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A COMPARISON OF TWO CARDIOPULMONARY RESUSCITATION PROGRAMS

By

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ABSTRACT

A COMPARISON OF TWO
CARDIOPULMONARY RESUSCITATION PROGRAMS

By

Joan Kay-Casemier Nelson

Too few lay people have learned CPR with one major reason cited as class length (4 hours or more). In addition, method of presentation and type of feedback are possible reasons for low success rates in those who do attend classes.

The purpose of the study was to determine the effectiveness of two video enhanced CPR classes, each lasting less than two hours, in teaching one-rescuer adult CPR to the lay public. The sample was 104 self-selected subjects who were assigned to one of two CPR Programs: AHA or Citizen. There were no statistically significant differences between the two groups on passing rates with few subjects able to pass either course (5.5% for Citizen and none for AHA). The low passing rate is consistent with the standard, longer programs reported in the literature.

However, when the component skills (sequencing, timing, compression, ventilation) were analyzed separately, the major problems were identified. In addition, a higher proportion of the Citizen CPR groups was able to complete all of the component skills successfully.

Implications include allowing longer practice time with multiple sources of feedback and more focused practice on ventilations and compressions.

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A special thank you also to my husband, M. Elliott Nelson for his commitment to enroll people into saving lives, his understanding support of my work and his advice and aid with this process.

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Introduction

Cardiovascular disease continues to be the number one killer in the United States today. Newman (1993) reports that cardiovascular disease claimed the lives of 930,000 Americans in 1990. According to the American Heart Association (AHA) "the cost of cardiovascular disease in 1991 is estimated by the AHA (to be) at $108.9 billion. This figure includes the cost of physician and nursing services, hospital and nursing home services, medications and lost productivity resulting from disability" (American Heart Association [AHA], 1993, p. 4).

To decrease the number of sudden deaths from cardiovascular disease the Emergency Cardiac Care (ECC) Committee of the American Heart Association (AHA), has recommended the "Chain of Survival" (Cummins, Ornato, Thies, & Pepe, 1991). The chain of survival is a sequence of events which, when performed rapidly, will increase the likelihood of survival from sudden cardiac arrest. The links in the chain of survival include: early access to care, early cardiopulmonary resuscitation (CPR), early defibrillation, and early advanced care. Weakness in any of the links of this chain decreases the chance of survival for the cardiac arrest victim. This study addressed the link of

CPR, specifically training programs for the lay public. The AHA has recommended that 20% of the lay public be trained in CPR (Cummins et al., 1991). Morbidity and mortality from out-of-hospital cardiac arrest is expected to be significantly decreased if this goal is achieved (Atkins, 1986; Becker & Pepe, 1993; Cobb & Hallstrom, 1982; Cobb, Hallstrom, Thompson, Mandel, & Copass, 1980; Copely, Mantle, Rogers, Russel, & Rackley, 1977; Cummins & Eisenberg, 1985; Cummins, Eisenberg, Hallstrom, & Litwin, 1985; Cummins et al., 1991; Guzy, Pearce, & Greenfield, 1983; Kellermann, 1993; Kirk-Gardner, Crossman, & Steven, 1992; Kowalski, Thompson, Horwitz, Stueven, Aprahamian, & Darin, 1984; Murphy, Murray, Robinson, & Campion, 1989; Steuven et al., 1986; Thompson, Hallstrom, & Cobb, 1979; Walz, 1991).

CPR has traditionally been taught by the American Red Cross (ARC) and the American Heart Association. Michigan has not met the goal of training 20% of the lay public in CPR (L. Choate, American Heart Association, personal communication, January 6, 1994 and L. Proctor, American Red Cross, personal communication, March 25, 1994). CPR recertification takes place at least every two years, so when estimating how many people are currently trained in CPR a two year time frame is examined. In Michigan between July 1, 1991 and June 30, 1993 there were 252,063 people trained in CPR by the ARC (L. Proctor, personal communication, March 25, 1994) and 395,096 people trained by the AHA (L. Choate, personal communication, January 6, 1994). Therefore, the

total number of people, of all ages, trained in CPR in the state of Michigan (population 9,295,297) during those two years, has been 560,484, or 6% of the population. Six percent trained is a long way from the recommended 20% trained. Additionally the population trained included medical professionals and children (ages 13 years and up), original CPR program completions and recertifications.

Statement of the Problem

According to Eisenberg, Bergner, and Hallstrom (1984), 77% of cardiac arrests occur at home and 15% of the cardiac arrests occur in a work or public place. Therefore, better than 85% of the cardiac arrests may be witnessed by someone who knows the victim. These witnesses, generally lay people, are the ones who must learn the skill of CPR.

However, the lay public are not learning the life-saving skill of CPR. Various reasons are cited in the literature for not learning CPR. Overall, lack of time is the most frequently cited reason (Ambrose & Stratton, 1993; Dracup, Moser, Guzy, Taylor, & Marsden, 1994). This barrier - lack of time - relates, at least in part, to the length of the CPR class. Traditionally most CPR programs have been three to four hours or more in length. If class length was shortened the barrier of lack of time could be eliminated or at least greatly affected. Currently there are several video enhanced CPR programs available that teach CPR in one and one-half to two hours. However, the outcome, adequate adult one-rescuer CPR, must not be compromised for the sake

of a shorter CPR course. There has not been any research published testing the efficacy of these new video enhanced CPR programs. This study will examine two currently available video enhanced CPR programs and assess their efficacy in teaching adult one-rescuer CPR.

One role of an advanced practice nurse is educator: to teach the client and family concerning health promotion, disease prevention and morbidity prevention. Health promotion education focuses on optimizing the clients' current health. Disease prevention includes assessment of the client for risk factors and education in how to avoid the development of the disease for which they are at risk. Morbidity prevention focuses on clients with known diseases such as cardiovascular disease. Education is provided to modify their current lifestyles to optimize their adjustment to the disease. Morbidity prevention also includes assuring the client and family are prepared in the event of an emergency, if they are at risk for cardiac arrest, they should know CPR.

The primary health care provider must be aware of the importance of early access to care and early CPR for the survival of the clients with cardiovascular disease. It is imperative that the primary health care provider include CPR training in the plan of care for families, especially families at high risk for cardiovascular disease because they are the ones who may need to perform CPR.

Research has shown families at high risk for

cardiovascular disease have not learned CPR because it had not been recommended by their health care provider (Dracup et al., 1994). "Discussions about CPR should be initiated early with competent patients as part of their annual physical examination" (Miller, Jahnigen, Gorbien, & Simbartl, 1992, p.582). Discussions about CPR should be expanded to include the families and significant others of patients with cardiovascular disease because they are the ones who may need to perform CPR.

Nurses in advanced practice are also concerned about the health of their community. Providing CPR education to a local work place and local churches, such as the sites of this study, may improve the potential outcome of a cardiac arrest victim in the work place as well as the community as a whole.

The purpose of this study was to compare the performance of adult one-rescuer CPR by lay public trained in two newly developed CPR programs. The two CPR programs were the AHA CPR video and Citizen CPR video. Both programs taught adult one-rescuer CPR in less than two hours, addressing the barrier of time limitation cited by the lay public. Each CPR program presented the CPR curriculum and demonstrated the CPR technique via a videotape with classroom manikin practice to follow. How the curriculum was presented in the video, practice, and feedback was different for each program. The quality of the outcome of these educational methods needed to be studied.

Research Question

Most cardiac arrests are witnessed by lay people who know the victim; not enough lay people know CPR because it takes too long to learn. Shortened video-enhanced CPR programs, lasting less than two hours, are now available. The research question addressed in this study was: Does the Citizen CPR video program produce significantly more students performing correct adult one-rescuer CPR than the AHA CPR video program? The hypothesis was: A significantly higher proportion of lay subjects participating in the Citizen CPR video program would correctly perform adult one-rescuer CPR than subjects participating in the AHA CPR video program.

Theoretical Framework Applied To Study

The concepts of CPR video programs and outcomes were adapted to the Gagné Model of Information-Processing Theories of Learning and Memory (Gagné, 1977). This study examined the successful performance of adult one-rescuer CPR through interaction with two different video curricula, methods of feedback, and practice.

Gagné (1977) classified human learning into five categories: verbal information, attitudes, intellectual skills, motor skills, and cognitive strategies. The performance of CPR is a motor skill. It was hypothesized, by Gagné, that each category of learning required different types of instruction. According to Gagné there are two kinds of conditions that must be met for any learning to

occur: internal and external. Internal conditions refer to acquisition and storage of prior capabilities the learner has acquired that are either essential to or supportive of subsequent learning. The internal condition needed for learning a motor skill is "recall of component motor chains" (Aronson & Briggs, 1983, p. 83). For this study, an example of an internal condition may be watching CPR performed on a television program prior to this class with resultant recall of what was seen. External conditions refer to various ways that instructional events outside the learner function to activate and support the internal processes of learning. The external condition needed for acquisition of a motor skill is "establishment or recall of executive subroutine (rules) [and] practice of total skill" (Aronson & Briggs, 1983, p.83). For this study the external conditions were either the instructor feedback in the AHA CPR program or the Skillmeter and instructor plus fellow student feedback in the Citizen CPR program.

To learn a motor skill, according to Gagné (1977), it was advised to teach the part skills that make up the total skill. This is performed similarly in both CPR programs by first learning how to check a carotid pulse and proper hand placement for CPR, for example, before attempting to put all the skills together to perform CPR. "When each of the part skills has been mastered, the person can practice them together in order to learn the timing and rhythm necessary for the smooth execution of the total skill" (Aronson &

Briggs, 1983, p. 89).

Figure 1 is Gagné's Model of Information-Processing Theories of Learning and Memory (Gagné, 1977, p. 53). According to Gagné (1977) the learner receives stimulation from the environment which activates the receptors and transforms the information into neural information. The neural information passes briefly through the sensory register and on to the short-term memory where it can persist for twenty seconds. A process called encoding, which occurs in the transfer of the information between the short and long-term memory, is the most critical transformation of the information. During encoding the information is transformed into conceptual or meaningful pictures and then stored in the long-term memory. In order to verify learning the information must be retrieved from the long-term memory, returned to the short-term or working memory, and transformed to stimulate the response generator. The response generator determines (1) the form of the response such as speech, use of large or small muscles, or whatever and (2) the pattern of the performance such as the sequence and timing of the movement. The ultimate information processing occurs in the effectors which results in patterns of activity that can be externally observed. Learning is a process that requires the closing of a loop which begins with stimulation from the external environment and ends with feedback. Executive control processes influence attention and selective perception and ultimately

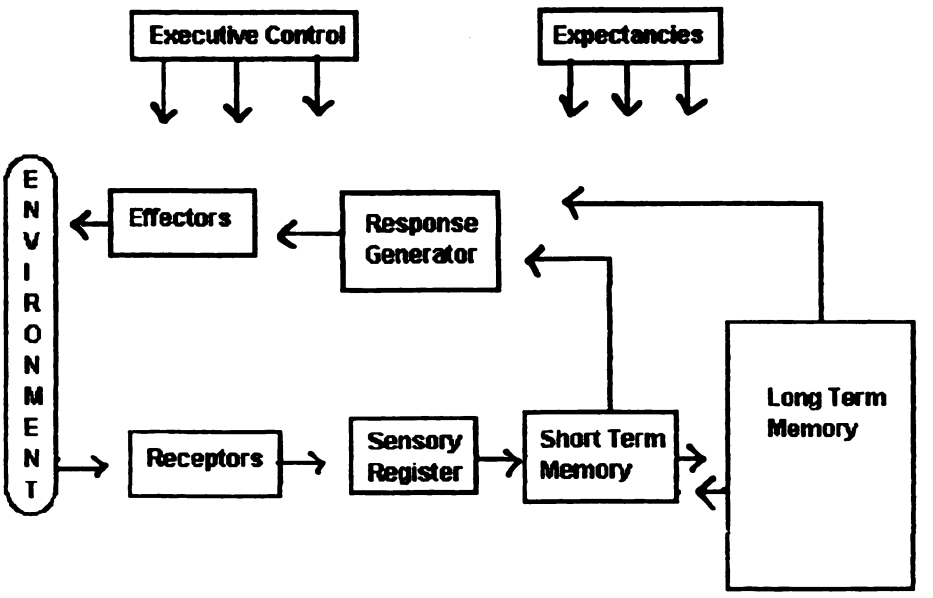

Figure 1. Model Employed by Information-Processing Theories of Learning and Memory. (Gagné, 1977, p. 53)

influence what is stored in the long term memory. Expectancies represent the specific motivation of the learners to reach the goal of learning which has been set by or for them. What learners intend to accomplish can influence what they pay attention to, how they encode their information, and organize their responses.

