws in design and user capability. The safety and effectiveness of these devices have been illustrated. The implementation of widespread public access defibrillation has been explored, and the

establishment of in-hospital first responder programs has been recommended. All of the evidence discussed points directly to the need for further study to determine how to make the process of early defibrillation run as smoothly as possible by insuring that responders are prepared to take action in the appropriate manner.

There is no doubt that early defibrillation has become one of the most important links in the chain of survival, which has the ability to rescue persons in cardiac arrest. The AHA's recommendation that early defibrillation programs should be instituted in every community should be heeded without question. However, the clinical trials, design improvements, and changes in training techniques must continue to insure the highest level of accuracy and efficiency. Only through continuing education can we learn all of the benefits of early defibrillation and the best way to see it successfully implemented in hospitals and communities across the U.S.

Literature Related to Adult Learning

The literature on adult learning theory provides a powerful knowledge base that offers guidance in the design, development and implementation of effective staff development programs. A working understanding of the nature of learning is important in understanding the characteristics of the participant learner. This knowledge foundation includes experiential and theoretical discussions, as well as more traditional research studies. Discussions of how and why adults learn and ways to facilitate that learning, for example, are essentially theoretical in nature; however, there is a good deal of research on how to organize staff inservice programs to support learning. This section provides a literature review that focuses on principles of adult learning including (a) the

characteristics of adult learners; (b) nurses as learners, (c) the characteristics of effective adult training programs, and (d) the organizational characteristics that contribute to effective adult learning. In addition, an overview of Knowles' theory of andragogy, the theoretical model chosen to direct this study is examined, and an analysis of the application of Knowles' theory used in this study is presented.

Knowles' Theory of Andragogy

The term andragogy was originally coined by Alexander Kapp, a German teacher who used the word in 1833 to describe elements of Plato's education theory (Knowles, 1978). The word did not reappear in the literature again until 1921 in a paper by Rosenstock referring to andragogy when speaking about the requirements of adult education. Although the term did not readily gain acceptance in North America, the term became popular in France, Yugoslavia and Holland where it was used extensively to refer to principles of adult education. According to Knowles (1998), andragogy (andr-meaning 'man') could be contrasted with pedagogy (paid-meaning 'child' and agogos meaning 'leading').

Knowles' (1980) theory of andragogy is an attempt to develop a theory specifically for adult learning that emphasizes adults who are self-directed and expect to take responsibility for decisions. Adult learning programs must accommodate this basic aspect. Andragogy makes the following assumptions about the design of learning: (a) adults need to know why they need to learn something, (b) adults need to learn experientially, (c) adults approach learning as problem-solving, and (d) adults learn best when the topic is of immediate value. In pragmatic terms, andragogy means that

instruction for adults needs to focus more on the process and less on the content being taught. Knowles suggested that instructors adopt a role of facilitator rather than lecturer.

Overview of Adult Learning Theories

According to Zemke & Zemke (1988), "No single theory or set of theories seems to have an arm-lock on understanding adults or helping us work effectively and efficiently with them" (p. 45). Considered a classic since its initial publication in 1981, this article in Training highlights "things we know" about adult learners and their motivation, about designing curricula for adults, and about working with adults in the classroom (p.57). Knowledge about the various theoretical approaches is useful in designing staff development that is effective for a broad variety of learners. In any learning situation, learners undergo some type of change, therefore understanding the nature of change is important.

Research on the implementation of innovations has defined elements of change that can be applied to staff training programs (Hall & Loucks, 1978). According to Hall & Loucks, change is a process, not an event. Introducing people to new ways of doing things does not assure that they will immediately begin to do them. Change is viewed as a gradual process that requires time to occur. Understanding how individuals may respond to changing their behaviors is critical. Each person perceives and reacts to change in an individual way. Change by individuals causes growth, both in terms of how they feel about the change and their skill in applying any changes. The growth is part of the process of change, which an individual undergoes over time.

Characteristics of Adult Learners

In reviewing the literature on adult learning, including examination of all types of learning theory, the following common descriptors of adult learners are seen: adults learn throughout their lives. Age does not reduce a person's ability to learn but may reduce the speed at which learning takes place. The adult learner is a person with a sense of self, bringing all previous life experiences to bear on new learning. Past experiences serve as the foundation for current learning. Adults learn best when new concepts are built upon past experiences. Adult learners' stages of development, whether personal (cognitive, moral, ego, conceptual), chronological (early adulthood, mid-life, etc.) or professional (new or experienced teacher, etc.), profoundly affect their learning. Adult learners are motivated to learn by changes in their situations and learn best when new concepts apply in practical ways and/or are relevant to the changes in their situations. The adult learner controls what is learned, selecting new information and/or deciding how to use it, and this takes place at both the conscious and unconscious levels. Adults tend to be problem-centered rather than subject-centered learners and learn best through practical applications of what they have learned. Adult learners must be treated as adults and respected as self-directed persons. They learn best in non-threatening environments of trust and mutual respect. The optimum role of the adult learner in the learning situation is that of an active participant in the learning process and who assumes responsibility for learning. New learning is followed by a period of reflection to facilitate integration and application of new knowledge and skills.

Nurses as Learners

Nurses are experienced professionals with varying backgrounds in educational practice. They are capable adult learners, and the variety of experiences they bring with them to inservice programs affects what and how they learn. Limited research exists which specifically examines knowledge and skills retention in nurses. For this reason, the focus of the literature is on the theoretical principles of adult learning as it applies to nurses.

Characteristics of Effective Adult Training Programs

Effective staff training programs should take into account the nature of adult learners and the need for making learning accessible to them. Smith (1982) suggested five optimum conditions for learning and that adults learn best when these conditions are met:

1. Adults feel the need to learn and have input into what, why and how they will learn.
2. Learning's content and processes bear a perceived and meaningful relationship to past experience, and experience is effectively utilized as a resource for learning.
3. What is to be learned relates optimally to the individual's developmental changes and life tasks.
4. The amount of autonomy exercised by the adult learner is congruent with that required by the mode or method utilized.
5. Adults learn in a climate that minimizes anxiety.

Information from the literature about motivating adults to learn supplements knowledge about learning and the adult learner to increase effectiveness of inservice programs. Based on an extensive review, Wlodkowski (1985) lists specific factors that have impact on motivation: (a) attitude, the learner's concepts, information and emotions about the learning which result in a tendency to respond favorably to need; (b) stimulation or any change in perception of the environment that prompts the learner's action; (c) affect, the learner's feelings and concerns; (d) competence, the learner's sense of efficiently interacting with the environment; and (e) reinforcement, the learning event maintains or increases the probability that the learner will achieve the appropriate response. Wlodkowski (1985) further suggested that attention to these factors during the learning process can increase motivation.

Smith (1982) adds that learners' expectations are important to their motivation and that programs should create the expectation that learners will succeed. Care should be taken that extreme structure and authority in the program do not become a disincentive for learning.

Kolb (1984), in his work on learning styles, identified three types of learning theory: (a) rationalist theory, in which learning focuses on the acquisition, manipulation and recall of abstract symbols, (b) behavioral, in which learning is a process of changing behavior with no role for a subjective experience in the learning process, and (c) experiential, a holistic learning theory that includes a combination of experience, perception, cognition and behavior.

