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EVALUATION OF ADVANCED CARDIAC LIFE SUPPORT WRITTEN EXAMINATIONS

By

Laura J. Borst

A THESIS

Submitted to
Grand Valley State University
in partial fulfillment of the requirements for the
degree of

MASTER OF SCIENCE IN NURSING

Kirkhof School of Nursing

1998

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ABSTRACT

EVALUATION OF ADVANCED CARDIAC LIFE SUPPORT EXAMINATIONS

By

Laura J. Borst

This study was conducted using a descriptive research design to determine the quality of two Advanced Cardiac Life Support (ACLS) written examinations. In addition, the relationship between demographic variables and subjects' performance on the written examinations was examined. Malcolm Knowles theory of Andragogy provided the framework for this study. A convenience sample of 367 subjects was recruited and randomly selected to take either Test A or Test B. The reliability estimates for Test A and Test B were found to be .45 and .54 respectively. Content validity and Item Analysis of test questions were performed. Relationships were found between Test A score and the number of codes an individual participates in per month, Test B score and the number of previous ACLS courses, and Test B score and profession. Recommendations for future research were made regarding ACLS education.

ACKNOWLEDGMENTS

I would like to express my sincere gratitude to the following individuals for their support.

My Thesis committee:

Dr. Katherine Kim, for her patience, advice, and great attention to detail.

Linda Scott, for her positive encouragement and for helping me to truly learn the application of statistics.

Dr. Richard Paschke, for his valuable input from a non-nursing perspective.

My business partner, mentor, and friend, Carol Gates, for her encouragement, insight, and input.

My parents, for their love, support, and for believing in me.

Walt, for his hours of proof-reading and his continuous support throughout this entire process.

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CHAPTER 1

INTRODUCTION

Cardiac arrests occur everyday both in and out of hospitals. For many individuals, cardiac arrest occurs prematurely. If resuscitative efforts take place quickly, cardiac activity can be restored spontaneously before brain damage occurs. (American Heart Association, 1997). Advanced Cardiac Life Support (ACLS) training provides health care professionals with a systematic, research-based standard for treating individuals with cardiopulmonary emergencies. ACLS trained professionals "use the same guidelines, the same approaches, inside the hospital, outside the hospital, nationally, as well as internationally" (AHA, 1997, p. 1-1). ACLS has provided a standard for the management of respiratory and cardiac arrest since it was introduced by the American Heart Association (AHA) committee on emergency cardiac care (ECC) in 1974 (AHA, 1997). The ACLS guidelines are among the oldest in the medical and nursing communities and have almost universal acceptance throughout the United States (Kirby & Sanders, 1996). ACLS courses are taken by a variety of health care professionals, including nurses, physicians, paramedics, respiratory therapists, and pharmacists. Many health care professionals learn ACLS because it is required by their employer while others learn ACLS because they want to increase their knowledge and ability to manage cardiopulmonary arrest.

ACLS courses have historically utilized teaching strategies that were not educationally sound. The majority of the ACLS course consisted of didactic lecture with very little student participation. Fear and intimidation were often used to "weed out" the weaker students. Students were so filled with anxiety that performance was adversely affected (AHA, 1997). Successful completion of the course required meeting the sometimes rigid expectations at the teaching stations and achieving a score of at least eighty-four percent on the written examination.

The ECC committee revises the ACLS guidelines approximately every six years based on the current research. The last meeting of the ECC committee in 1992 produced not only changes in ACLS content, but a shift in the educational paradigm as well. High levels of stress and anxiety have been found to be barriers to learning (Alfaro-LeFevre, 1995). Course directors were encouraged to make courses more learner-friendly. The new ACLS Instructor Manual states that "aspects of the course which threaten failure or raise anxiety should be minimized or eliminated" (Billi & Membrino, 1993, p. 475). "Numerous studies of adult learning and adult education have confirmed that adults learn best when material is presented in ways that resemble how they will actually use the information" (Cummings & Graves, 1996, p. 2). Therefore, a recommendation was made that ACLS should be taught using a case-based approach rather than using the traditional subject-based format. The written test was encouraged to be used primarily for its educational value, to assist instructors and students to identify areas for improvement. "Rather than focusing on whether all participants have reached some predetermined competency level, the course faculty should focus on improving each individual participants' ability regardless of his/her precourse level. It may be more valuable to

improve the ability of one novice than to verify the performance of ten accomplished participants" (Billi & Membrino, 1993, p. 477).