Figure 2 is an adaptation of the CPR programs to Gagné's model. The students watched the CPR video and received the information through their eyes and ears (receptors), the skills to be performed were transferred through the sensory register to the short term and then to the long term memory along with any prior knowledge of how to perform CPR. The students practiced CPR skills and received feedback, an external condition, from the

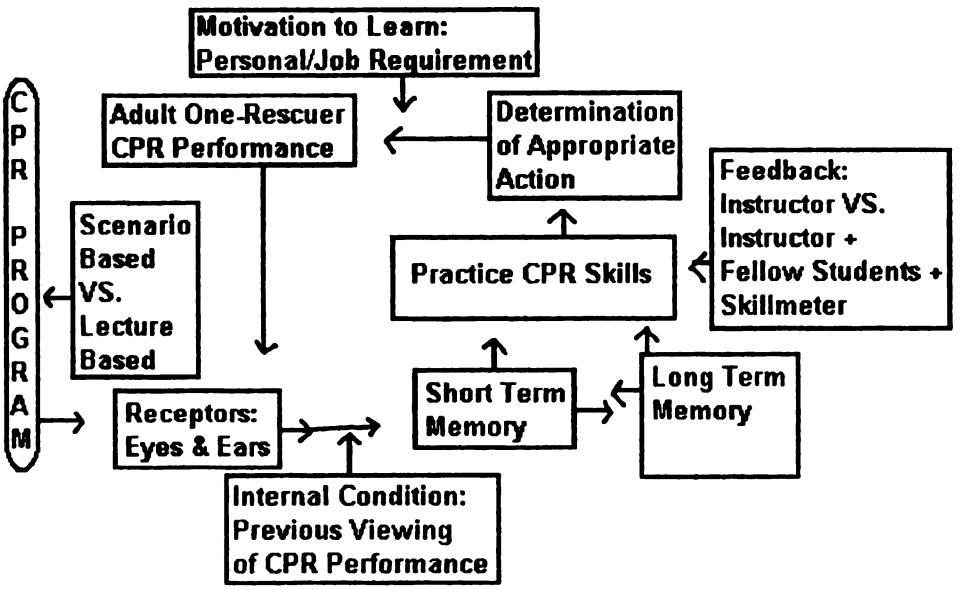

Figure 2. Adaptation of Gagné's Model to CPR Programs (Gagné, 1977, p. 53)

instructor or Skillmeter plus instructor and fellow students which helped the student determine the appropriate reactions (response generator) leading to the performance of adult one-rescuer CPR (activation of effectors). In this adaptation of Gagnés model executive control and expectancies are both included in one box describing motivation to learn. Internal condition and feedback, an external condition, are added to Gagné's model to show their impact on the process. Personal motivation is an example of an executive control process and performance of CPR may be influenced by the students personal motivation for learning the skill: the possibility of using the skill on a loved one or the need to learn the skill as a job requirement.

Gagné (1977) also described instructional events: that is, classes of events that occur in a learning situation. Each event functions to provide the external conditions of learning described previously. The instructional events usually occur in the following order: gaining attention, informing the learner of the objective, stimulating recall of prerequisite learning, presenting the stimulus material, providing learning guidance, eliciting performance, providing feedback about performance correctness, assessing the performance, enhancing retention and transfer.

Table 1 shows the instructional events, their definitions and how the two CPR programs compared. Both CPR programs were consistent with Gagné's theory, however, there were differences between the programs which are outlined in Table 1. One important difference is the AHA CPR program provided one source and type of feedback: subjective delayed feedback on performance. The Citizen CPR program provided multiple sources and types of feedback: immediate objective feedback from the Skillmeter plus delayed subjective feedback from the instructor and fellow students. "The usefulness of frequent feedback during the acquisition of newly learned capabilities should not be overlooked" (Gagné, 1977, p. 298). The multiple sources and kinds of feedback were hypothesized to produce better learning than providing only the delayed subjective instructor feedback. "When entire topics are being learned, feedback for the correct accomplishment of each subtopic can be of considerable value

Table 1. Comparison of the AHA and Citizen CPR Programs by Gagné-Briggs Outline (Aronson & Briggs, 1983)

Instructional Events	Definition	AHA CPR Program	Citizen CPR Program
Gaining Attention	Gain the learner's attention so other instructional events can function properly	On-screen instructor guided video, few rapidly changing stimuli	Scenario based instruction with rapidly changing stimuli
Informing learner of objective	How will I know when I have learned?	Covered during introduction	Covered during introduction
Stimulate recall of prerequisite	Recall of subroutine and part skills	Learned in parts after the video is completed	Learned during video when stopped to practice
Presenting the stimulus material	Varies from demonstration of skills to written information	AHA Videos and HeartSaver Book	Citizen CPR Video
Providing learning guidance	Designed to help learner acquire capabilities of the objective	Instructor feedback on performance	Skillmeter, instructor and fellow student feedback on performance
Eliciting the performance	Perform an overt action	Find a carotid pulse or proper hand placement	Same
Providing feedback about performance correctness	An informative, crucial instructional event	Delayed subjective instructor feedback	Immediate Skillmeter feedback + instructor and fellow student feedback
Assessing performance	Objective attained and consistently performed	Assessed subjectively by instructor	Assessed objectively by Skillmeter and subjectively by instructor and fellow students

Table 1. Continues

Table 1 Continued.

Instructional Events	Definition	AHA CPR Program	Citizen CPR Program
Enhancing retention and transfer	Transfer information from one situation to another	Practice continues until student is comfortable	Same plus visual scenarios aid in application to different real-life situations

in increasing the efficiency of learning" (Gagné, 1977, p. 298). The Skillmeter provided immediate feedback on each component CPR skill learned, the amount of instructor feedback varied by instructor. The differences between the programs were believed to strengthen the Citizen CPR programs' ability to teach the students the skills of CPR.

Conceptual Definitions

Concept: CPR Program

For the purpose of this study a CPR program will be defined as: a video presentation of CPR skills and life-saving information with practice of CPR skills on a manikin with feedback on performance. The skills learned in these programs included the psychomotor skills of adult one-rescuer CPR and adult foreign body airway obstruction (FBAO) management. Additional vital information regarding heart attack symptom recognition, how and when to access the emergency medical system, and identification and modification of personal cardiac risk factors were provided in both of the programs. This study focused only on adult

one-rescuer CPR skill acquisition.

Motor skills, attitude and knowledge are essential concepts of CPR programs. The motor skills learned included: assessment of unresponsiveness, activation of the EMS system, positioning the victim, rescuer position, opening the airway, determining breathlessness, rescue breathing, determining pulselessness, and performing external chest compressions.

The importance of appropriate response in the event of an emergency such as a cardiac arrest, the ability to stay calm and take definitive action are attitudes discussed in the CPR programs. These attitudes are included as part of the content because the appropriate quick response in an emergency is a learned response and a quick response is often critical to the survival of the victim.

The curriculum taught in a lay person CPR program has been determined by the AHA Emergency Cardiac Care Committee and includes heart and lung structure and function; a discussion of coronary heart disease including pathology, risk factors, prudent heart living, and clinical presentation of coronary heart disease; events requiring resuscitation; introduction to the performance of CPR; techniques of CPR including airway, breathing, circulation; the sequence of one-rescuer CPR; and manikin practice. Because the AHA was the body that established the current recommended standards for CPR, their programs have been the traditional standard for CPR training. The Citizen CPR

Program teaches according to the AHA standards of CPR using a scenario based video tape and a unique practice format with multiple types and sources of feedback.

Concept: Adult One-Rescuer CPR Skills

The outcome variable, for this study, was performance of the motor skill of adult one-rescuer CPR according to AHA standards for health care providers. A motor skill is a kind of human performance. Motor skills involve different portions of the body musculature and a variety of internal processes. To learn motor skills it is advised to first teach the parts of the skill that make up the total skill. "If the component motor acts of a total skill have been previously well learned, a minimal amount of time may have to be spent in 'putting them together' in a procedural sequence" (Gagné, 1977, p. 217).

Motor skills improve with practice: "Without practice during and after training, CPR skills retention is doomed to be inadequate" (Moser & Coleman, 1992, p. 378). Practice is important to learn a motor skill because:

> some very important stimuli (cues) are internal to the learner and arise as feedback from the muscles... By repeating the essential movements in successive trials of practice, the learner is discovering the kinesthetic cues which signal the difference between error and error-free performance. In addition to the external cues, these internal cues come to control and regulate the performance, and thus lead to increasing degrees of precision and timing accuracy. Practice is necessary, then, because only by repeating the essential movements can the learner be provided with the cues that regulate the motor performance. (Gagné, 1977, p. 219)

Practice is the repetition of the procedure "(1) with the

intent on the part of the learner to achieve an improved performance, and (2) with feedback, which provides information to the learner" (Gagné, 1977, p. 217). Feedback for CPR performance has been provided by: instructors observing performance and giving subjective feedback; manikins producing a rhythm strip after performance which can be used to provide objective delayed feedback; and a newer manikin with a Skillmeter which provides continuous immediate objective feedback while performing CPR. Gagné (1977) described "augmented feedback" which provided additional external cues while the motor skill was being performed, like the Skillmeter. The subjects receiving augmented feedback performed superiorly to the subjects receiving feedback following performance.

Review of Literature

Many different methods of teaching the content of the CPR program to adult lay public have been reported in the literature. There have been no published studies, however, about the efficacy of the AHA videos. The AHA video program is comparable to the traditional AHA HeartSaver program as the same skills are taught in each program. Other types of CPR programs including additional content and skills, such as pediatric basic life support, were not reviewed. The literature review was classified according to the criteria of teaching method: (1) instructor lecture, demonstration by instructor and supervised manikin practice with instructor feedback; (2) video presentation of curriculum with

demonstration of CPR performance in the video or by the instructor with supervised manikin practice; and (3) self-training systems.

Instructor Lecture/Demonstration Method

CPR programs with instructor lecture, instructor demonstration of skills and instructor supervised practice have been reviewed (Mandel & Cobb, 1982; Ramirez, Weaver, Raizner, Dorfman, Herrick & Gotto, 1977; Weaver, Ramirez, Dorfman, & Raizner, 1979). These studies have shown that no students to 11% of the students were able to perform adult one-rescuer CPR following training. Ramirez et al. (1977) reported 84.3% of the trainees were capable of correctly performing the sequencing of CPR, 2.8% were able to correctly perform the ventilations and compressions, and only 1% correctly put all the skills together to perform CPR. Weaver et al. (1979) found 10% to 100% of their students were able to complete various skills of CPR and only 2% were able to put all the skills together to successfully perform CPR. Mandel and Cobb (1982) reported 11.7% to 97.1% of their students were able to perform individual CPR skills with no students able to successfully perform CPR. Weaver et al. (1979), Ramirez et al. (1977), and Mandel & Cobb (1982) utilized tape recording manikins for objective evaluation of CPR performance. The Weaver et al. (1979) lay public sample, from Houston Texas, was small (N = 61) and randomly selected from a larger self-selected sample (N = 280). Ramirez et al. (1977) had a larger

convenience sample (N = 772) of lay public from business, civic, religious organizations and the general community in Houston, Texas. Mandel & Cobb (1982) reviewed a random small sample (N = 105) of lay citizens from Seattle, Washington.

Video/Film Presentation of Content With Instructor Supervised Practice

The only study reported in the literature that consisted of curriculum delivered by video, video or instructor demonstration of skills, and supervised manikin practice was by Ambrose and Stratton (1993). Ambrose & Stratton compared a video-enhanced CPR program with the traditional four hour instructor taught AHA Heartsaver CPR program. Ambrose & Stratton reported, "overall the students compliance with AHA standards was 85% for the video-enhanced course, while the students attending the AHA Heartsaver course met 41% of the AHA standards" (p.66). However, upon closer examination of the results, the lowest reported percentage for any one section of the final evaluation: sequence, timing, ventilations and compressions, was 6% for the control group and 60% for the experimental group. Therefore, the total number possibly completing all four sections of the AHA standards correctly was 6% for the control (AHA HeartSaver) and 60% for the experimental group (video-enhanced CPR).

Some negative aspects of the Ambrose & Stratton (1993) study included the research variables were not clearly

defined, inter-instructor reliability was not controlled, the sample was not randomized, the sample selection was not defined, there was incomplete statistical analysis, and there was a small sample (N = 100). The most critical fault of the Ambrose & Stratton study was allowing the experimental group to observe and self-correct their performance during the testing process (R. Ambrose, Citizen CPR, personal communication, February, 1994). By watching the Skillmeter the experimental group was able to correct any errors in performance immediately and thereby improve their score overall. This investigator believes the Ambrose & Stratton study did not indicate that the students in the experimental group integrated the concept of how far they need to compress the chest or how much air they need to breathe into the victim to perform effective CPR, only that they successfully learned how to read the Skillmeter and self-correct their performance. Positive aspects of the Ambrose & Stratton study included the use of the Skillmeter Resusci® Annie and the equal, although not random, distribution of the sample between control and experimental groups.