Characteristics of Effective Programs

A substantial frame of research exists which examines the characteristics of effective staff inservice programs. The research base focuses primarily on teacher inservice experiments; basic skills instruction experiments; teacher effects research; implementation research; descriptive survey research on teachers' preferences and attitudes; and research on teacher expectations, principles and achievement testing (Gall & Renchler, 1985). These studies show that there are identifiable characteristics, which contribute to the success of inservice programs. Overall, the desired outcome of inservice training is one of the following: (a) information transfer in which participants receive information about new approaches and/or techniques, (b) skill acquisition in which participants are taught a particular way to do something, and (c) behavior change in which new information and/or skills are taught with the expectation that participants will apply the new learning and change their behaviors (Korinek et al., 1985).

Showers et al. (1987) identified four levels of impact for staff development programs, in terms of the response of the participants: (a) awareness; participants realize the importance of new information; (b) concepts and organized knowledge, concepts are understood and organized; (c) principles and skills, principles and skills for action are understood and participants can think effectively about them and have the skills needed to act to apply them; and (d) application and problem solving, participants transfer new information in problem-solving fashion to real-life situations.

In a review of available research, effective structures for staff development programs appear consistently across studies. Designs are based on principles of adult

learning and an understanding of the process of change. Programs are conducted long enough and often enough to assure that participants progressively gain knowledge, skill and confidence. Training is conveniently scheduled to avoid interfering with on going job requirements of participants. Activities take place at a convenient location. Trainers have credibility with the participants. Participants are involved in the planning, development and presentation of the training program.

A review of the literature on adult learning provided guidelines from a variety of sources for designing curricula for adults. A review of past research provided the following characteristics of effective content for staff inservice programs:

1. Programs are planned in response to assessed needs of the participants (Zemke & Zemke, 1988).
2. Course content matches the current developmental level of participants (Zemke & Zemke, 1988).
3. Course content is aimed at developing specific skills concepts (Griffin, 1982).
4. Rationale for learning new skills is included in the course content (Berman & McLaughlin, 1975; Showers et al., 1987).
5. Professional development focuses on job-related tasks (Fullan 1982; Purkey & Smith 1983).
6. Clear, specific goals and objectives related to implementation are present (Griffin, 1982).

7. Course content is research based and tied to student performance (Sparks 1983; Gall & Renchler 1985).

8. The use of new behaviors is made clear (Sparks 1983; Orlich 1984).

Overall, content of staff development programs reflects clear program goals and operational objectives defining what participants will learn and how they will be able to use the new skills. Content should build on participants' prior experience and prepare them to apply what they have learned. Research support for the selected program content should be clear, providing the rationale for applications. Both knowledge (the understanding of background and concepts) and skills (the ability to put knowledge into operation) should be included in the program. Participant evaluation and accountability should also be integrated into inservice programs to increase incentives for learning and application. Several researchers have studied program components to identify those that are essential.

Showers et al. (1987) identified five components of effective development programs that have become widely acknowledged as important: (1) description of the new skill, (2) demonstration of skills, (3) practice in simulated and/or actual settings, (4) open-ended feedback to provide information about performance in the practice, and (5) follow-up evaluation to help with the implementation of the new skill and/or knowledge.

To facilitate learning, training programs should include presentation of new material, demonstration, practice, feedback, and follow-up for evaluation and accountability. Showers et al. (1987) recommended that complex new material be presented incrementally, with repeated checking for understanding.

Sparks and Loucks-Horsley (1990) identified characteristics of organizations where staff development is most successful: (a) staff members have a common set of goals and objectives reflecting high expectations of themselves and their students, (b) administrators exercise strong leadership by promoting collegiality, (c) administrators place high priority on staff development promoting formal training programs and informal sharing of job knowledge.

Often taken for granted is that the improvement of instructor skill results in improved student performance. While there are few existing studies examining the important connection between staff development programs and improved student performance, a small group of studies (Gage 1984; Sparks & Loucks-Horsley, 1990) do indicate that staff development programs can have positive effect on student performance. Further studies of this type are needed to support what is generally believed to be true: staff development can and does have impact on student performance.

Summary

Knowles' theory of andragogy aided in establishing conditions necessary for the achievement of learning objectives. An explanation of why specific course content was being taught was elucidated in the beginning of each teaching session. Learning objectives identified included cognitive and psychomotor objectives. Knowledge objectives were presented through lectures, handouts, and a slide show. For the cognitive objectives, the learners were told what they must know and how that knowledge would be evaluated. For the psychomotor objectives, the learners were told which physical skills they must perform. According to Cummins et al. (1985), "...learning to use an

AED in combination with basic CPR poses a familiar problem in adult education-that acquiring a new psychomotor skill during initial training, and then retaining that skill for weeks or more before finally being called on to perform” (p.758).

Past research has demonstrated that “adults will make a commitment to learning when the goals and objectives are perceived as immediately useful, realistic, important, and relevant to professional, and career needs” (Van-Hoozer et al.,1987, p.48). Specific commands, functions, and operations of the use of the AED were defined and clarified.

The literature provided guidelines for the present study. For example, class instruction used in this study was task-oriented instead of memorization. Each of the learning activities was included in the context of common tasks to be performed. The instruction took into account the diverse range of different backgrounds of the learners. Learning materials were prepared with the previous educational experiences of the participants in mind. All participants in the class had attended a CPR class before but the information and training on the AED was new to everyone. Although only nurses were evaluated for the study, class participants included nursing assistants and unit secretaries. Research has consistently demonstrated that adults seem to learn best through experiences in which they apply what is being learned (Knowles,1984; Van-Hoozer et al., 1987). As adults are primarily self-learners, instruction allowed learners to discover for themselves with the instructors serving as facilitators and resource personnel. Students were first allowed to try their actions, the instructors as needed provided them coaching. Satisfactory completion of the course was criteria-based and determined by a written and skills evaluation.

Chapter III - Methodology

In this chapter, the methodology used in this study is described. The population, sampling design, instrument, protection of human rights, collection of data, and methods used for data analysis are discussed.

Population Sample

Participants for this study were selected from a convenience sample of 44 nurses who attended an employer required annual CPR class. All participants were full time employees of a 130-bed general acute care hospital in rural Southeastern Georgia.

Participants were selected from the CPR roster provided by the facility's Education Department. Nurses included Registered Nurses (Associate degree, Bachelor of Science, and Diploma-prepared) and Licensed Practical Nurses.

Inclusion Criteria

All full-time nurses, who completed their initial AED course in February, March, and April 1999, were invited to participate in the study. Only full-time employees were considered for the study to enhance availability of the participants for re-testing purposes. A total of 26 RNs and 9 LPNs were evaluated, which included 33 female nurses and two male nurses.

Research Design

Outcome evaluation research using a descriptive repeated measures design was conducted to determine if the level of knowledge and skills necessary to safely use an AED significantly declined after initial training. Retention was evaluated by comparing the participants' six-month follow up scores with those achieved immediately post-training. The research design was based on a similar study conducted by Kaye et al. (1995) at two university teaching hospitals. The study focused on whether nursing staff could be easily trained to use AEDs and whether they would retain these skills.