The AHA states that ACLS is a continuing medical education course. Participants attend an ACLS program to improve their skills. The role of the ACLS Instructor is to help course participants improve their skills and knowledge as much as possible (AHA, 1994). While the AHA has created a more learner-friendly atmosphere, it must still maintain a standard. Therefore, in order to successfully complete an ACLS course and receive an ACLS card that is valid for 2 years, participants must demonstrate mastery of the nine core cases through a 50 question written examination, psychomotor demonstration, and ECG interpretation. The nine core cases include: respiratory arrest, witnessed ventricular fibrillation, refractory ventricular fibrillation, pulseless electrical activity, asystole, acute myocardial infarction, bradycardia, and stable/unstable tachycardia (AHA, 1994).

Defining mastery has been a challenge for ACLS Instructors. The AHA supplies five written examinations. Instructors may select any of the five to administer at their courses. The remaining four tests may be used as pre-tests or as remedial tests in the event a participant does not successfully pass the initial test. Before the 1992 guidelines were established, a minimum passing score of 84% was required to pass the course. Now, the AHA states that the written test must be used as an evaluation tool and no longer requires a passing score. Test performance is considered in combination with psychomotor performance to determine if course objectives are met. If a participant does poorly on both the written examination and psychomotor stations, he or she will not be

passed. Participants who do not pass will have the opportunity to attend future courses free of charge until mastery of course objectives can be demonstrated.

A second challenge for educators is teaching to heterogeneous groups. "Most classes are composed of learners representing a variety of educational preparations and different levels of practice" (Abruzzese, 1992, p. 217). ACLS courses are taken by a diverse group of individuals from different professions and therefore have different learning needs. For example, pharmacists would require very little review of medications, but would need to concentrate more heavily on electrocardiogram (ECG) interpretation. Respiratory therapists are usually proficient in airway management, but would need more information on medications and ECG interpretation.

Purpose

ACLS courses have been taught throughout West Michigan for many years. ACLS Instructors have found that the same test questions are often missed by course participants and feel that a better written examination is needed. ACLS Instructors have also found it easier to teach to homogenous groups (i.e. all critical care nurses or all cardiologists). The purpose of this study is to examine reliability of two ACLS written examinations. Difficulty and discrimination indices will also be calculated for each question on both examinations. In addition, the relationship between selected demographic variables (i.e. profession) and subjects' performance will be examined.

CHAPTER 2

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

Conceptual Framework

Malcolm Knowles' theory of Andragogy provided the conceptual framework for this study. Knowles (1990) differentiates Pedogogy (the art and science of teaching children) from Andragogy (the art and science of helping adults learn). His theory states that adults learn very differently from children and therefore, must be taught using different methods.

According to Knowles (1990), there are four definitions of "adult". First, there is a biological definition, when humans reach the age at which they can reproduce. Second, using a legal definition, we become an adult when we can vote, get a drivers license, or get married without parental consent. Third, within the social definition, humans become adults when they start performing adult roles, such as spouse, parent, or full-time worker. Finally, applying the psychosocial definition, human beings become an adult when they develop a self-concept of being autonomous and responsible for their own lives. From an educational standpoint, Knowles (1990) states that the psychosocial definition is most crucial.

The andragogical model is based on the following assumptions that make it different from the pedagogical model (Knowles, 1990, pp. 85 – 87).

Need to know. Adults do not learn for the sake of learning, they learn for a reason – to accomplish a task, solve a problem, or learn a skill. Adults need to know why they need to learn something before they learn it.

The learners' self -concept. Adults have a self-concept of being autonomous and of being responsible for their own decisions and their own lives. Adults have a need to be treated by others in a way that respects this component of their self-concept. If not treated this way, adults become resentful and any teaching efforts will be counter-productive.

The role of the learners' experience. Adults bring with them a wealth of experience. The range of experience among a group of adults with diverse ages will vary more greatly than among a group of 12 year olds. Because of their varied experiences, adults are rich resources for one another. (Although, adults may be less flexible and have preconceived ideas because of their experience.)

Readiness to learn. The andragogical model assumes that adults become ready to learn when they experience a need to know something and can apply it to real life situations. Readiness to learn can by induced by exposure to effective role models, career planning, simulated situations, or experiences in which they can assess the gap between where they are currently and where they would like to be.

Orientation to learning. In contrast to pedagogy which is subject-centered, the andragogical model is problem-centered or task-centered. Adults will learn when they think it will help them deal with real life situations.

Motivation to learn. Although adults may respond to some external motivators (job promotion, higher salary), the most potent motivators are internal, such as self-esteem, recognition, self-confidence, or self-actualization.