In summary, the Ambrose and Stratton (1993) study appears on the surface to show dramatic differences between the abilities of the students to perform CPR in the control and experimental groups. However, in reality, this author believes the Ambrose and Stratton study shows how well students can perform to the Skillmeter, not how well they

can perform CPR.

Self Training Studies

Two studies (Edwards & Hannah, 1985; Kaye, Montgomery, Hon, Linus, Stewart, & Richards, 1983) compared an interactive videodisc, self training CPR program with the traditional instructor led CPR program. Kaye et al. (1983) reported the computer led session and the instructor led session had 60% and 44% passing rates, respectively. Kaye et al. summarized that the results obtained indicated the computer led session was more effective in teaching the skill of CPR than the instructor led session. When comparing the computer videodisc CPR and instructor led CPR courses Edwards and Hannah (1985) reported "no statistical differences between the two groups" (p. 250). Edwards and Hannah concluded these results signify the computer is at least as effective as the currently accepted instructor led sessions. However, they did not cite specific numerical results.

Not enough information is included in the articles to consider the positive and negative aspects of general considerations, experimental design, validity, or reliability of measurements. Edwards and Hannah (1985) and Kaye et al. (1983) both had small, adult, lay public samples of 65 and 46 subjects respectively.

One self-training study that used only a videotape to teach CPR, no instructor, and no manikin practice is reported in the literature (Schluger, Hayes, Turino,

Fishman, & Fox, 1987). The study does not report on pass/fail of CPR, only on individual CPR skills achieved. The CPR skills were performed accurately by 23% to 85% of the subjects (N = 262). Schluger et al. (1987) concluded that the use of a video may be a valuable, inexpensive vehicle for training the lay public in the key skills of cardiopulmonary resuscitation using television broadcast or other mass viewing situations.

Method

Design

This study was a quasi-experimental design in which subjects were randomly assigned to one of two video enhanced CPR programs. The independent variable was type of video enhanced CPR program. The dependent variable was the performance of the skill of adult one-rescuer CPR according to the AHA standards for health care providers.

Sample

There were 148 subjects trained and 44 were eliminated from the study because of previous CPR training within the past ten years. The 104 remaining subjects included in the study were: 32 (31%) male and 72 (69%) female. Subjects were recruited from S. D. Warren Company in Muskegon, Michigan and churches in the Grand Haven, Michigan area. The sample size was based on an estimated power of .8, with an effect size of 0.3 (a medium effect size), and an α of .05. The sample consisted of 10 S. D. Warren employees and 94 parishioners of local churches. S. D. Warren is a medium

sized industry which employs approximately 2,000 associates in Muskegon, Michigan. Three church sites were used in the Grand Haven, Michigan area: First Christian Reformed Church, Gospel Chapel, and Christ Community Church.

Exclusion criteria for this study included: (1) formal CPR training in the past ten (10) years; (2) any disease or physical impairment that would confound the results - such as emphysema, blindness, arthritis, or a heart condition; and (3) anyone under the age of 18 years. The determination of prior CPR training and age was on self-report from the participants. Determination of physical impairments was made by the primary investigator by questioning the subjects regarding health problems.

Operational Definitions

CPR Program

The independent variable in this study was type of CPR program. The AHA CPR program was considered the traditional method of teaching CPR because the AHA has always been the organization to establish the standards for CPR. The Citizen CPR program was the comparison program for this study, it was developed privately by Robert Ambrose and consultants, but teaches according to the AHA standards (R. Ambrose, Citizen CPR, personal communication, February, 1994).

The basic outline for both programs consisted of: (1) introduction, (2) video presentation of curriculum, and (3) practice of skills until student and instructor were

comfortable with the student's ability to perform. The two programs differed in: (1) how the curriculum was presented in the video, (2) practice format, and (3) practice feedback. The similarities and differences of these three aspects follows.

Presentation of Curriculum.

Both of the CPR programs presented the curriculum and demonstrated the technique of CPR via a videotape. The Citizen CPR video was scenario based, meaning it depicted what may actually happen during a cardiac arrest. The Citizen CPR video also showed a lay person realistically demonstrating the signs and symptoms of a heart attack and then going into cardiac arrest, another lay person performing CPR and an additional lay person calling the emergency number for help.

The AHA CPR video had an instructor describing the signs and symptoms of a heart attack, why CPR training is needed and then leading a demonstration of CPR skills. The information was presented without scenarios. Table 2 compares the AHA and Citizen CPR video contents. Detailed outlines of each program's content can be seen in Appendices A and B.

Practice Feedback.

Method of feedback on performance of CPR varied in the two programs. The AHA CPR program provided delayed subjective feedback. Delayed subjective feedback is defined as an instructor responding to performance with advice for

Table 2. Curriculum and Format of AHA CPR and Citizen CPR Programs

AHA Videos	**Citizen CPR Video**
***Introduction Video**	***All included in one video**
***Sudden Death Statistics**	
Actions for Survival	Actions for Survival
***Anatomy and Physiology**	Brief Anatomy and Physiology
Recovery Position	Recovery Position
***Special Conditions**	
Coronary Heart Disease	Coronary Heart Disease
Warning Signs of Heart Attack	Warning Signs of Heart Attack
Actions to Take	Actions to Take
Risk Factors for Heart Disease	Risk Factors for Heart Disease
Prudent Heart Living	Prudent Heart Living
***Adult CPR Video**	
Techniques of CPR (ABC's)	Techniques of CPR (ABC's)
Manikin/Demo Practice	Manikin Demo/Practice including *** Skillmeter Demo**
***Foreign Body Video**	
Foreign Body Airway Obstruction (FBAO) Recognition	FBAO Recognition
Techniques of Management	Techniques of Management
Conscious FBAO	Conscious FBAO
Conscious->Unconscious FBAO	Conscious->Unconscious FBAO
***Unconscious FBAO Management**	Brief unconscious FBAO including *** Pregnant or Obese FBAO Management**
Review	Review
Practice FBAO	Practice FBAO *** Chain of Survival Information** ***Shield-Barrier Device Use**
Instructor led CPR practice	Instructor and *** Student led** CPR practice
Subjective delayed instructor feedback	*** Immediate objective Skillmeter,** with instructor and *** fellow student feedback**

Note. Differences between programs printed in bold print with an asterisk *

changes during and after performance. The instructor utilized no objective instrument to evaluate performance, they would watch, analyze performance based on their experience, and comment on ways to improve performance. In the comparison program, Citizen CPR, objective and subjective feedback on performance was provided. The Skillmeter provided immediate objective feedback by showing how well the student performed on a screen the student could watch, and delayed subjective feedback from the instructor and fellow students.

Practice Format.

Only the instructor coached all students through practice in the AHA CPR program. In the Citizen CPR program fellow students coached each other through practice, with help from the instructor, once the first student was coached by the instructor.

Adult One-Rescuer CPR Skills

The outcome measure, or dependent variable, was performance of adult one-rescuer CPR according to the AHA standards for health care providers. CPR performance was measured for both groups using the Laerdal Skillmeter Resusci® Anne (see Appendix C). The Skillmeter provided an analysis of performance which could be printed or copied onto a recording sheet (see Appendix D). This analysis was used to evaluate performance of CPR.

Historically, the lay public skills of CPR performance were tested according to the health care provider criteria.

In 1992, however, the Emergency Cardiac Care Committee of the American Heart Association changed their recommendation in an attempt to make learning CPR less frightening for the lay public (see Appendix E). A written and skill performance test was no longer required of the lay person. At the same time the development of the AHA videos began. In this study the participants were measured according to this criteria because it was the benchmark or gold standard for correct performance of CPR (AHA, 1987).

There are four specific components of the AHA criteria for adult one-rescuer CPR: sequencing, timing, ventilations, and compressions. All criteria must be successfully completed according to the established guidelines in all four components in order for the performance to be considered passing. Table 3 shows the pass/fail criteria for CPR.

CPR manikin practice varied in the two programs. The AHA CPR group received only instructor feedback whereas Citizen CPR group received multiple sources of feedback. Feedback on performance allowed the student to correct errors and perform correctly while practicing a skill and therefore improved outcomes. The feedback on performance was received only from the instructor in the AHA CPR program and feedback came from the resuscitation manikin, instructor and fellow students in the Citizen CPR program. Recent literature reports "quantitative, simultaneous feedback is most effective (in learning CPR), the use of a recording

Table 3. CPR Pass/Fail Criteria

Sequencing	**Timing**	**Ventilations**	**Compressions**
Determine responsiveness Activate EMS System Position Victim Open Airway Determine responsiveness Ventilate Twice Determine Pulselessness > 5 seconds Recheck Pulselessness	15-35 seconds Step A to Step H (determine unresponsiveness through 4 cycles of CPR. 50-76 seconds for 4 cycles of comp/vent (allowed 10% error: 47-79 seconds). 5-10 seconds for initial pulse check	During the one-rescuer sequence 10-12 ventilations are given. 2 ventilation errors are acceptable. Ventilation errors include: -incorrect number of ventilations - incorrect volume <.8 or >1.2 Liters -not allowing total exhalation between breaths -breaths given in <1.5 seconds or >2 seconds	During the one-rescuer sequence 60 compressions are given. 6 compression errors are acceptable. Compression errors include: -incorrect hand placement -compression depth too shallow or deep -pressure maintained on chest during relaxation (upstroke) -incorrect number of compressions per cycle -unequal compression/ relaxations ratio (50%)
For scoring purposes omission of steps was a failure.	**For scoring purposes any timing outside these parameters was a failure.**	**For scoring purposes <84% performance (>2 errors) was a failure.**	**For scoring purposes <90% performance (>6 errors) was a failure.**

resuscitation mannequin is recommended for lay...CPR training" (Moser & Coleman, 1992, p. 378). The AHA group of students were not exposed to the Skillmeter during practice. The Citizen CPR group of students used the Skillmeter initially during practice. After CPR skills were improved the Skillmeter was placed out of their eyesight and they continued to receive feedback from the instructor and fellow students who could see the Skillmeter. This allowed the student to develop the "kinesthetic cues" (Gagné, 1977, p. 219) or get the feel of the appropriate compressions and ventilations without relying on the feedback directly from the Skillmeter. The resuscitation manikin used in the study was the Laerdal Skillmeter Resusci® Anne. "The Skillmeter Resusci® Anne is a sensorized manikin connected to the Skillmeter, which is a computing and displaying device for storing and handling up to ten minutes of CPR data received from the manikin" (Laerdal, 1986, p. 12). The Skillmeter provides immediate and continuous objective feedback on the performance of the skills required to perform CPR.

Operationalization of the students performance by the Skillmeter manikin was as follows:

Step A: The Skillmeter was capable of displaying an **"r"** when the student taped or shook the victim to establish unresponsiveness.

Step B: "Activate EMS system." This step was not recorded on the screen or printout. (The tester recorded on the testing form if this was done.)

Step C: "Position the victim." This step was evident by any documentation on the manikin. The manikin would not record properly if the positioning was incorrect.

Step D: "Open the airway" and **Step E:** "Determine breathlessness". When both steps were performed correctly a "b" was displayed on the Skillmeter.

Step F: "Ventilate twice." This was demonstrated by a horizontal bar created at the top of the sequence tracings as the student performed ventilations. Each ventilation was accompanied by an ascending bar graph which correlated to ventilation volume.

Step G: "Determine pulselessness." A "c" appeared when the student palpated for a carotid pulse for a minimum of five seconds. A signal bar was displayed at the bottom of the Skillmeter as soon as the student correctly located the carotid pulse area.

Step H: "Perform 4 cycles of compressions/ventilations (ratio 15:2)." A horizontal bar was created at the bottom of the sequence tracing line as student performed chest compressions, additionally each compression was accompanied by a descending bar graph which correlated to compression depth (1 1/2"-2"). Each of the four cycles of compressions and ventilations was indicated on the Skillmeter by the sequence tracing lines for compressions (the lower line) and ventilations (the upper line). Any erroneous ventilations or compressions were recorded when performed for analysis at completion of performance.

Step I: "Recheck the pulse." This was recorded by a "c" on the screen following a minimum of a 5 second pulse check in the carotid pulse area.

Upon completion of the testing, the Skillmeter screen was placed on "freeze" and "analyze" to give the exact number of correct/incorrect breaths and compressions, the compression rate, ratio, percentages of correct ventilations and compressions. This information was then compared to the established AHA criteria. Mistake markers, errors in compressions or ventilations, lit during performance were permanently lit when the analysis button was pressed. The number, type, and classification of each mistake was given. All of this information was recorded from the Skillmeter at completion of the test. A copy of the Skillmeter printout can be seen in Appendix D.