Information was conveyed in a manner geared toward a spectrum of age groups with varying medical backgrounds. An introductory 8-minute video portraying a victim of ventricular fibrillation who had been saved by an AED was shown first, followed by a standardized watch-then-practice videotape to demonstrate psychomotor skills. This approach provided consistent skill demonstrations, avoiding the variability of skills display and class time that may occur from instructor to instructor (Chandra et al., 1997, p.7-7). The psychomotor portion of the training was based on the principle that the rescuer using an AED device performs reflex action skills learned through repetitive hands-on-practice (AHA, 1997, p.26.)

Realistic case scenarios that mimicked real-life events and role-playing were employed to promote learning. During this phase of training, instructors supervised skills, corrected skill performance, and provided explanations to questions. A low participant-to-instructor (4 students to 1 instructor) was provided in an effort to meet the individual needs of each learner. Past research has shown that an adequate amount of

practice time will result in more successful learning and retention (Knowles, 1978; Korinek, et. al 1985). The focus on skills acquisition as a reflex action and the idea that more practice time will result in improved skills performance “reflects the philosophy that students learn by doing” (Chandra et al., 1997, p.7-7).

Intervention

Permission was obtained for use of the Heartstream Forerunner® semi-automatic AED for initial training, evaluation and re-evaluation of AED performance skills (see Appendix A). The Heartstream Forerunner® is a portable shock-advisory semi-automatic AED with a monitor screen. When the device detects a shockable arrhythmia (ventricular fibrillation or pulseless ventricular tachycardia), it automatically charges and signals the operator with a voice prompt that defibrillation is indicated. The operator is then required to push the “Shock” button to deliver a countershock. The AED machine is programmed to assess the heart rhythm and to charge the defibrillator for a sequence of three shocks, each time requiring the operator to push the “Shock” button. This particular AED model delivers the three countershocks in approximately fifty seconds. After three successive countershocks, a voice prompt directs the operator back to the initial stage of CPR. A standardized scenario included with the Heartstart AED trainer model was used to evaluate the initial performance of participants immediately post-training. The same standardized scenario used for initial performance evaluation was used for re-evaluation of performance skills six months post-training.

Instrumentation

Study participants were asked to complete the Automatic External Defibrillator (AED) Written Evaluation as a pre-test, a post-test immediately following the training session, and again as a post-test six months after initial training. The multiple-choice follow-up examination duplicated the cognitive test administered prior to the basic life support (BLS) course and immediately following the training session. Permission to use the test was obtained from the American Heart Association (AHA)(see Appendix B). The AED written exam is a 20-item multiple choice examination prepared by the AHA (see Appendix C). The written test had a total value of 100 points with each question worth 5 points. The examination covered material presented in the videos, lecture, and demonstrations. According to the AHA (1997), the written exam is "...in a case-based format to reinforce realistic scenarios that participants may encounter" (p. 17). No statistics were available from AHA regarding reliability or validity of this instrument , however item analysis of the written exam was performed on four separate pilots courses. According to information obtained from the Heartsaver's AED Instructor Manual, "questions with consistently poor performance were deleted, confusing words were identified, confusing wording of some questions were identified and revised, and continuous modification of the written evaluation occurred based on these pilot studies" (1997, p.23).

Satisfactory skills evaluation consisted of course participants' ability to safely deliver a shock within 90 seconds of placing an AED on a manikin with simulated ventricular fibrillation. The criteria coincided with the recommended guidelines by the AHA for satisfactory AED skill performance (AHA, 1990, p.291).

Protection of Human Rights

Approval from the Institutional Review Board of Georgia Southern University was obtained prior to initiation of the study. Permission to utilize equipment and nursing staff for the purpose of the study facilities was obtained from the hospital administrator and the director of nursing. The quality assurance coordinator at the hospital was informed in writing of the ongoing research. In addition, letters pertaining to consent and a time schedule for testing were provided to the two additional CPR instructor/trainers assisting with the CPR courses. The subjects' rights were protected by the following actions:

1. Participants were assured of the voluntary nature of participation and the fact they may withdraw from the study at any time. Completion and return of the AED written pre-test implied consent to participate in the study.
2. A letter to participants was included in their pre-course packet with a description of the study, explanation of risks and benefits, time requirements, assurance of confidentiality, rights as a participant, and availability of results at completion of the study (see Appendix D).
3. Participants were informed that any reported findings would be presented as group data; responses could not be associated with any individual.

Demographic Information

Demographic information was obtained from the participants by data supplied on a Demographic Data Tool developed by this author (see Appendix E). The questions included on the tool provided the investigator with contact information including name,

address, and phone number in addition to gender, job title, area of work, length of nursing experience, and educational degree.

Collection of Data

A list of potential participants was selected from the CPR rosters provided by the Education Department within the hospital. From the rosters, a list of nurses meeting the inclusion criteria was obtained. The American Heart Association's AED written evaluation was placed in a sealed packet labeled with each nurse's name containing CPR pre-course materials, to be taken as a pretest prior to the AED course. A cover letter containing information on the course and the study was secured to the front of each packet. The packets were hand delivered to the individual nurse's stations by the Education Coordinator. Nurses who were registered for the course picked up their packets in the office of their Head Nurse. Packets were available two weeks prior to the course date.

The written post-test and skills evaluation were administered immediately following an AED slide presentation, a video demonstrating AED use, and instructor-led practice scenarios. A score of 85% on a 20-question multiple choice written examination reflected successful understanding of the material. Participants were allowed 20 minutes to complete the written test. Satisfactory completion of the skills evaluation included the course participants' ability to safely deliver a shock within 90 seconds of placing the AED on a manikin with simulated ventricular fibrillation. Satisfactory completion of the written test and skills evaluation immediately post-training was required for successful completion of the AED course.

All registrants attending the class took the written test and completed the skill evaluation. The written test and skills check was repeated at six months after initial training to nurses participating in the study. The written AED test was administered to the participants' one week before the six-month anniversary of their initial training. Skill evaluations were conducted with each of the three groups at six months post-training.

Data collection, including administration of pre-test, post-tests, and AED skills check was completed by this investigator with the assistance of two instructor/trainers that co-taught the initial training session. Each of the instructor/trainers including this investigator, had completed an AED provider course prior to participating in this course. A precourse meeting was held with the instructors one week prior to each training session to review the outline for the course, and to confirm equipment and facility availability. The AED written post-tests were administered at the completion of the AED demonstration in each session. To assess retention of performance skills the instructors focused on whether the subjects could deliver a defibrillatory shock to a manikin with simulated ventricular fibrillation within 90 seconds. Each instructor participated in the AED skill performance check by timing the nurses' delivery of a shock after the AED was placed on the floor next to the manikin's ear. To insure uniform data collection, the investigator discussed the criteria for measuring skill performance with the instructors, such as when to begin and end the skill evaluation. Participants were graded on a pass or fail scale. Skill performance was considered satisfactory if participants were able to deliver a shock to a manikin with simulated VF within 90 seconds. Demographic data

collected from participants and all written tests were collected in sealed manila envelopes in order to ensure privacy and confidentiality.

Data Analysis

Demographic data and data from the pre-tests, immediate post-tests, and six month post-tests, were coded for computer entry. Demographic data were grouped by frequency distribution and displayed in tables. The Statistical Package for Social Sciences (SPSS-X) was used for data analysis.

Outcome evaluation using a descriptive repeated measures design was utilized to determine if the level of knowledge and skills necessary to safely use an AED significantly declined six months after a training program. Statistical analysis of the data was performed using an analysis of variance with single sample, randomized block design to adjust for the affect of demographic variables.