Instrumentation

The Laerdal Skillmeter Resusci® Anne, a CPR training manikin, was utilized to measure the outcome of the CPR programs. Sensors in the head, neck, and chest of the manikin detected the student's physical interaction with the manikin, see Appendix C. The ventilations and compressions were electronically recorded on the manikins' Skillmeter screen and a record of the performance was produced.

The manikins did not need any calibration prior to use according to the manufacturers, Laerdal Medical Corporation, (A. Davis, personal communication, January 5, 1994). There were two "potentiometers" inside the manikin, one for

responsiveness (which marked "r" on the printout) and one for opening the airway (which marked "b" on the printout). The potentiometers could be set according to the amount of effort required to obtain the "r" or the amount of hyperextension required in the neck to get a "b". The potentiometers were set by the investigator at the lowest setting prior to any training programs. There was no written documentation on the reliability or validity of the potentiometers. Accuracy of the Skillmeter manikins was tested by the principal investigator prior to each class. During the study eight manikins were used and three were taken out-of-service because the chest plates were recording compressions and/or ventilations incorrectly. When the chest plates malfunctioned the errors were very obvious. Appendix C shows an overview of the Skillmeter keyboard and button functions, recording of displayed results and the criteria for Skillmeter calculations.

The reliability of the Skillmeter Resusci® Annie was questioned during this study. When a tester observed a subject checking a pulse in the correct location for the appropriate amount of time but no "c" appeared, was the manikin erroneous or the tester observing the student? Without documentation of the reliability and validity of the Skillmeter it is unknown if the error was with the manikin or the instructor. Additional errors in recording the students assessment of breathlessness and pulselessness were noted. These errors occurred frequently and necessitated a

subjective evaluation of assessment of responsiveness, breathlessness and pulselessness to accurately reflect the students performance.

Field Procedures

1. Seven experienced AHA CPR instructors were recruited from the Muskegon/Grand Haven area. Training of instructors for the Citizen CPR program was done by the principal investigator (see Appendix F). The instructors taught both the AHA and Citizen CPR programs.

2. Seven testers, also experienced CPR instructors, were recruited to do final testing of all subjects. See Appendix G for outline of tester orientation.

3. Subjects were recruited from S. D. Warren with pamphlets placed at the time clock and posters placed throughout the plant. Classes were scheduled before and after work hours for all four shifts. The classes took place in the training center at S. D. Warren. The times and dates of the classes were on the posters and pamphlets with instructions to register at the medical office of S. D. Warren. There were six CPR programs held at S. D. Warren with 1 to 6 students in each class.

4. Subjects were also recruited from local churches with the use of notices in the church bulletins, posters placed throughout the churches, and word of mouth promotion by the pastors. The times and dates of the classes were determined by the pastors of the churches. Registration for the programs occurred at the church offices. There were 12 CPR

programs held at the various church sites with 2 to 49 students in each class. There was an instructor assigned to every 6 to 7 students in the classes. For the largest class of 49 students the principal investigator also participated as an instructor.

5. When subjects arrived for the class, consent was obtained and questionnaires were completed (see Appendices H, I, and J).

6. Randomization of program type was achieved by the closed envelope technique. There were an equal number of envelopes for AHA CPR and Citizen CPR assignment. The principal investigator randomly predetermined which program would be taught at each class prior to the classes being scheduled.

7. AHA CPR and Citizen CPR programs followed the previously described outlines in Appendices A and B. When the program was completed the student was instructed to remove their name badge, leave on their student number badge and proceed for testing with one of the testers. Simultaneous AHA CPR and Citizen CPR programs were not held, so the testers were not blinded to which program the subjects had attended.

8. The primary investigator audited each of the CPR classes to assure consistency of content and method in each group.

9. Frequently questions are raised by the participants during a CPR program. In an effort to standardize all responses to these questions some frequently asked questions with appropriate answers were provided to the instructors (Appendix K). Instructors were directed to answer questions

based on Appendix K.

10. Each participant was tested, see Appendix L, following the completion of the CPR program as follows:

A. Students were tested individually.

B. Upon entering the room the tester asked the student to perform one minute of CPR as he/she was just taught in their respective CPR programs.

C. In the initial classes it was noted that the Skillmeter did not always accurately record if responsiveness was checked, airway opened, or pulses checked. The student would check responsiveness but if the manikin was not shaken hard enough or the correct way (side to side) the "r" would not appear; or if the pulse was not checked in exactly the correct spot on the manikins' neck the "c" would not appear, many times the pulse bar would flicker indicating the student was in the correct spot but unless the pulse bar stayed lit long enough the "c" would not be recorded. So to remedy this problem, the tester documented if the student assessed responsiveness of the victim, opened the airway, and checked the initial and second pulses according to AHA criteria. Additionally, the request for EMS at Step B was recorded on the form shown in Appendix M.

D. At the completion of the one minute of CPR the student was excused after the student number badge was obtained.

E. The tester froze the Skillmeter and recorded the results with the attached printer or Skillmeter score sheets. The students number badge was attached with the printout to the testers form shown in Appendix M.

The same Skillmeter Resusci® Anne manikins were used for testing both AHA CPR and Citizen CPR groups. Eight manikins were supplied by Muskegon and NorthWest Ottawa County Project HeartStart Fire Departments.

Data Analysis

The descriptive demographic data obtained from the sample included: sex, age, marital status, prior medical or CPR training, occupation, family member at high risk for cardiovascular disease, educational level, and an optional ethnic group question. Chi-square analysis and Analysis of Variance, as appropriate, were used to compare the number of AHA CPR and Citizen CPR students who successfully completed all four components of CPR: sequence, timing, ventilations and compressions - the definition of successful completion of CPR. Both methods of evaluation, (1) the objective Skillmeter reports and (2) the subjective instructor reports with the objective Skillmeter reports, were analyzed. Chi-square analysis or Analysis of Variance, as appropriate, was also done comparing AHA CPR and Citizen CPR students for each of the CPR component skills.

Human Subjects Protection

Prior to initiation of the study, approval was obtained from the Michigan State University Committee on Research Involving Human Subjects (Appendix N). Subjects were informed that data obtained from the CPR programs would be used for research purposes and the purpose of the study was to compare two programs for teaching CPR. Participants in the study were identified during testing only by their student number on an adhesive name badge. The student number badge was affixed to the testing form following completion of the testing sequence. Only the principal investigator has a list, at her residence, of names and student numbers of the participants. Data were reported in aggregate form only.

Assumptions and Limitations

Certain assumptions were made for this study as follows:

1. Adult one-rescuer CPR skills can be learned by the lay public.
2. The students would truthfully report if they had CPR training before - there would be minimal contamination of the environment.
3. Students would not share information about the teaching sessions with other students waiting for the training.
4. The Laerdal Skillmeter Resusci® Anne Training Manikin was a valid and reliable instrument.

Limitations of this study were:

1. The Hawthorne effect - knowledge by the students that they would be tested following the CPR program may have made them try harder than if this class was offered to the lay public without additional testing.
2. External validity concerns: generalizability of results to other settings or samples. This sample was a convenience sample.
3. Interaction of history and treatment effect - a family member of a high-risk patient may be more motivated to learn the skill at a higher performance level and could alter the overall results.
4. Measurement effect - the results obtained may not be applicable to anyone except another group exposed to the same data collection situation.

Results and Findings

Demographic Characteristics of Subjects

The subjects were white, predominantly female, married, and had at least a high school education. The mean age of the sample was 44 years (SD = 11.5), with a range of 18 to 74 years. Sixty-eight percent (68%) of the subjects had family members at risk for cardiovascular disease and eighty-three percent (83%) participated because of a potential need to perform CPR on a family member, friend, or co-worker. Table 4 provides more demographic and CPR background data.

The sample was divided into two groups, AHA CPR, and

Table 4. Frequency and Percent of Demographic and CPR Background Characteristics

Demographic Variable	AHA CPR No. (%)	Citizen CPR No. (%)	Total No. (%)
Sex			
Male	18 (37)	14 (26)	32 (31)
Female	31 (63)	41 (74)	72 (69)
Age			
18-40	20 (41)	21 (38)	41 (40)
41-60	24 (49)	29 (53)	53 (51)
61+	5 (10)	5 (9)	10 (9)
Ethnicity			
White	49 (100)	55 (100)	104 (100)
Marital Status			
Single	4 (8)	8 (15)	12 (11)
Married	41 (84)	44 (80)	85 (82)
Widowed	2 (4)	0 (0)	2 (2)
Divorced	2 (4)	2 (5)	5 (5)
Education			
< High School	3 (6)	3 (6)	6 (6)
High School	17 (37)	15 (28)	32 (32)
Some College	11 (24)	15 (28)	26 (26)
Associates Degree	4 (9)	7 (13)	11 (11)
Bachelors Degree	8 (17)	12 (21)	20 (20)
Graduate Degree	3 (7)	2 (4)	5 (5)
Occupation			
Sales/Customer Service	10 (20)	9 (13)	17 (16)
Factory Worker	9 (18)	4 (7)	13 (12)
Homemaker	7 (14)	5 (9)	12 (11)
Teacher	3 (6)	7 (13)	10 (10)
Manger	6 (12)	3 (5)	9 (9)
Retired	2 (4)	5 (9)	7 (7)
Nurses/Medical	2 (4)	4 (7)	6 (6)
Accountant	0 (0)	6 (11)	6 (6)
Secretary	2 (4)	3 (5)	5 (5)
Other	8 (8)	9 (11)	19 (19)
CPR Background			
Past CPR Experience			
None	38 (78)	41 (75)	79 (76)
> 10 years ago	11 (22)	14 (25)	25 (24)
Members in family at risk for cardiovascular disease	33 (69)	36 (66)	69 (68)
Reason for Participation in CPR program			
Personal - may need to perform on family/friend/ co-worker	37 (83)	44 (81)	81 (81)
Job Requirement	1 (2)	9 (17)	10 (10)
Other	7 (15)	1 (2)	8 (8)

Citizen CPR. There were no statistically significant differences between the groups in the categories of sex, age stratification, marital status, presence of a family member at high risk for heart disease, number of subjects who had taken a CPR class over 10 years ago or had never taken a CPR class, occupation, education level, or ethnic origin (see Table 4). There was a statistically significant difference between the groups in reason for participation in the CPR program. The Citizen CPR group had more subjects (n = 9) participating because of a job requirement then the AHA CPR group (n = 1). In summary, the AHA CPR and Citizen CPR groups were alike for all demographic variables except one, reason for participation in the CPR program.

Analyses to Test the Research Hypothesis

Pass/fail criteria was obtained by two methods: (1) objectively by the Skillmeter criteria alone and (2) subjectively by the tester in combination with the data obtained from the Skillmeter. There were no statistically significant differences in the outcomes of the AHA CPR program and the Citizen CPR programs when either pass/fail criteria was evaluated.

Using objective Skillmeter criteria alone, no subjects passed the AHA CPR program and 5.5% (n = 3) passed the Citizen CPR program, $X^2(1, N = 104) = 2.75$, $p > .05$. When the subjective evaluation by the instructor in combination with the objective Skillmeter evaluation was analyzed 4.1% (n = 2) passed the AHA CPR program and 14.5% (n = 8) passed

the Citizen CPR program, $X^2(1, N = 104) = 3.26, p > .05$. These results indicate that neither program successfully taught a large number of subjects adult one-rescuer CPR to the standards required of health care providers.

Analysis of Component CPR Skills Learned in Each CPR Program

Table 5 compares the number and percentage of students who successfully performed the individual CPR component skills in each program. Sixteen skills were objectively measured by the Skillmeter and six skills were subjectively measured by the testers.

More subjects in both groups performed sequencing and timing skills accurately than ventilation and compression skills. Sequencing showed a statistically significant difference between groups X^2 $(1, N = 104) = 7.41, p < .01$. Fifty-five percent (55%) and eighty percent (80%) of the subjects, AHA and Citizen CPR respectively, were able to accurately perform the correct sequence of events. The other three component skills of timing (47% and 66%), ventilations (33% and 46%) and compressions (10% and 20%), AHA and Citizen CPR groups respectively, were done accurately by more Citizen CPR subjects than AHA subjects but not at statistically significant levels. Ventilations and compressions were poorly performed by both groups with compressions being the worst performed CPR skill.

Every component CPR skill was performed accurately by more Citizen CPR subjects than AHA CPR subjects. A statistically significant number of Citizen CPR subjects

Table 5. Frequency and Percentage of Successful CPR Component Skill Completion by CPR Program.

CPR Component Skill	AHA CPR Program No. (%)	Citizen CPR Program No. (%)
Sequencing		
Comp:Vent Ratio	41 (83)	46 (84)
Second Pulse Check	21 (43)	51 (93)***[S]
"r" present	34 (69)	46 (84)
Responsiveness Checked	44 (90)	55 (100)*[S]
EMS Activated	40 (82)	52 (95)*[S]
15:2 Ratio	41 (84)	46 (84)
Sequencing done correctly	**27 (55)**	**44 (80)**[S]
Timing		
One minute of CPR	23 (47)	36 (65)*
Initial pulse check	35 (71)	49 (89)**[S]
Four cycles of CPR	26 (53)	40 (73)*
"c" present	10 (20)	28 (51)**
Second "c" present	3 (6)	22 (50)***
Initial assessment to first compression	36 (73)	44 (80)
Timing done correctly	**23 (47)**	**36 (66)**[S]
Ventilations		
>84% correct	16 (33)	21 (38)
Correct number of ventilations given	28 (57)	39 (71)*
"b" present	46 (93)	51 (93)
Ventilations done correctly	**16 (33)**	**25 (46)**
Compressions		
>90% correct	3 (6)	11 (20)*
Correct number of compressions	24 (49)	31 (56)
Compression rate	24 (49)	35 (64)
Compressions done correctly	**5 (10)**	**11 (20)**

Note. [S] = Subjective Measurement, all others objectively measured by the Skillmeter.
*P<.05. **P<.01. ***P<.001.

performed better on ten of the component CPR skills, five objectively measured and five subjectively measured. Of those ten skills, eight (8) were sequence or timing skills. The only skill performed by 100% of the students in either group was assessment of responsiveness done by the Citizen CPR students. Obtaining more than 90% correct compressions was the most difficult skill for the Citizen CPR (20%) and AHA CPR (6%) students to perform. Over 80% of the subjects in each group activated the emergency medical system (EMS) as required in the CPR sequence. Activation of the EMS is an essential component to a good outcome from a cardiac arrest.

Interpretation of Findings Related to Model

The Gagné Model of Instruction (Gagné, 1977) in its entirety was applicable to teaching the motor skill of CPR. Gagné (1977) emphasized gaining the students attention and the Citizen CPR video appeared to gain and hold the students' attention for a longer period of time than the AHA CPR video. (This notation is by primary investigator observation only, no objective data was collected to validate this observation.) Perhaps the faster paced scenario Citizen CPR video was more appealing than the lecture based AHA CPR video. Both CPR programs informed the learner of the objective, stimulated recall of prerequisite information, presented the stimulus material, and enhanced retention and transfer in comparable manners.

The practice format and feedback correlated strongly

with Gagné's instructional events of emphasis on providing learning guidance, providing feedback about performance correctness, and assessing performance. Both CPR programs allowed for practice of CPR skills as long as desired by the student or instructor. However, most student were ready to leave after only practicing 1-2 CPR sequences whether they performed well or poorly.

Gagné (1977) recommended practice to improve motor skills. The practice or repetition of the procedure is more successful if it is done with "(1) intent on the part of the learner to achieve an improved performance, and (2) with 'feedback' which provides information to the learner" (Gagné, 1977. p.217). The Citizen CPR course provided multiple sources of feedback; the Skillmeter, instructor, and fellow students, and produced better results than the AHA CPR course which had only one source of feedback, the instructor. The multiple sources of feedback provided additional information to the student and might be thought to have improved the outcome.

Interpretation of Findings Related to Literature

Students in this study were able to perform the individual CPR component skills but unable to put them all together to perform CPR according to AHA standards, which is consistent with most findings in the literature (Mandel & Cobb, 1982; Ramirez et al., 1977; and Weaver et al., 1979 [see Table 6]). Mandel & Cobb (1982) reported no students were able to perform one minute of CPR according to the AHA

Table 6. CPR Study Literature Review Results

CPR Study	Percent Passing CPR	Percent Passing CPR Skills
Casemier Nelson (1995)	0-5.5%	6-100%
Ramirez et al. (1977)	1%	8-84%
Weaver et al. (1979)	2%	10-85%
Mandel & Cobb (1982)	0%	12-76%
Ambrose & Stratton (1993)	85%	6-60%
Kaye et al. (1983)	60%	Not reported

standards and the CPR component skills providing the most difficulty were: timing (12% done correctly), compressions (32% correct), ventilations (50% correct), and sequencing (76% correct). Ramirez et al. (1977) reported 1% able to perform CPR with 8% doing compressions correctly, 16% performing ventilations correctly, and 84% performing sequencing correctly. Timing was not reported. Weaver et al. (1979) results were similar with 2% able to perform CPR, 10% performing correct compressions, 17% performing correct ventilations, 85% performing correct sequencing, and timing not reported. The component skills of compressions, ventilations and timing are consistently the most poorly performed skills reported in the literature.

When compared to the Ambrose and Stratton (1993) study many field procedures were similar: the same type of manikins were used, similarly trained CPR instructors were used, the same practice format and practice feedback was used. The results, however, are extremely different;

Ambrose and Stratton reported an 85% passing rate. The major reason for the extremely different results was the variation in the testing procedure. Ambrose and Stratton allowed the students to watch the Skillmeter and correct performance while testing (R. Ambrose, Citizen CPR, personal communication, February, 1994), whereas this study did not allow the student to see the Skillmeter during testing.

Ambrose and Stratton do not report on the manikins' accurateness in recording assessment of responsiveness, breathing or pulselessness. If the Ambrose and Stratton data was collected strictly from the Skillmeter the same problem encountered in this authors' study could have occurred, the student performed the skill however the Skillmeter did not record the action. This could explain the lower scores noted for Ambrose and Stratton control group.

Unfortunately the only information available regarding the Kaye et al. (1983) study is an abstract with limited information. The overall performance of CPR is recorded but the performance on the component skills of CPR and the criteria utilized to evaluate the CPR performance was not revealed. Therefore the reason for the significantly improved results is not known.

Interpretation of Findings Related to Methods

The reason or motivating factor for participating in the CPR program may have influenced the component CPR skills or the overall CPR performance results. Several Citizen CPR

students (n = 9) were participating because of a job requirement which may have motivated them to strive for better CPR performance. Because of the small sample size, removing these nine subjects could cause a significant change in the overall results.

Another motivating factor for participation in the CPR classes was a potential need to perform this skill on a loved one (85%), which would be an interaction of history and treatment effect. The anticipation of performing CPR on a loved one may have increased the students' anxiety and therefore altered the results with better or poorer performance. A certain amount of stress is needed to effect good learning however too much stress can hinder learning.

One methodological constraint was the reliability of the Laerdal Resusci® Anne manikin in measuring some of the component CPR skills. The use of the Skillmeter to record all of the CPR skills except calling for help was supposed to remove the potential bias or inadvertent error of the subjective testers. However, during this study the Skillmeter did not accurately record pulse checks, determination of responsiveness and determination of breathlessness. Additionally three of the eight manikins had chest plate failure during this study teaching 148 subjects over two months. The unanticipated problems with the reliability of the manikin necessitated a subjective evaluation of those component CPR skills by the testers. The increased failure rate of the chest plates during the

short duration of this study was disappointing but did not interfere with the results of the study.

Sample characteristics such as gender and age may have affected the results of the component skill of compression which would then affect the overall results. The majority of the AHA and Citizen CPR groups were female, 63% and 74% respectively. The AHA and Citizen CPR groups also had several students over the age of 60, 10% and 9% respectively. The upper body strength necessary to perform correct chest compressions may not be as developed in women and the elderly. Therefore, with a sample composed of a large percentage of women and elderly, the number performing correct chest compressions could be lower.

The criteria used to measure satisfactory CPR performance definitely affected the results obtained in this study. The AHA health care provider criteria was very strict criteria. Other studies reported in the literature have used subjective instructor criteria and older model recording manikins which provided delayed objective feedback. Some studies measured CPR performance at times other than at the completion of one minute of CPR. So many different CPR measurements complicated comparisons between studies. Additionally, it is unknown how well CPR needs to be performed by the lay person to have a positive eventual outcome (Schluger, 1987). The use of less strict criteria in research studies, as is being done in real classes, would perhaps be more applicable. Perhaps reducing the lay public

criteria from eighty-four percent (84%) to seventy-five (75%) or even fifty percent (50%) correct ventilations and ninety percent (90%) to eighty (80%) or even sixty (60%) percent correct compressions would be a better evaluation of successful completion of CPR for a lay person.

Additional methodological constraints were interrater reliability, number of instructors and testers, and inability to blind the testers. Subjective measurements by testers are more prone to inadvertent errors in recording than objective measurements. Use of numerous testers increased the chance of inconsistency between measurements. Ideally a select few instructors and testers would be used to conduct a research study however seven (7) instructors plus the principal investigator were utilized for this small study. The testers were not blinded to which program the subject had attended, so the level of anonymity hoped for was not attained.

Discussion

The video enhanced CPR program of less than 2 hours produced comparable results to the traditional four hour CPR courses reported in the literature. Few subjects were able to perform adult one-rescuer CPR according to the AHA standards for health care providers but many were able to effectively perform the individual CPR component skills. Results noted in this study were: (1) every component CPR skill was performed accurately by more Citizen CPR subjects than AHA CPR subjects, and (2) component skills were

performed better than the performance of one-rescuer adult CPR.

The acquisition of the component CPR skills was positively influenced by the use of Gagné Model of Instruction, with the best results coming from the program which used a scenario based video tape presentation of the curriculum and multiple types and sources of feedback on performance. It is hypothesized that the component CPR skill acquisition could be further improved with practice focused on the most difficult skills, compressions and ventilations. Improvement of the performance of the component skills would then improve the performance of one-rescuer adult CPR.

The recommendations from this study include expanding the practice time and format to emphasize ventilations and compressions as separate skills. Recommendations for future CPR courses/research studies, summarized in Table 7, include:

1. Use of a scenario based video to present the content of the CPR course to capture and hold the students' attention. The use of a video provides concise, consistent, and correct curriculum presentation.
2. Utilization of the Citizen CPR model of multiple sources of feedback such as the Skillmeter, instructor and fellow students.
3. CPR practice to be organized and performed in distinct practice sections as follows:

Table 7. Recommendations for CPR Programs

A. Use of a scenario based videotape to present the curriculum.
B. Multiple sources of feedback while practicing CPR, using objective and subjective feedback.
C. Focused CPR practice:
1. Location/palpation of carotid pulse.
2. Compression practice.
3. Ventilation practice.
4. Initial sequencing practice.
5. Practice cycle of ventilations and compressions.
6. Practice one minute cycle of CPR viewing Skillmeter.
7. Practice one minute cycle of CPR with subjective feedback only.

a. Location and palpation of carotid pulses on each other.

b. Location of proper hand placement for chest compressions on each other.

c. Correct hand placement on the manikin with correct compressions and rate.

d. Correct ventilation depth and speed of delivery on the manikin.

e. Initial sequencing segment from assessing responsiveness through assessment of pulselessness.

f. Cycles of ventilations and compressions until timing is appropriate.

g. Entire sequence of one minute of CPR with Skillmeter until performance is acceptable.

h. Practice entire sequence without the student viewing the Skillmeter. The instructor will provide objective corrections in performance but

the student must get a feel for how far to compress the chest and how deeply to ventilate.

Implications for Practice

Victims in cardiac arrest have no hope of surviving without CPR. Eight-five percent of the cardiac arrests occur at home or work and could be witnessed by someone who knows the victim. Schluger (1987) reports the quality of bystander CPR is not as much of an issue as the time of its initiation. The lay public needs to learn the life-saving skill of CPR which includes how and when to notify the emergency medical system.

Implications for the nurse in advanced practice are numerous. The shortened video CPR programs offer an opportunity for the advanced practice nurses (APN) to provide CPR education in their practice to high risk families or to the practice clientele in general. The APN can easily identify the clients and families at risk for cardiovascular disease: the diabetic, the family/client with a family or personal history of cardiovascular disease, those with hyperlipidemia, tobacco abuse, obesity, sedentary lifestyle, and hypertension. After identification, annual participation in CPR classes would be an essential part of the management plan. The client at risk, their family members, their co-workers and friends should also learn CPR. The client can be encouraged to schedule or request annual CPR classes in the workplace, neighborhoods, churches, and social groups both to benefit themselves and others.

The information obtained in this study should be used by the APN when referrals to CPR programs are made. Having knowledge of what has been shown to be effective in teaching CPR in this study allows the APN to refer clients only to programs utilizing similar principles.

Fellow CPR instructors, the AHA, and ARC should be informed by lecture, letter, or publication of the results of this study to allow them to integrate these findings into their classes or prompt them to do more CPR research. American Heart Association or American Red Cross committee membership to participate in the decision making regarding lay person CPR training would be appropriate for the advanced practice nurse.

The APN must also be aware of the community and how best to reach the 20% who need to know CPR. Approaching individual churches and schools in the community resulted in a large number of lay people learning CPR as a result of this study. These same tactics, an APN teaching the lay public through churches and schools, may work in other communities. If for some reason this method does not work an assessment of the community may be needed to best determine how to reach the target population.