Polit and Hungler (1995) stated that with outcome analysis “evaluations typically focus on whether a program or policy works, that is, whether or not it is effective in meeting its objectives...the intent of such evaluations is to help people decide whether the program should be discarded, replaced, modified, continued or replicated” (p.190). This type of evaluation was appropriate for this study because “such an analysis documents the extent to which the goals of the program are obtained...” (p.190). The nurses’ raw scores on the written AED examination and their ability to use an AED within a 90-second time limit six months following initial training was compared to their performance of the same tasks immediately post-training. The dependent variable or

outcome measure was the retention of cognitive and performance skill six months post-training and the independent variable was the training.

An ANOVA with a randomized block design with repeated measures was utilized for statistical analysis. According to Kuzma (1992), the theoretical basis for using this particular statistic is the distribution of the available variance between the group means and variation within each group (p.144). The intent of this design is to remove from the error term the variation due to the blocks (Kuzma, 1992, p.152). A randomized block design was done to determine if there was a significant decrease in the mean scores of the post-tests between the groups, while controlling for the affect of the demographic variables. Significantly lower mean post-test scores would indicate a significant decline in learning retention.

Initially, chi-square was chosen to determine if there was a difference in performance skill six months after the initial training program. However chi-square was not deemed appropriate since all participants passed the skills performance tests after the initial training session in this study. According to Johnston, Rust, Rust, & Orpet (1995), “chi-square is a nonparametric statistic that is used to determine whether observed frequencies are significantly different from frequencies that are expected or predicted” (p.560).

Summary

This chapter provided an outline of the study methodology. The population of the sample was defined and the procedure for selecting the convenience sample was given. The interventions and instruments used in the study were discussed, protection of human

rights was reviewed, and discussion of the data collection and analysis was included.

Specific details regarding administration of written tests and skill performance evaluations were reviewed.

Chapter IV - Data Findings and Analysis

A total of 26 RNs and 9 LPNs participated in the study. The sample population consisted of full-time, hospital-employed nurses in a southeastern rural hospital in the United States. A total of 35 nurses participated and completed the study. Forty-four nurses completed the initial pre-test and immediate post-test, but were later excluded from the study because of leaving hospital employment ($n = 5$) or changing to part-time status ($n = 4$). In this chapter, demographic findings are described followed by the results of the data analysis. Statistical analysis was accomplished by use of the Statistical Package for Social Sciences (SPSS/PC Version 8.0). A significance level of $p < .05$ was set for all statistical tests. Demographic variables including age, gender, job position, area of work, years of nursing experience, type of licensure, and educational degree are reported.

Demographic Findings

Each of the 35 nurses participating in the study completed a demographic survey which was included with the pre-test. Summaries of the demographic characteristics of the sample, assessed through the demographic data tool are presented.

Descriptive statistics revealed that the majority of the nurses (54 %) was 42 years of age or older. The mean age was 40 years with a range from 21 –58. Over 95%

(n=33) of the participants were female. Only two male nurses participated in the study representing 5% of the sample.

The nurses' job positions were examined. Only three nurses employed in management positions participated in the study. Nurse management personnel included one (3%) House Supervisor and two Head Nurses (6%). The majority (91.00 %) of the sample was employed as staff nurses.

Over one fourth (28.57 %) of the participants in the sample (n = 10) worked as staff nurses on the medical floor. There were four surgical staff nurses, which comprised 11.43% of the sample. Four participants comprising 11.43% of the sample represented emergency room staff nurses, while six ICU/CCU staff nurses (17.14%) completed the study. A total of seven nurses from the obstetrics area comprised 20.00% of the sample, with two nurses for labor and delivery (5.71%), four nurses from the nursery (11.43%), and one nurse from postpartum (2.86%). Only two endoscopy staff nurses (5.71%), one house supervisor (2.86%), and one nurse employed in radiology (2.86%) participated.

The length of nursing experience among the participants ranged from less than one year to >26 years. Within the sample, two-thirds of the nurses (77.15%) had more than 5 years of nursing experience. Nine of the nurses (25.71%) participating in the study had over 20 years of nursing experience. Only two (5.71 %) of the nurses completing the demographic tool had less than one year of nursing experience.

The majority (74.30%) of the sample were RNs and one-fourth (25.70%) of the participants were LPNs. An examination of the educational experiences of the sample

indicated that the majority of nurses (62.90 %) who completed the study were educated in Associate Degree programs. With only four nurses prepared at the baccalaureate level, over 25 % of the participants were educated in practical nursing programs.

Inferential Data

Outcome evaluation research using a descriptive repeated measures design was used in an effort to answer the following research question: Does the level of knowledge and skills necessary to safely use an AED significantly decline after initial training? Retention was evaluated by comparing the participants's six-month follow up scores with those that had been achieved immediately post-training.

Test scores

Results of the randomized block design, single sample ANOVA (RANOVA) are reported in Table 1.

Table 1.

Analysis of Variance for Test Scores

Source	ss	df	MS	*F
Between	1751.90	1	875.95	20.43
Within	4666.66	34	66.67	
Total	6289.05	35	60.47	

$p = .00.$

The RBANOVA yielded a significant effect $F(1, 34) = 20.43, p = .00$ in this study, which indicated a statistically significant difference between mean scores. The mean percentage (with standard deviation in parentheses) correct on the six month follow-up test for the entire sample was 96.28 % (5.3334) as compared with 97.00% (5.1735) on the test given immediately after the initial course. Mean score for the pre-tests were 88.00 % (8.8451) (see Table 2). A post hoc test was inappropriate for the design, therefore, the means that differed significantly could not be determined. However, the mean scores between the pretest and post-tests are substantially different (88 %, 97 %, 96%, respectively), while the difference between the means of the two post-tests is minimal (97 % and 96 %, respectively).

Table 2.

Comparison of Pre-test, Immediate Post-Tests, and Post-Tests at Six Months

Written Tests	<u>M</u>	<u>SD</u>	<u>n</u>
Pre-test	88.00	8.85	35.0
Immediate-Post Tests	97.00	5.17	35.0
6 Month Post-Test	96.29	5.33	35.0

Summary

The analysis of data was presented in this chapter. Of the 44 nurses who met the inclusion criteria, 35 nurses (79.31 %) completed the study in its entirety. A total of 105 written evaluations, including pre-tests, immediate post-tests, and post-tests repeated at 6 months, were examined for completeness and summarized using descriptive and inferential statistics. A description of the sample was obtained through calculations of frequency distributions of the demographic data. Demographic variables were reported. The demographic variables included age, gender, job position, area of work, years of nursing experience, licensure, and educational degree.

Outcome evaluation research using a descriptive repeated measures design was employed to determine if the level of knowledge and skills necessary to safely use an AED declined six months after the training. An ANOVA with repeated measures using a randomized block design revealed a significant effect, $F(1, 34) = 20.43, p = .00$ between nurses' tests scores immediately following the training program and test scores.

Chapter V - Summary, Conclusions, Recommendations

In this chapter, a summary of the study, interpretation of the findings, and conclusions are presented. Implications for nursing are discussed and recommendations for further research are made.