The advanced practice nurse could also influence health policy to place CPR training in the schools, by becoming actively involved in school boards/committees. There are so many causes attempting to gain the attention of the public: fund raising activities, family activities, community

involvement, employment issues, church/religious involvement, etc. that unless a concentrated effort is made to push CPR education for the lay public the goal of 20% trained will not be achieved.

Implications for Research

The advanced practice nurse should be involved in further research on effective CPR teaching methods for the lay public. This study could be duplicated and expanded to include a larger sample from more geographic locations and ethnic groups to expand the generalizability of the results.

A secondary analysis of this data comparing the results of those subjects with family members at risk for heart disease and those without family members at risk would be of interest. Secondary analysis could also be done on the results of this study in regards to the motivating factor for participation, job requirement versus potential need to perform CPR on a loved one. Further research into how well lay people need to perform CPR after training and/or how important is it for lay people to perform perfect CPR on victims would add insight into this issue. The frequency with which lay people should take CPR classes to maintain/improve their skills is unknown. Perhaps increasing the frequency of their class participation to every 6-9 months would improve results.

Further testing of the reliability of the Skillmeter to accurately document assessment of responsiveness, breathlessness and pulselessness is needed. The reliability

increasing the frequency of their class participation to every 6-9 months would improve results.

Further testing of the reliability of the Skillmeter to accurately document assessment of responsiveness, breathlessness and pulselessness is needed. The reliability of the instructor is questionable because their subjectivity, a reliable objective CPR instrument would greatly add to the reliability of the results of a study.

Summary

The video enhanced CPR program of less than 2 hours produced comparable results to the traditional four hour CPR course. Few lay subjects were able to perform adult one-rescuer CPR according to the AHA standards for health care providers but many were able to effectively perform the individual CPR component skills. More than 80% of the students in both programs quickly contacted the emergency medical system which is an essential component for a positive outcome with a cardiac arrest. Both programs should be further studied with larger, more heterogeneous, samples with more focused practice on ventilations and compression and multiple sources and types of feedback on performance.

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APPENDICES

APPENDIX A

Appendix A

Detailed Outline of the AHA CPR Program

1. Welcome, instructor introduction
2. Ask to sign consent form and agree to not discuss the educational session with students waiting for the training. Reassure about confidentiality.
3. Ask to complete the demographic questionnaire.
4. Thank participants for agreeing to participate in this study comparing two CPR programs. Following this class you are asked to leave on your student number badge and go the testing site. There you will be asked to give your student number badge to the tester and perform one minute of adult one-rescuer CPR as you have learned it here today.
5. Apply adhesive student number tag.
6. Conduct AHA CPR program with AHA Introduction, AHA Adult CPR and AHA Foreign Body Airway Obstruction Videos:

Time	Topic
0000	Begin AHA Introduction Video
02:10	Definition of Basic Life Support
02:50	Chain of Survival/Sudden Death
03:20	Definition of CPR
03:50	Cardiovascular Anatomy/Physiology
04:30	Respiratory Anatomy/Physiology
06:20	Respiratory Arrest Definition
07:20	Chain of Survival - Statistical Survival

07:40 AHA BLS Program - Prevention/Guidelines for CPR

08:10 Warning Signs of Heart Attack

09:10 Actions to take

10:20 Prudent Heart Living

- low fat, low cholesterol diet
- exercise
- stop smoking
- control high blood pressure
- maintain ideal weight

12:30 End of video

Begin One Rescuer Adult Video

15:00 Definition of CPR

16:20 Assess - when to do CPR

17:10 Check Responsiveness with demonstration

17:30 Call 911, what to tell them

18:30 Victim Positioning

19:10 ABC's of CPR

19:40 Opening Airway Demonstration

20:50 Assess Breathing

21:20 Recovery Position

21:30 Rescue Breathing

22:20 Reposition & attempt to ventilate

22:30 Pulse Check

23:10 Rescue breathing for Respiratory Arrest only

23:30 Chest Compressions

23:40 Hand Positioning for Compressions

25:40 Ratio of Compression to Ventilations

26:10 When to stop CPR after beginning

26:40 How to hand victim over to EMS personnel

27:30 Review of Sequence

28:40 End of Video

29:00 Manikin Practice - students will be allowed to practice two cycles of one minute of adult one-rescuer CPR each. (*teaching method will be generalized supervision with individual aid as needed, no specific sequence for practice*) (approximately 15 minutes)

Begin Foreign Body Airway Obstruction Video

45:10 Definition of FBAO/causes/differentiation

46:20 Partial Airway Obstruction

47:00 Total Airway Obstruction

47:40 Assessment

48:00 Demonstration of Abdominal Thrusts

48:50 Treatment of conscious victim becoming unconscious

49:10 Finger Sweep

49:50 Opening Airway

50:40 Rescue Breathing

51:00 Reposition Airway if breath unsuccessful

52:10 Abdominal Thrusts for Unconscious

52:50 Ventilations

53:00 Pulse Check

53:40 Recovery Position

54:00 Review of Sequence

54:50 Production Credits

56:00 End of Credits/Video

Group practice of FBAO Management

7. When student and instructor are satisfied with the students performance, escort students to the testing site, and remain with students until testing is completed. Provide student with card of program completion. (A CPR program held in the community would be completed when the student and instructor were satisfied that the student had reached their optimal performance level.)

APPENDIX B

Appendix B

Detailed Outline of Citizen CPR Program

1. Welcome, instructor introduces self
2. Have participants sign consent form, discuss not telling future students about the educational sessions to prevent any contamination of the study. Reassure about confidentiality.
3. Ask participants to complete the demographic questionnaire.
4. Thank participants for agreeing to participate in this study comparing two CPR programs. Inform participants that following this class they will be asked to remove their name badge and go to the testing site. There they will be asked to perform one minute of adult one-rescuer CPR as learned.
5. Apply adhesive student number tag that was assigned at registration.
6. Explain outline of program: Video and practice until comfortable, then they will be released to go for testing.
7. Begin video (differences from control teaching method are written in italics)

Time	Topic
0000	Introduction
00:35	Adult CPR Scenario
	Heart Attack
	Drowning
	Electrocution

01:50 Chain of Survival

02:25 Instructor Identification

03:00 Coronary Heart Disease Review

- Signs and Symptoms
- Take charge of situation
- Lay victim down
- Offer reassurance
- Call emergency number
- Begin CPR

06:35 Review of signs and symptoms

07:50 Purpose of CPR- Anatomy and Physiology

08:50 CPR demonstration one rescuer real time

12:25 Detailed steps of CPR performance:

Determine unresponsiveness

- Call Emergency number
- Position the victim
- Open airway
- Determine breathlessness
- Ventilate twice
- Determine pulselessness

13:50 Practice pulse check

14:15 Stop video - practice pulse checks on each other for approximately three minutes, until all students are comfortable with the skill.

17:20 Hand placement for chest compressions

18:00 Student practice of hand placement

18:10 Stop video- practice checking proper hand placement on self for approximately three minutes.

21:15 Chest compressions

rate, body position

Ventilate twice

Perform four cycles

Reassess pulse and continue

22:50 Review sequence of CPR

23:40 CPR demonstration

Individual face application

Review of CPR steps with

partial explanation of Skillmeter

28:35 Freeze and analyze function of

Skillmeter

29:35 Use of face shield-barrier device

30:10 Description of student practice

30:55 Practice CPR in the following manner: The CPR instructor will coach the first student in how to perform correct one-rescuer adult CPR through one minute of CPR. The first student will then coach the second student through one minute of CPR. This process will continue with each student coaching the next student until all 6 students have completed one minute of CPR. Then the last student will again coach the first student through one minute of CPR and the cycle begins again, however, this time the student is not allowed to see the Skillmeter and is provided feedback from the Skillmeter via the instructor and fellow students.

At completion of the second one minute performance of CPR the students will return to their seats. (approximately 15 minutes)

47:00 Signs and symptoms of foreign body airway obstruction
Anatomy and physiology of Heimlich maneuver

48:30 Hand placement for Heimlich

48:50 Conscious victim - FBAO sequence

49:55 Conscious victim becomes unconscious

51:35 Review of steps for FBAO management

52:20 Treatment for FBAO management if alone

53:05 Pregnant or obese FBAO management

54:20 Rescue breathing

55:30 Recovery position

55:50 Review of conscious and unconscious FBAO management

57:30 Practice FBAO management on each other with instructor assistance. When last student has successfully performed FBAO management all students will return to their seats. (approximately 10 minutes)

67:35 Risk factor for coronary heart disease and prudent heart living

72:20 Review of risk factors

Risk factors will play a total of two times. After the first time through allow any students who wish to practice any portion of the program again to do so now.

Practice adult one-rescuer CPR or FBAO management if desired.

8. Inform the students that the difference between teaching and testing is that you will not be allowed to watch the Skillmeter results as you test.

9. When student and instructor are satisfied with performance escort student to testing center for testing. Provide student with a card of program completion. (A CPR class held in the community would be completed when the student and instructor were satisfied that the student had reached their optimal performance level.) Remain with the students until testing is completed.

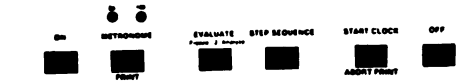
APPENDIX C

Laerdal Instruction Manual for Skillmeter

Appendix C

TO OPERATE

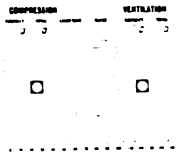
The following overview shows the Skillmeter keyboard and button functions.



On	Metronome	Evaluate	Step sequence	Start clock	Off
Turns power on Prepares for manikin input, which starts clock Resets all functions	Provides audible counting Selects 80/min or 100/min. OFF Print	1 Freeze stops clock, accumulated numbers sequence tracings 2 Analyze specifies mistakes, recalculates correct absolute numbers to percentages	Displays another 150 sec of sequence tracings totalling up to 600 sec	Starts clock to allow checking of student's response time Abort print	Turns power off If ignored, power will shut off automatically after 10 min

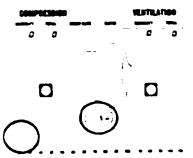
To start:

Batteries must be installed and the Skillmeter must be connected to the manikin. To prepare for registration of CPR performed on the manikin, push On.

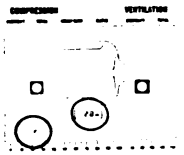


Accumulation of CPR data can now be started in two different ways:

1. *Automatic activation*
   When a CPR measure (i.e. check responsiveness, breathing, circulation, compression or ventilation) activates one of the sensors in the manikin, the Skillmeter clock starts and a graphic symbol denoting the first performed CPR measure appears on the lower left part of the display.
   Example: Responsiveness checking starts registration (r).

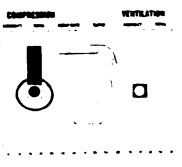


2. *Manual activation*
   To test the student for reaction time from encountering an unconcious patient until initiation of CPR, push On, then press the Start clock button when you wish to start measuring the student's reaction time.

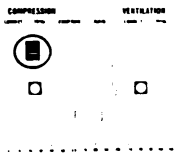


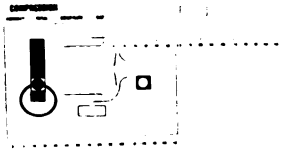
Immediate feedback during training

1. *Compression bargraph* is synchronized with compression *direction* (downwards) and compression *depth*. Sufficient depth is obtained when the black bargraph converts the "target" to a black dot.

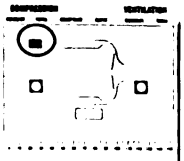


Mistakes signalled by compression bargraph:
If the bargraph does not convert the target, compression is *too shallow* (less than 1 ½", about 4 cm).
If bargraph surpasses the target, compression is *too deep* (more than 2", or 5 cm).

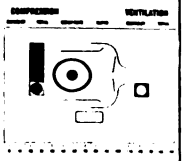




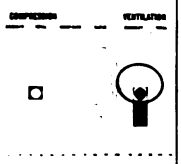
If *pressure is not fully released* between compressions, a portion of the bargraph is retained on top during the pause between compressions.



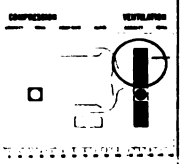
2. *Incorrect hand placement markers*
If compression force is applied to an incorrect area on the chest, a black dot marker will appear to denote that the hands were placed *too high*, or *too low*, or *too far left*, or *too far right*. Markers appear within the chest outline on the display screen, to clearly indicate hand misplacement. *No marker will appear for compressions with correct hand placement.*



3. *Ventilation bargraph* is synchronized with directions of the chest wall movement during inflation (up-wards) and exhalation (downwards). Sufficient volume is obtained when the black bargraph converts the "target" to a black dot.

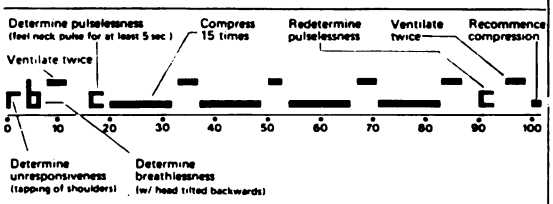


Mistakes signalled by ventilation bargraph: If the bargraph does not convert the target, ventilation volume is *insufficient* (less than 0.8 liter). If the bargraph surpases the target, volume is *excessive* (more than 1.2 liters). If inflation speed and/or inflated volume is so high that it could cause *stomach distention* in a real resuscitation case, the word "Stomach" is shown to the right of the bargraph.



4. *Sequence tracing*

SEQUENCE TRACING. Example: One rescuer CPR for 100 sec. Adult victim.

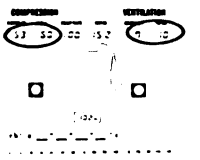


Performed CPR steps are traced by symbols across the lower portion of the display screen. The symbols are gauged against a 150 sec. time scale.

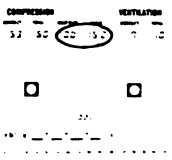
The sequence tracing represents the succession of performed CPR steps, the duration of each step, the duration of a series of steps, and the progression of the entire sequence.

To read a sequence traced over a period of time longer than the 150 sec. display line, press the "Step Sequence" button to display up to three more lines of tracings, each of 150 sec.

5. *Quantification*
Compressions and ventilations are counted. *Total numbers* of compressions and ventilations are given on the top line, along with *numbers of correct* compressions and ventilations.



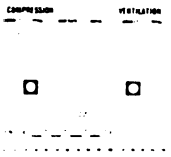
The *comp.-vent. ratio* is shown for each cycle of compressions and ventilations. In addition the *compression rate* is given. This will appear for each compression-ventilation cycle as soon as a following cycle is started.



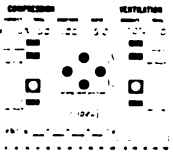
Note: Pressing the "On" or "Off" button removes any registered data.

Final assessment

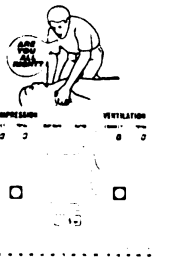
1. *Freeze*
Press the Evaluation button once to *freeze* the displayed numbers and sequence tracing, for further study and discussion. Rate and ratio are then automatically recalculated to show average values.

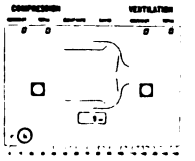


2. *Analyze*
Press the "Evaluation" button again to *analyze* the performance. A *detailed overview of mistakes*, and a calculation of "correct" numbers to *percentages* will appear on the display. *Mistake markers* lit occasionally during performance will be permanently lit during the analyze period. *Numbers* for each type of mistakes are given along with the classification of mistakes. However, one number is given for all four types of hand misplacement.

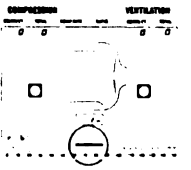


3. *Assessment of sequence*
Responsiveness check:
The letter "r" comes up immediately when the manikin's shoulders are shaken, confirming that an attempt to check responsiveness was made.

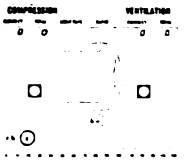




Breathing check:
The letter "b" comes up when the manikin's head has been held continuously in the open airway position for 3 sec.



Circulation check:
An easily seen black line is lit in the lower midportion of the display as soon as fingers are in the correct location and feeling the neck pulse. *This marker must be lit continuously for at least 5 sec. before the letter "c" comes up* to indicate that the pulse has been checked appropriately.

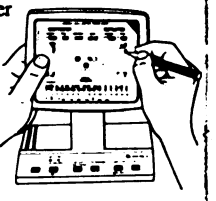


Initial checks should be followed by comp.-vent. cycles plus a repeated pulse check. Succession and timing should comply with valid guidelines. See example of complete tracing on page 13.

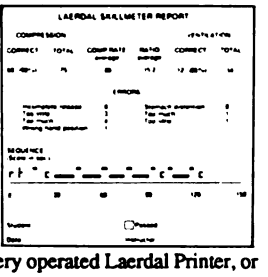
RECORDING OF DISPLAYED RESULTS

Results shown on the Skillmeter can be saved for review in one of two ways:

1. **Manual copying**
   To use Skillmeter "Score Sheets":
   - Hold Skillmeter in one hand and press the "Evaluate" button twice for performance analysis.
   - Apply score sheet over Skillmeter display so that numbers and tracings can be read through the clear score sheet windows.
   - Copy numbers and tracings onto windows using a permanent ink felt tip pen. Discard paper interleaving.



2. **Printed report**



The optional battery operated Laerdal Printer, or certain standard computer printers, (*See "Standard computer printer", page 15*) can be connected to the Skillmeter and will produce a printed report which graphically is similar to the display on the Skillmeter, incorporating a tabulation of results.

APPENDIX D

Appendix D

Print out of Skillmeter Report

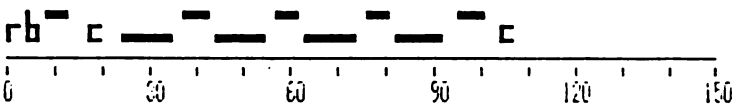
LAERDAL SKILLMETER REPORT

COMPRESSION				VENTILATION	
CORRECT	TOTAL	COMP.RATE average	RATIO average	CORRECT	TOTAL
60 (100%)	60	91	15:2	10 (100%)	10

ERRORS

Incomplete release	0	Stomach distention	0
Too little	0	Too much	0
Too much	0	Too little	0
Wrong hand position	0		

SEQUENCE
(Scale in sec.)



Student :

☐ Passed

Date :

Instructor :

APPENDIX E

Skill Performance Sheets for Adult One-Rescuer CPR

Appendix E

Skill Performance Sheet
Adult One-Rescuer CPR

American Heart Association

Student Name _____ Date _____

Performance Guidelines	Performed
1. Establish unresponsiveness. Activate the EMS system.	
2. Open airway (head tilt–chin lift or jaw thrust). Check breathing (look, listen, feel).*	
3. Give 2 slow breaths (1½ to 2 seconds per breath), watch chest rise, allow for exhalation between breaths.	
4. Check carotid pulse. If breathing is absent but pulse is present, provide rescue breathing (1 breath every 5 seconds, about 12 breaths per minute).	
5. If no pulse, give cycles of 15 chest compressions (rate, 80 to 100 compressions per minute) followed by 2 slow breaths.	
6. After 4 cycles of 15:2 (about 1 minute), check pulse.* If no pulse, continue 15:2 cycle beginning with chest compressions.	

*If victim is breathing or resumes effective breathing, place in recovery position.

Comments _____

_____

_____

Instructor _____

Circle one: Complete Needs more practice

APPENDIX F

Appendix F

Training Guide for Citizen CPR Instructors

Seven AHA CPR instructors will be trained to teach the Citizen CPR program for this study. Following is the outline of the training procedure:

Intro

Review of the Video and Detailed Outline of Citizen CPR Program in Appendix B.

Practice with Skillmeter until proficient.

APPENDIX G

Appendix G

Training Guide for Testers

1. Review of testing procedure in Appendix L.
2. Demonstration and return demonstration for how to freeze, analyze and print or record subject's CPR results.
3. Student identification by student number badges.
4. Where to place reports when completed.

APPENDIX H

Appendix H

Participant Questionnaire

PLEASE ANSWER THE FOLLOWING QUESTIONS:

ID # _ _ _ _Group # _ _ Day/Date_____ Instructor #_ _

(circle)

1. Male 1

   Female 2

2. What was your age on your last birthday?_____

3. What is your marital status?

   _____ Single, never married _____ Widowed

   _____ Married _____ Divorced

   _____ Separated

4. Do any of the members of your family (spouse, parents, in-laws, etc) have heart disease, high blood pressure or diabetes? (Circle correct answer) Yes No

5. Have you ever had any medical training? Yes No

   Did it include learning CPR? Yes No

6. Have you ever had a formal CPR class before? Yes No

7. What is your occupation?_____

8. Why are you participating in this CPR program?

   _____May need to perform CPR on family/neighbor/co-worker

   _____Job requirement

   _____Other -Please explain_____

_____

CONTINUED ON BACK OF FORM

9. What is the highest level of education you completed?

_____ Some elementary school (grades 1-7)

_____ Completed elementary school (8th grade)

_____ Some high school (9-11 years)

_____ Graduated from high school

_____ Some college/technical training (1-3 yrs)

_____ Graduated from technical program

_____ Graduated from college (associate's degree)

_____ Some college beyond an associate's degree

_____ Graduated with a bachelor's degree

_____ Some graduate school beyond bachelor's degree

_____ Graduate degree (Please specify _____)

_____ Other (Please specify_____)

10.OPTIONAL QUESTION Ethnic origin: _____African American _____White _____Hispanic _____Asian _____Oriental _____Other _____American Indian

APPENDIX J

Appendix J

Consent for church classes

CPR SKILLS TRAINING STUDY CONSENT FORM

I, _____, voluntarily consent to participate in the study comparing two alternate methods of teaching adult one-rescuer cardiopulmonary resuscitation (CPR). This study is being conducted by Joan Nelson RN, graduate student from Michigan State University. I understand I will attend a lecture session and then be supervised in practicing the skills of adult one-rescuer CPR. At the completion of my class time, and when I am comfortable will my CPR skills, I will perform one minute of adult one-rescuer CPR which will be analyzed for the study. I understand that at the completion of my class session I will receive a card of completion signifying I have completed the CPR program.

I will attend one training session which will be approximately 1 1/2 to 2 hours in length. I understand testing will take approximately five minutes per student at the completion of the CPR program.

Risks or discomforts possible from participation in this study may be physical soreness of my lips, wrists or back. I may also be uncomfortable with the knowledge that I may need to perform CPR on a loved one sometime in the future. I understand that if I am injured during this study I should seek medical care from my personal health care provider or the health care provider of my choice. I further understand that I will be responsible for any medical expenses incurred as a result of this injury.

CONTINUED ON BACK

I understand the purpose and outline of the study, including any inherent risks and/or discomforts.

I understand that I am freely choosing to participate in this study. I know I may choose to not participate at all, or may discontinue my participation at any time prior to the completion of the study without penalty or loss of benefits to which I may otherwise be entitled.

I understand that all results obtained with this study will be treated with strict confidence, my identity will not be revealed in any report of the research findings. A copy of the findings will be available to me upon written request to the author of the study.

If I have any questions or concerns regarding participation in this study I may contact Joan Nelson RN at 844-1266.

Signature:_____

Witness:_____

Date:_____

APPENDIX K

Appendix K

Commonly Asked CPR Questions and Answers

The following has been copied from the Basic Life Support, Heartsaver Guide, a Student Handbook for Cardiopulmonary Resuscitation and First Aid for Choking. 1993 American Heart Association ISBNO-87493-614-4. Pages 60-67.

Appendix 1
Your Commonly Asked Questions About CPR

1. **What about AIDS or hepatitis or other disease transmission during CPR?**

   Disease transmission, particularly of the AIDS and hepatitis viruses, while performing CPR is an obvious concern. The probability that a rescuer will become infected with either the AIDS or hepatitis virus as a result of performing CPR is minimal. To date, transmission of AIDS and hepatitis during mouth-to-mouth resuscitation has not been documented. If you are still concerned, face masks and shields can be used as barrier devices. These devices are placed over the victim's mouth.

   More important, remember that about 70% to 80% of respiratory and cardiac arrests occur in the home. In these situations the rescuer usually knows the victim and knows about the victim's health. A primary reason to learn CPR is for the benefit of one's family and close friends.

2. **What are the hazards of CPR?**

   Incorrect performance of CPR can cause injury to victims. Performance guidelines should be followed, and manikin practice is often useful.

   Incorrect performance of CPR may include

   - **Incorrect hand position** for chest compressions, which may cause rib fracture, xiphoid fracture, and bruising or bleeding of the liver, lung, or spleen
   - **Failure to release pressure completely between chest compressions,** which prevents the heart from filling with blood
   - **Bouncing chest compressions,** which may cause the rescuer's hands to move off the sternum
   - **Failing to compress the sternum deeply enough,** which results in inadequate blood flow to the brain and other vital organs

   - **Compressing the chest too deeply,** which may cause internal injury
   - **Using rescue breath volumes that are too great,** breathing too rapidly, or not having the airway opened completely, allowing gastric distention to build up, which may predispose the victim to vomiting or decrease the effectiveness of ventilation
   - **Incorrect hand positions** for abdominal thrusts (the Heimlich maneuver), which may damage the internal organs

   Even when CPR is performed correctly, you may hear popping noises or cracking sounds as you are compressing. If this happens, you should stop, check for proper hand position, and continue. If hand position is correct, the sounds are probably due to separation of the ribs from the sternum at the costochondral (bone-cartilage) junction, and the injury will heal after successful resuscitation. Rib fractures are possible even with correct hand position, especially in the elderly or chronically ill victim, but they will also heal. Not performing CPR or not applying the necessary force to the chest for fear of causing injury to the cardiac arrest victim will certainly result in the victim's death.