Outcome evaluation research using a descriptive repeated measures design was used to determine if the level of knowledge and skills necessary to safely use an AED significantly declines after initial training. A list of all nurses who met the inclusion criteria for the study was compiled. Of the 44 nurses that initially enrolled in the study, 35 nurses were employed full-time at the hospital at the time of the six-month evaluation. Out of the 44, four nurses had changed to part-time status and five nurses had moved to jobs at other facilities. Therefore, a total of 35 participants were able to complete the study for a response rate of 79.50 %.

Retention of Knowledge and Skills

This study confirmed that hospital-employed nurses who are skilled in Basic Life Support (BLS) can learn and retain the knowledge and skills to use AEDs for six months after initial training. Kaye et al. (1995) reported a similar study involving hospital nurses, which corroborates these findings. McKee, Wynne, & Evans (1994) also reported comparable findings with student nurses in the United Kingdom.

The simplicity of the AED trainer model used in the training sessions, the Heartstart 1000 ®, may have had a positive effect on the high retention of AED skills. With the Heartstart 1000 ®, the operator requires minimum intervention. To operate an AED, only three steps had to be learned; (a) turning on the AED, (b) attaching the electrodes, and (c) locating and pressing the defibrillation button. Loud voice prompts, auditory beeps, and flashing lights, guided the operator through each of the interventions. Other types of AED models that are available require more operator intervention, and may not yield such excellent retention skills.

The nurses participating in the study received the pre-test on AEDs two weeks prior to their initial training. Nurses may have had some AED use prior to this training program. The mean pre-test scores of 88.00% (SD = 8.84) indicated that the majority of nurses had some prior knowledge of AED operation.

Study Limitations

Although the results of this study are encouraging, the investigation does present several limitations. Potential threats to internal validity and external validity were identified.

Threats to Internal Validity

Internal validity is achieved in an investigation when "...the findings can be shown to result only from the effect of the independent variable of interest and cannot be interpreted as reflecting the effects of extraneous variables" (Polit & Hungler, 1995, p. 217). In this study, maturation was a pertinent consideration because of the pre-test-post-test-post-test design. In research, maturation refers to any change that occurs with an

individual as a “function of time” (Polit & Hungler, 1995, p. 219). Events that occurred between the initial training and the re-testing at six months must be considered when evaluating the retention of skills and knowledge after a passage of time. This study would be highly susceptible to threat that maturation poses due to the pretest – posttest – posttest design used. Any interventions which occurred between the initial pretest and subsequent post-tests may have exerted an effect on the outcomes. In the following discussion, other potential threats to internal validity are examined.

1. History. In a repeated measures design study, history poses a significant threat to internal validity. Polit & Hungler (1995) explained that if an external event that has an effect on the dependent variable occurs during any course of the study, then the treatments would be altered by the effect of that event.
2. Testing. Due to the fact that a comparison group was not used, it was not possible to isolate the effects of the instruction from the effects of having taken the pre-test. Although steps were taken to insure that testing at 6 months was done the same way as the pre-test and post test were done, differences were noted. The six month post-test and skill check-off was completed in the hospital setting, after a unit meeting, in a less structured format, several variables related to testing which may have affected the outcome.
3. Instrumentation. The study is limited by the lack of an instrument with well-established validity and reliability. The subjective interpretation of some items on the AED written exam and the questionable ability of some nurses, particularly

those with less nursing experience, to interpret particular items on the written test must be taken into consideration when interpreting the findings.

4. Mortality. Nine nurses were dropped from the study after the initial pre-test due to change of job status and change of employment at the time of the 6-month follow up study. According to Polit & Hungler (1995) "... biases are generally of concern if the rate exceeds 20%". In this incidence the attrition rate was 25.71%, posing a moderate risk for sample bias.
5. Interrater reliability. Although the investigator was the primary observer in the study, two co-instructors assisted with post-skills check-off and data collection. Although criteria for performance testing were reviewed prior to the study, no test for interrater reliability was conducted.

Threats to External Validity

Polit & Hungler (1995) explained that external validity is attained when the results of a study can be generalized to situations outside the specific research setting (p.217). The major limitation of this study was the non-random sampling. Since the participants were nurses working in a rural hospital, the findings cannot be generalizable to an urban or community setting. Furthermore, the small sample size drawn from a single hospital further limits the findings of this study to hospital-employed nurses in this particular institution. In addition, the study is limited to nurses previously trained in BLS.

Several major characteristics of the sample that limit the generalizability of the study findings, which may pose threats to the external validity of the study, were

identified. The following effects were identified which could have affected the study's representativeness:

1. **Experimenter effects.** Performance of the participants may have been affected by communication of the investigator's expectations to the nurses. Polit & Hungler (1995) explained that replication of the original study may be difficult in a more neutral environment (p.223). Nurses participating in the study may have tried to score well on their tests in an effort to please the researcher or their employer. Results of the tests may have been different if the researcher had been a neutral person and the environment had not been in the employment setting. No attempt was made to discern if nurses had "studied" for the six-month post-test.
2. **Novelty effects.** Participants and researchers may alter their behavior when doing new things (Polit & Hungler, 1995). Learning to use an AED device was a new experience for each of the participants involved in the study. The results of the research may be different as the novelty wears off.
3. **The Hawthorne effect.** Polit & Hungler (1995) describe this phenomena as "the effect on the dependent variable caused by subjects awareness that they are participants under study" (p.643). In essence, subjects in a study may behave in a certain manner because they are aware of their participation in the research.
4. **Interaction of history and treatment effect.** Events external to the study may have influenced the results of the research. According to Polit & Hungler (1995), in a

- repeated measures design, history is a potential threat because "...an external event could differentially affect subjects in different treatment orderings and because the different orderings in themselves are a kind of differential history" (p. 221). During the course of the study extensive media coverage was aired on television advocating the use of automatic external defibrillators in the work place and in public places such as on airlines, amusement parks, and shopping centers. It would be difficult to assess whether or not the observed effects would be the same in the absence of the newfound media coverage of AED devices.
5. Measurement effects. Data collection procedures included collecting extensive background information, pre-tests, initial post-tests and repeat evaluations at six months. An effort was made by the investigator to keep data collection techniques consistent for the three groups to reduce the risk of this threat. Although the pre-tests were given to participants two weeks prior to the class, some of the participants were observed completing the pre-test immediately before the class began. According to Polit & Hungler (1995), variations in results may occur if each group were not subjected to the same data collection methods (p.223).

Conclusions Regarding Demographic Data

The mean age of the nurses completing the AED training sessions was 40 years. A review of adult learning concepts examined how adults learn best when new concepts are built upon past experiences. With the majority of nurses in this age range, age could potentially have enhanced their ability to learn new concepts. Only two nurses (5.71%)

had less than one year of nursing experience. The majority of the nurses (77.15%) reported over four years of nursing experience with 45% reporting more than ten years of experience. Results of the high retention rate were not surprising considering that the nurses had many years of life experiences to serve as a foundation for learning new concepts and skills. The greater number of the nurses (94.30%) completing the training program was female. Of this percentage of nurses, only two of the nurses had been employed at the hospital for less than a year. As a small hospital, the nurses had known each other and worked together for many years. The environment in the training session was non-threatening and relaxed. Throughout the training session nurses demonstrated respect for their peers by practicing and demonstrating skills among themselves. Only three members of nursing management participated in the study, representing 8.57%. The majority (91.43%) of the sample worked as staff nurses. A feeling of camaraderie was evident in the training sessions as co-workers prompted each other in learning new skills. Members of nurse management participated in the training session as willing learners without any attempt to intimidate the staff nurses noted by the researcher. It may be concluded that the non-threatening environment facilitated the learning of the group as a whole.