3. **How do I open the airway of a victim who may have a neck injury, such as the victim of an automobile accident?**

   Chin lift without head tilt is the first step in opening the airway in a victim with suspected neck injury. If this is unsuccessful, the head is tilted back slowly and gently until the airway is open.

4. **What should I do if the victim vomits?**

   You should turn the victim's head and body to the side so that the victim will not choke on the vomitus, then clear the airway by sweeping the mouth. A cloth (corner of clothing, handkerchief, etc) over your fingers can be used to sweep out the mouth. The victim should then be repositioned, and CPR should be continued.

5. How will I know if CPR is effective?

The compression and ventilation that you are providing for the victim should meet AHA guidelines. For example, depressing the sternum 1½ to 2 inches should provide adequate compression for the adult. One way to assess your performance is for a second rescuer to monitor the carotid pulse while you administer CPR. A good, strong carotid or brachial pulse should be present with each compression.

Rescue breathing can be checked by watching to see if the victim's chest rises with each lung inflation. Remember, too much volume will cause stomach distention.

6. How will I know if pulse and breathing return?

The spontaneous return of pulse with or without breathing may be dramatic or subtle. If dramatic, the victim may take a big gasp of air, begin moving, or even start to regain consciousness. If subtle, it will be found only as you check the pulse.

This assessment is to be done after the first 4 cycles of breaths/compressions in the adult (and after 20 cycles in the child or infant) and then every few minutes.

After delivering the 2 breaths of the last cycle for the adult (or the 1 breath for the child and infant), check for pulse (reassessment): leave your hand on the forehead to keep the airway open, and then with two fingers of the other hand feel for the carotid pulse (in infants, the brachial pulse). If the pulse is still absent, resume CPR. If the pulse is present, check for breathing.

- If breathing is present, keep the airway open and monitor pulse and breathing. Place the victim in the recovery position to maintain an open airway.
- If breathing is absent, perform rescue breathing 12 times per minute (once every 5 seconds) for the adult and 20 times per minute (once every 3 seconds) for the child or infant, and keep checking the pulse.

7. What should I do about a "neck breather" in need of CPR?

Neck breathers are persons who have undergone surgical removal of the voice box (larynx) and have a permanent opening (stoma) that connects the airway or windpipe (trachea) directly to the skin. This is recognized by observing the opening at the base of the front of the neck.

To tell whether the victim's breathing has returned, place your ear over the opening in the neck.

If rescue breathing is required, do direct mouth-to-stoma rescue breathing. For more information, contact the International Association of Laryngectomees, c/o the American Cancer Society, 1599 Clifton Rd. NE, Atlanta, GA 30329.

8. If a victim is found on a bed, how do I move him or her to the floor so that I have a hard surface under the victim's spine?

When moving a victim, protect the head and neck at all times. If you are alone and cannot move the victim, leave the victim on the bed and find something flat and firm to slide under the back to provide a hard surface.

9. What do I do for an adult who I think is having a heart attack?

The initial reaction should be to have the victim rest quietly and calmly. Both angina pectoris and heart attack are caused by too little oxygen to the heart muscle. Thus, activity should be kept to a minimum.

If chest discomfort lasts more than a few minutes, the EMS system should be activated. (Phone First!)

10. What do I do if a person takes nitroglycerin and is having chest discomfort?

Have the person rest and take the nitroglycerin as prescribed. If the chest pain persists after several doses of nitroglycerin, the EMS system should be activated.

11. If I find a victim and I am alone, should I telephone for help first or should I immediately begin CPR?

For the adult victim, phone first and then begin CPR. The sooner EMS arrives, the better the chance for survival of the adult because of the special skills and equipment of EMS units (Phone First!). Because children have respiratory arrests more often than cardiac arrests, begin CPR first, and if, after about 1 minute, the child has not regained spontaneous pulse and breathing, take the least time possible and phone for help (Phone Fast!).

12. What should I do if the victim is wearing dentures?

Leave the dentures in place if possible. This will help you make an airtight seal around the victim's mouth. Remove the dentures only if they are so loose or ill-fitting that they get in your way.

13. What should I do to prevent stomach distention (gastric distention)?

Distention of the stomach (air getting into the stomach) is most likely to occur when excessive pressures are used for inflation or if the airway is partially obstructed. The chance of gastric distention can be minimized by controlling the force and speed of rescue breaths: breathe slowly into the victim for 1½ to 2 seconds each time, and check that you are not forcing breaths after the chest rises.

14. What if the victim of complete airway obstruction is pregnant or very obese?

The pregnant or obese victim of choking should have the same treatment as any other victim unless it is impossible to perform safe or effective abdominal thrusts because the pregnancy is advanced or the obesity is extreme. In these cases, chest thrusts should be performed rather than abdominal thrusts.

To perform chest thrusts in the conscious victim (standing or sitting):

- Stand behind the victim.
- With your arms under the victim's armpits, encircle the victim's chest.

- Place the thumb side of your fist in the middle of the breastbone. Grab your fist with the other hand.
- Perform backward thrusts until the foreign body is expelled or the victim becomes unconscious.

To perform chest thrusts in the unconscious victim (lying on a firm surface):

- Place the victim on his or her back.
- Kneel close to the victim's body.
- Use the same hand position as that for chest compressions.
- Perform each thrust decisively and distinctly, with the intent of relieving the obstruction.

15. How will I know when to start the obstructed airway sequence in a conscious choking victim?

Foreign bodies may cause either partial or complete airway obstruction. With partial airway obstruction, the victim may be capable of either "good air exchange" or "poor air exchange." With good air exchange the victim can cough forcefully, although frequently there is wheezing between coughs. As long as good air exchange continues, the victim should be allowed and encouraged to persist with spontaneous coughing and breathing efforts. At this point *do not* interfere with the victim's attempts to expel the foreign body. The victim is more likely to be able to expel the foreign body than you are at this point.

Poor air exchange may occur initially, or good air exchange may progress to poor air exchange as indicated by a weak, ineffective cough and high-pitched crowing noises while inhaling. At this point treat the partial obstruction as though it were a complete airway obstruction.

With complete airway obstruction, the victim is unable to speak, breathe, or cough. The victim also may clutch his or her neck (universal distress signal). If he or she cannot speak, *begin the obstructed airway sequence.*

16. What should I do if I am unable to open the mouth to give rescue breaths?

Mouth-to-nose rescue breathing is an effective alternative to mouth-to-mouth rescue breathing.

- Tilt the head back with one hand on the forehead.
- With the other hand, lift the chin and close the mouth.
- Take a deep breath, seal your lips around the nose of the victim, and blow into the nose.
- Release the pressure on the chin to let the air out during exhalation.

17. What are the dangers of the Heimlich maneuver?

There is a chance of damage to internal organs or vomiting. Your hands should be above the navel and below the xiphoid process (the tip of the sternum) for abdominal thrusts.

In infants there is heightened concern about potential damage to internal organs from abdominal thrusts. Therefore, back blows and chest thrusts are used instead of the Heimlich maneuver.

For chest thrusts, the hands should be above the xiphoid process.

18. What can I do if I am a choking victim and I am alone?

The victim who is alone can perform the thrust on himself or herself in the following manner: press a fist into the upper abdomen with a quick upward thrust as described for the standing victim or lean forward and press the abdomen quickly over any firm object, such as a table or the back of a chair.

19. Should I handle a drowning victim differently from any other victim?

Not really. After determining unresponsiveness, opening the airway, establishing breathlessness, and attempting rescue breathing, if rescue breaths do not inflate the chest, begin the obstructed airway sequence:

- Reposition head and attempt rescue breathing.
- If still unable to give rescue breaths, give 5 abdominal thrusts (the Heimlich maneuver).

- Use tongue-jaw lift and sweep mouth with hooked finger.
- Try to give rescue breaths.

There are cases of drowning victims, especially children, for whom successful resuscitations have taken place after 20 to 30 minutes of submersion in cold water. *Never* assume that it has been too long. Always attempt CPR. You may save a life!

20. How long can I stop CPR to move the victim?

Do not interrupt CPR for more than a few seconds for any reason except for special situations, such as transporting the victim. If it is necessary to move a victim up or down a stairway, perform effective CPR at the head or foot of the stairs, then interrupt CPR and move quickly to the next flat area, where effective CPR must be resumed.

21. For rescuers with arthritic problems of the hand and wrist or other problems that make compression difficult, how can chest compressions be done?

An acceptable alternative hand position is grasping the wrist of the hand on the chest with the hand that has been locating the lower end of the sternum.

22. How often should I retake this CPR course?

The national ECC Committee recommends retraining at least every 2 years to refresh CPR skills. Your local AHA may recommend even more frequent skill renewal. The affiliate will inform you of local suggested renewal procedures. For more information, please contact your local American Heart Association.

APPENDIX L

Appendix L

Testing Procedure

A. Students will be tested individually.

B. When beginning to test the tester will ask the student for their student number badge and to perform one minute of one-person adult CPR as he/she was just taught in their respective programs.

C. The tester will document if the student properly requests notification of EMS at Step B of the CPR procedure, checks responsiveness initially, opens airway, checks pulse initially and after one minute of CPR.

D. At the completion of the one minute of CPR the student will be excused.

E. The tester will freeze the Skillmeter and record the results with the attached printer or onto a Laerdal Skillmeter Report sheet. The Skillmeter report will be stapled to the testing form along with the student number.

APPENDIX M

Appendix M

Testing Form

Student Number Badge: Staple Here

Student requests notification of

EMS at step B Yes No

Responsiveness checked Yes No

Initial Pulse Check Yes No

Second Pulse Check Yes No

Skillmeter printout: Staple here

APPENDIX N

UCRIHS Letters

Appendix N

MICHIGAN STATE
UNIVERSITY

November 14, 1994

TO: Joan K. Nelson
1700 Robins Road #132
Grand Haven, MI 49417

RE: IRB#: 94-526
TITLE: A COMPARISON OF TWO CPR (CARDIOPULMONARY RESUSCITATION PROGRAMS)
REVISION REQUESTED: N/A
CATEGORY: 1-A,B
APPROVAL DATE: 11/14/94

The University Committee on Research Involving Human Subjects (UCRIHS) review of this project is complete. I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the UCRIHS approved this project including any revision listed above.

RENEWAL: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Investigators planning to continue a project beyond one year must use the green renewal form (enclosed with the original approval letter or when a project is renewed) to seek updated certification. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for complete review.

REVISIONS: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB # and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

PROBLEMS/ CHANGES: Should either of the following arise during the course of the work, investigators must notify UCRIHS promptly: (1) problems (unexpected side effects, complaints, etc.) involving human subjects or (2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of any future help, please do not hesitate to contact us at (517)355-2180 or FAX (517)336-1171.

Sincerely,

David E. Wright, Ph.D.
UCRIHS Chair

DEW:pjm

cc: Rachel F. Schiffman

OFFICE OF
RESEARCH
AND
GRADUATE
STUDIES

University Committee on
Research Involving
Human Subjects
(UCRIHS)

Michigan State University
225 Administration Building
East Lansing, Michigan
48824-1046

517/355-2180
FAX 517/432-1171

MICHIGAN STATE
UNIVERSITY

February 2, 1995

TO: Joan K. Nelson
1700 Robins Road #132
Grand Haven, MI 49417

RE:

IRB#:	94-526
TITLE:	A COMPARISON OF TWO CPR (CARDIOPULMONARY RESUSCITATION) PROGRAMS
REVISION REQUESTED:	01/16/95
CATEGORY:	1-A,B
APPROVAL DATE:	11/14/94

The University Committee on Research Involving Human Subjects'(UCRIHS) review of this project is complete. I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the UCRIHS approved this project including any revision listed above.

RENEWAL: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Investigators planning to continue a project beyond one year must use the green renewal form (enclosed with the original approval letter or when a project is renewed) to seek updated certification. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for complete review.

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If we can be of any future help, please do not hesitate to contact us at (517)355-2180 or FAX (517)336-1171.

Sincerely,

David E. Wright, Ph.D.
UCRIHS Chair

DEW:pjm

cc: Rachel F. Schiffman

OFFICE OF
RESEARCH
AND
GRADUATE
STUDIES

University Committee on
Research Involving
Human Subjects
(UCRIHS)

Michigan State University
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48824-1047

517-355-2180
FAX: 517-336-1171