The educational level of the sample revealed that the majority of nurses (74.30%) was RNs. Twenty-five percent (or 9) of the nurses participating in the study were LPNs. Of the RNs, only four (11.40%) had been educated in a baccalaureate program. The programs that the majority of the nurses were educated in placed heavy emphasis on acquiring clinical skills. In view of their educational backgrounds, the nurses prior

educational experiences prepared them to learn specific skills. Although a small percentage of the nurses were LPNs, role differences between the two types of licensed nurses are practically nonexistent in the facility where the study was completed. All of the nurses worked collaboratively without any observed tension noted between the RNs and the LPNs.

In the demographic survey it was noted that six of the nurses (17.43%) worked in the Intensive Care Unit and four of the nurses (11.43%) worked in the Emergency Room. Nurses in these given specialty areas are already well trained in the use of conventional defibrillators and are used to operating such devices on a regular basis. Satisfactory AED testing results of nurses with prior knowledge and experience with conventional defibrillators is understandable.

Pre and post-tests were given to the nurses who attended the training program. The pre-test results revealed knowledge deficits in various aspects of AED use. This lack of knowledge may be due to the educational background of the nurses. Baccalaureate prepared nurses educational background is more grounded in research whereas the associate degree nurses and practical nurses' curriculum is geared more toward clinical skills. Since only a small percent (11.40%) was baccalaureate-prepared, the majority of nurses may have not been aware of ongoing research with AEDs.

The post-test results revealed that the knowledge regarding AED use substantially increased and was retained six months after the training session. The mean score on the six-month follow-up test was 96.28% (SD =5.33) as compared 97.00 (SD =5.17) on the test immediately following the initial training. Results of the RBANOVA yielded a

significant effect [$F(1, 34) = 20.43, p = .00$]. The results, while undifferentiated with a post hoc test, reflected a difference between means.

The primary purpose of this study was to answer the research question, “Does the level of skill and knowledge of hospital-employed nurses following a training session on automatic external defibrillators (AEDs) significantly decrease six months after initial training?” Results of the findings demonstrated that AED training to hospital-based nurses already trained in BLS is highly effective and indicated that the knowledge and skills necessary to use AEDs was satisfactory six months after initial training. No substantial decline was observed in performance on the written or skill performance Testing. The six-month post-training data demonstrated only an 8.29 % decrease in written evaluation scores. A 97.14 % passage rate for the written post-test taken 6 months after the initial training was a strong indication of successful retention of AED knowledge.

Only two performance errors occurred that may have the potential for delaying time to shock delivery, however, in each instance the participants were able to correct their error within the ninety second time limit allowed for defibrillation. The single most common delay in skill performance observed was the initial inversion of the electrodes.

Out of 35 participants, nine nurses (25.71%) inverted the electrodes but adjusted placement after visualizing the diagram on the electrode facings. The second most common error observed in the participants was a tendency to attach the electrodes to the patient before turning on the AED and following the voice prompts. This error resulted in the AED trainer device to advise the operator that the AED was ‘analyzing’ before the

cables were properly connected. A total of seven participants (24.50%) encountered this problem, but again each was able to readily troubleshoot the problem and start over by first turning on the AED before attaching the monitoring cables to the patient. In both testing sessions, immediately after initial training and at six months, all of the nurses were able to deliver a shock within the 90-second guideline.

This study was designed to answer the following question: Do the levels of skill and knowledge of hospital-employed nurses following a training session on automatic external defibrillators (AEDs) significantly decrease after initial training?" Results of the findings demonstrated that the mean percentage correct on the pre-test was 88.00% as compared with 97.00 % (SD = 5.70) on the test given immediately on completion of the course, and 96. 28 % (SD = 5.33) on the exam given six months after training.

Implications for Nursing

Findings from this study may be of interest to the nurses who participated in the study, to the hospital administrator, the education coordinator, and quality control personnel for purposes of validating the effectiveness of the newly implemented AED teaching program. The study provided an opportunity for nurses to impact public awareness on advances in cardiac care by targeting attitudes which influence those behaviors. Nurses must be knowledgeable about current advances and developments in medicine to facilitate positive and progressive changes within their work settings. The financial implications of this study may be of particular interest to the hospital administrator. The hospital compensates hospital employees for mandatory inservices. Brief and effective training sessions with high retention rates of knowledge may

contribute to overall financial savings for the institution (Ornato et al., 1988, p.108). For the education coordinator and the quality assurance coordinator, the study provided documentation of goals for the program and systematic reviews to determine if those goals were met.

Interpretations related to Literature

An extensive literature review revealed that there is limited research on the retention of AED skills in hospital-trained personnel. Most of the studies on retention and training issues regarding AEDs have focused on first responders and lay people in settings outside of the hospital.

The few clinical studies that did examine the retention of AED skills of health care personnel in a hospital setting (Dickey & Adgey, 1991, Kaye et. al, 1995, Kaye & Mancini, 1996) demonstrated promising results that AED skills were retained satisfactorily immediately post training and at various intervals after the initial training. The results of this study supported previous findings that AED skills can be retained satisfactorily by nurses working in a hospital setting. Evaluation of the participants' cognitive and psychomotor skills immediately post-training and six months later were encouraging. Findings of this study are congruent with existing research findings that there is no significant decline in AED skills six months after initial training (Cummins, Schubach, Litwin, & Hearne, 1989). Due to the limited availability of literature on AED training and retention, a definite need for further studies, which examine the comprehension and retention of AED skills has been identified.

Interpretations related to Theoretical Framework

The high retention rate of knowledge and performance skills demonstrated by the satisfactory written post-tests and performance evaluations at six months, supports the authors proposal that Knowles' andragogy principles of adult learning are particularly applicable to this target group. Findings from this study may lead to the development of educational interventions directed at further improving the quality of the initial content of the AED course. Program development should be an ongoing process continuously tested against changing needs.

Recommendations Regarding Sampling

Replication of this study using a more diverse population that includes other hospital employees who are required to respond to cardiac arrest emergencies within the hospital is recommended. Other people that would be included in an AED program are physicians, pharmacists, respiratory therapists, medical students, nursing students, and nursing assistants. A larger sample using a probability sampling design such as random sampling would permit the researcher to estimate the magnitude of the sampling error. Random samples also tend to be more representative of the population. Polit & Hungler (1995) explained that although the nonprobability design of convenience sampling is one of the more commonly used sampling method in nursing studies, it is among the weakest form of sampling (p. 233).

Recommendations for Further Research

This study was conducted to examine learning retention in nurses immediately after an AED educational session and six months later. Further research is needed to

include varying intervals between initial training and follow up evaluation. A comparison of the cognitive and skills performance at six months with the same participants's evaluation at their next annual CPR refresher course is strongly recommended. If testing at one year reveals that skills have deteriorated, then provisions for practice sessions should be considered. The ability to perform skills necessary to use an AED safely and effectively should guide the decision about the time for re-certification. At present, the facility where the study was conducted has recommended annual AED training that is uniform with the hospital's policy for CPR re-certification.

Past research retention data reported by Kaye et al. (1995) suggests that an AED will be effective in an environment where responders seldom treat a person experiencing cardiac arrest (p.166). As AEDs become more readily available, prompt defibrillation on each of the hospital floors or units may increase the victims' chance of survival (Cummins et al., 1997). Presently, defibrillation is often delayed until personnel skilled in rhythm analysis initiates defibrillation. The rationale behind this suggestion is to promote rapid defibrillation within the hospital setting. More research is needed to evaluate the effectiveness of AEDs in the hospital setting. Additional studies are needed to determine if AED use by in-hospital personnel shortens the time to defibrillation, subsequently improving long-term survival, as has been demonstrated in the pre-hospital setting. Furthermore, the performances of nurses using real AEDs (not AED trainers) need to be evaluated in actual emergency situations within the hospital.

Most studies on AED training and retention issues have focused on first-responders and lay persons in the pre-hospital setting, few studies have been conducted

that examined AED training and learning retention of nurses, particularly in the hospital setting. With the current interest in CPR and AED training, there is an evident need for more research in teaching methodology and promoting skills retention. Ongoing research needs to focus on the evaluation of cognitive knowledge and AED performance skills in an effort to identify when knowledge and skills significantly diminish.

Summary

The primary purpose of this study was to answer the research question, “Do the levels of skill and knowledge of hospital-employed nurses following a training session on automatic external defibrillators (AEDs) significantly decrease six months after initial training?” Results of the findings demonstrated that AED training of hospital-based nurses already trained in BLS is highly effective and indicated that the knowledge and skills necessary to use AEDs were satisfactory six months after initial training. No significant decline was observed in performance on the written or skill performance testing. The six-month post-training data demonstrated only a 0.72 % decrease in written evaluation scores. A 97.14 % passage rate for the written post-test taken 6 months after the initial training was a strong indication of successful retention of AED knowledge.

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Out of 35 participants, nine nurses (25.71%) inverted the electrodes but adjusted placement after visualizing the diagram on the electrode facings. The second most

common cause of performance error observed in the participants was a tendency to attach the electrodes to the patient before turning on the AED and following the voice prompts. This error caused the AED trainer device to advise the operator that the AED was ‘analyzing’ before the cables were properly connected. A total of seven participants (24.50%) encountered this problem, but again each was able to readily troubleshoot the problem and start over by first turning on the AED before attaching the monitoring cables to the patient. In both testing sessions, immediately after initial training and at six months, all of the nurses were able to deliver a shock within the 90-second guideline.

In this chapter, a brief summary of the study was provided. The research question was discussed in terms of the data analysis, the significance of the results in relation to a literature review and Knowles’ theoretical framework. Study limitations were discussed which included threats to internal and external validity. Conclusions and implications for nursing were presented in addition to recommendations for further research.

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Appendix A

Approval from Hewlett-Packard

Hewlett-Packard Company
Heartstream Operation
2401 Fourth Avenue, Suite 500
Seattle, Washington 98121-1436
206/664-7630



May 4, 1999

Ms. Susan Brown, RN, BSN, CCRN
110 Holland Drive
Jesup, GA 31546

Dear Ms. Brown:

I received your letter requesting permission to use the HP Heartstream ForeRunner AED in your research project. As you noted, permission is not required from Hewlett-Packard to use the ForeRunner. However, per your request, please feel free to use the ForeRunner AED in your research and thesis.

Please be certain that the credit given to Hewlett-Packard accurately reflects our position as the manufacturer of the Heartstream ForeRunner AED and not a supporter of or participant in your project.

As a courtesy, I would appreciate receiving a copy of the results of your research.

If you have questions, need digital graphics of the device or technical information about the ForeRunner, please call me at (206) 664-2058. Good luck with your research and completing your thesis.

Best Regards;

A handwritten signature in cursive script that reads "Craig Aman".

Craig Aman
Training Development Manager
Heartstream Operation

Appendix B

Approval from the American Heart Association



National Center
7272 Greenville Avenue
Dallas, Texas 75231-4596
Tel 214 373 6300
www.americanheart.org

January 27, 1999

Susan Brown
110 Holland Drive
Jesup, GA 31546

Dear Ms. Brown:

We have received your letter requesting permission to reproduce a material from the American Heart Association

The American Heart Association is pleased to grant you permission to reproduce the Heartsaver AED written evaluation for your thesis. You will need to obtain permission to publish this information in other form other than your thesis.

Approval of this request is contingent upon receipt of a \$25 processing fee. Please send a check with a copy of this letter payable to the American Heart Association, P.O. Box 841750, Dallas, Texas 75284-1750. (This is a fee for service, not a charitable contribution.) Our tax id number is 13-5613797. Please consider this letter an invoice.

We understand that this will be included in your thesis. We ask that the material not be adapted or changed. When reproducing, you must use the following credit lines on each page in which our materials appear:

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Heartsaver AED Written Evaluation, 1998
Copyright American Heart Association.

This permission letter does not give you permission to use this material in any other form than your thesis. We would need to review each request for any future use of this material.

We hope we have been of service to you on this matter.

Sincerely,

Misty Arapida
Copyright Specialist

Appendix C

Heartsaver AED Written Evaluation

Heartsaver AED Written Evaluation

Please answer each of the following questions by selecting the *one best answer*:

1. **You should attach an AED *ONLY* to a victim who is :**
 - a. unresponsive, with shallow, rapid breathing, and has a pulse
 - b. unresponsive, not breathing and has no pulse
 - c. conscious, complaining of severe crushing pain
 - d. unconscious and has a history of a heart attack or stroke

2. **You are the FIRST PERSON to arrive at the side of a person who has collapsed and appears unconscious. What should you do *NEXT*?**
 - a. give 2 breaths and 15 compressions
 - b. verify unresponsiveness, call 911 and get the AED
 - c. assemble the pocket face mask
 - d. perform the Heimlich maneuver

3. **Only one of the following conditions does *NOT* pose a hazard when using an AED.**

Select the *ONE* condition that is *NOT* a potential hazard.

 - a. the victim has a medication patch on his chest
 - b. the victim is wet and lying on a wet surface
 - c. the victim is lying on metal
 - d. the victim is lying on the living room carpet

4. **You have powered *ON* your AED and attached electrode pads and cables. What should you do *NEXT*?**
 - a. Call “Clear!” (check that no one is touching the victim); then press ANALYZE
 - b. Give 2 breaths and 15 compressions
 - c. Press the shock button
 - d. Recheck the pulse

5. **One coworker has called 911; another coworker is performing CPR. As the AED-rescuer what should *You* do *NEXT*?**
 - a. Wait for coworker to complete 2 minutes of CPR
 - b. Check the AED carrying case to make sure there is an extra battery and extra set of electrode patches
 - c. Tell the 2 coworkers to switch to 2-person CPR
 - d. Open the AED case, POWER ON the AED, and follow the voice prompts.

6. **When you perform CPR your chest compression and rescue breathing help the victim in which of the following ways?**
 - a. provides oxygen-rich blood flow to the heart and brain
 - b. shocks the heart in ventricular fibrillation back to a normal rhythm
 - c. constricts the pupils to help preserve vision
 - d. decreases the need for future coronary artery bypass surgery
7. **You have powered *ON* your AED; attached the AED to the victim, and delivered 3 shocks. What should you do next?**
 - a. Remove the electrode pads
 - b. Give 4 slow rescue breaths
 - c. rapidly press the AED SHOCK button 3 times in a row
 - d. Check pulse; if no pulse: begin CPR for 1 minute
8. **If a cardiac arrest victim is wearing a transdermal medication patch stuck on the chest, right where you need to place the electrode pad, you should quickly:**
 - a. proceed to place the AED pad directly over the medication patch
 - b. not apply the AED pads; this victim can not be shocked
 - c. place the AED pad at least 6 inches away from side of the medication patch
 - d. remove the medication patch, wipe the skin clean, apply electrode pads in the usual locations.
9. **When you encounter a cardiac arrest victim lying with wet clothes, in a puddle of water, the first actions you should take are:**
 - a. power ON the AED, attach electrode pads, analyze, shock if indicated
 - b. perform CPR until the chest feels dry under our hands
 - c. move the victim to a dry surface, wipe off the chest, proceed with the AED sequence
 - d. place several blankets under the victim to soak up the water, and then shock if indicated.
10. **On your very first ANALYZE the AED gives you a “*no shock indicated message.*” What should you do next?**
 - a. do 1 minute of CPR
 - b. check all connections between the victim and AED
 - c. press ANALYZE immediately
 - d. check pulse

11. After 1 SHOCK from your AED, you reanalyze, and get a “*no shock indicated message.*” You check pulse and feel a strong pulse. What should you do next?
- check whether EMS personnel has arrived
 - open the airway and check for breathing
 - remove the electrode pads
 - press down firmly on each electrode pad
12. Which of the following victims should NOT be treated with an AED?
- victim less than 8 years of age
 - victim with a history of severe diabetes and a prosthetic (artificial leg)
 - victim who is recovering from recent heart surgery (scar on chest)
 - victim who is recovering from a recent stroke
13. Your AED charges and advises SHOCK on a victim you are helping. Just before pressing the SHOCK button, however, you should always:
- “clear,” making sure no one is touching the victim
 - perform 1 minute of CPR
 - recheck breathing and pulse
 - confirm proper electrode pad position
14. One electrode pad should be placed on the right side of the chest, between the right nipple and right collarbone. The other electrode should be placed:
- over the center of the chest
 - on top of the left nipple
 - on the left side of the chest, between the left nipple and left collarbone
 - on the left side of the chest a few inches below the armpit
15. After successful completion of the Heartsaver AED course you are authorized to use an AED on an actual victim under only one condition:
- the AED manufacturer has provided you with the official AED company pen and card
 - the victim is a spouse or other family member
 - a medical authority, operating with state regulations, provides specific authorization
 - a team of EMTs or paramedics arrive on the scene and direct you to perform 1 minute of CPR

- 16. The Heartsaver AED Course teaches you to first check responsiveness and call 911 when you witness cardiac arrest. This “call first” approach ensures early arrival of which one of the following?**
- a. police responder to help secure scene safely
 - b. EMS professionals equipped with a defibrillator to provide shocks and patient monitoring
 - c. EMS professionals trained to provide oxygen and to help perform CPR
 - d. an ambulance team to provide rapid transportation to the nearest emergency department
- 17. You have just called 911 and have returned with your AED to a victim who did not respond to gentle shake and shout. What should you do next?**
- a. open the airway, check breathing, if not breathing give 2 breaths
 - b. peel the backing from the adhesive electrode pads
 - c. carefully place the victim in the recovery position
 - d. perform 2 finger sweeps
- 18. The best method you have to tell whether you are doing good rescue breathing is to :**
- a. see the pupils of the victim’s eyes become very wide
 - b. see the skin color change to a “blue, mottled” pattern during rescue breathing
 - c. feel the pulse return
 - d. see the chest rise and fall with each breath
- 19. You get a message form your AED: “loose electrodes/pads” or “check electrodes/pads”. What should you do next?**
- a. power AED “OFF” then back “ON”
 - b. “look, listen, and fell “ for return of breathing
 - c. press down firmly on each of the electrode pads and see if the problem corrects
 - d. check for a pulse at the carotid artery
- 20. Which of the following is a correct statement about CPR for one-rescuer CPR?**
- a. compress 15 times then do 3 finger sweeps; repeat
 - b. compress 15 times then do 2 rescue breaths; repeat
 - c. compress 5 times then do 1 rescue breath; repeat
 - d. compress 10 times then do 2 rescue breaths

Appendix D

Letter to Participants

January 15, 1999

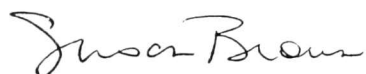
Dear Participant,

I am a Registered Nurse enrolled in the Family Nurse Practitioner program at Georgia Southern University. As a nurse working in ICU, many of the patients I care for experience life threatening heart rhythms. Fortunately, in the ICU setting, staff with emergency cardiac training and defibrillators is readily available to treat these patients rapidly and efficiently. In the past few years automatic external defibrillators are being placed in hospital settings on medical floors and ancillary departments so that prompt defibrillation is possible for all patients. An advantage of these defibrillators is that they require minimal training. The American Heart Association has recommended that AED instruction be incorporated into all healthcare provider classes. The purpose of this study is to assess the effectiveness of the initial AED training after a 6-month period.

Participation in this study requires taking about fifteen minutes to answer a twenty-item multiple choice exam on three separate occasions. Return of the completed examination and skills check-off will be your consent to be included in my study. A self-sealing envelope will be provided for you to return your pre-tests and post-tests prior to collection by myself, or one of the other CPR instructors for the course (Charlene Hand, RN, or Barbara Lane, RNC). Participation is voluntary. You will be asked to fill out a demographic data sheet, which will include your name, age, phone number, gender, job title, area of work, years of nursing and educational degree. Your responses will be strictly confidential.

The results of this study will be available approximately four months after the six-month evaluation is completed. Findings of this study will be presented at a regularly scheduled unit meeting on the Medical Unit at Wayne Memorial Hospital, Jesup, Georgia. Responses will be kept confidential. Findings will be presented in such a way that the responses could not be associated with any individual. If you have any questions or concerns about your rights as a research participant in this study, they may be directed to the IRB Coordinator at the Office of Research Services and Sponsored Programs at (912) 681-5465. Thank you in advance for your participation in this study. The results should provide helpful information for planning future courses.

Sincerely,



Susan Brown, BSN, RN, CCRN
110 Holland Drive
Jesup, GA 31546

Appendix E

Demographic Data Tool

Demographic Data Tool

1. Name: _____
2. Address: _____
3. Telephone: _____
4. Age: _____
5. Gender: _____
6. Job title: _____
7. Area of work: _____
 - Medical Floor _____
 - Surgical Floor _____
 - ER _____
 - ICU/CCU _____
 - Endoscopy _____
 - One-day Surgery Unit _____
 - OB _____
 - Post-partum _____
 - Nursery _____
 - Radiology _____
8. Years of Nursing: _____
 - less than 1 year _____
 - 1-5 years _____
 - 6-10 years _____
 - 11-15 years _____
 - 16-19 years _____
 - >20 years _____
9. Educational degree: (Please circle degree)
RN: _____(ADN) _____(BSN) _____Diploma _____Other _____(specify)
10. LPN _____