The new educational direction of ACLS has taken the principles of Andragogy and applied them in the following ways: First, ACLS participants are adults and not children. The need to know is established in many ways. The dysrhythmia lecture on day one is introduced by telling participants that they will need to take a static dysrhythmia test on day two and that the lecture will consist of only the dysrhythmia which appear on the test. The ACLS pretest is also meant to serve the purpose of helping participants identify the need to know because it gives them a sample of what to expect during the course.

The learners' self concept is taken into account by allowing learners to grade their own examinations. Then, either the course director or the medical director reviews each question answered incorrectly. The intent is for learners to be able to identify areas that need further review.

Using a case scenario format for much of the content takes the learners' experience into consideration. Group discussion encourages learners to share their own experiences and learn from others. Also in the individual psychomotor testing stations, the instructors use a scenario that is similar to the participants' workplace.

Another way in which ACLS recognizes the learners' experience is the fact that if a learner does not demonstrate mastery of the acquired skill and knowledge of ACLS, the AHA mandates unlimited opportunity for remediation without any additional expense to the learner (Billi et al., 1993).

Literature Review

Major concepts discussed in the literature review include: the ACLS educational philosophy and instrument reliability and validity testing. In addition, the development and testing of the ACLS written examinations is discussed.

ACLS Educational Philosophy

Changing the educational paradigm for ACLS began at the 1985 National Conference on Cardiopulmonary Resuscitation and Emergency Cardiac Care. Educational issues were identified and presented at a preconference American Heart Association meeting in September 1991. The resolutions of the 1991 meeting were then presented by a panel at the National Conference on Cardiopulmonary Resuscitation and Emergency Cardiac Care in February 1992. Some of the issues presented included the philosophy of education, educational design, program flexibility, and evaluation methods (Billi et al., 1993). The most controversial topic discussed was the criteria for awarding documentation of successful completion (Billi et al., 1993)

According to Billi et al. (1993, p. 478) the ACLS written examination was to fulfill the following purposes:

a) allow participants to identify specific areas of knowledge deficit for further work.

b) assist instructors in identifying specific areas of knowledge deficit for further work.

c) provide instructors and course directors with educational assessment of the overall success of the course.

Course directors and instructors should be able to identify participants having difficulty accomplishing the educational objectives, identify the problem, and then take steps to remediate the participant. "If the participant continues to demonstrate failure of the acquired skill and knowledge of ACLS, opportunity for unlimited remediation at subsequent courses without additional charge must be offered" (Billi et al., 1993., p. A-6).

Since its inception, the AHA has been clear of its intent that "successful completion of a course implies nothing other than that: successful completion of a course" (Billi et al., 1993, p. 486). Completion of an ACLS course does not mean the participant is clinically competent to perform ACLS. The responsibility of competency evaluation lies with the participants' employer (i.e. hospital, emergency medical system, or other health care organization). The Joint Commission on Accreditation of Health Care Organizations and other regulatory agencies already require demonstration of competency. There are legal and liability concerns as well that put the responsibility of competency validation with the employer (Billi et al., 1993). Also, not all of those who have completed ACLS perform the entire range of skills taught in ACLS. For example, a registered nurse may never be required to intubate or a pharmacist may not be authorized to defibrillate under his/her employing hospital policy.

Another educational topic discussed at the 1992 national meeting was the flexibility of course design. Course directors and instructors are not only permitted, but

encouraged to be flexible with the course design in order to tailor the course to its participants (Billi et al., 1993). According to Billi et al., the needs of the group should be assessed and the design of the course should be tailored to meet the needs of the participants.

Reliability and validity of measuring instrument

Health professionals apply research findings to their clinical practice. As valuable as research findings may be, the results are worthless if quality research has not been conducted. Although all aspects of research should be evaluated before interpreting the results, the most important aspect is the quality of the instrument. The psychometric concepts of reliability and validity are used to evaluate the quality of an instrument.

Reliability, the most important criterion of quality, is the "degree of consistency with which it measures the attribute it is supposed to be measuring" (Polit & Hungler, 1991, p. 367). Validity, the second most important criterion for measuring the quality of an instrument, is the "degree to which an instrument measures what it is supposed to be measuring" (Polit & Hungler, 1991, p. 374).

Instrument reliability and validity is a crucial part of the research process. "Without detailed information about the instrument, the data and results should be viewed as meaningless" (Lynn, 1989, p. 421). Lynn (1989) also states that a complete evaluation cannot take place without "knowing how accurately the data were obtained (reliability) and the extent to which the data reflect the areas being studied (validity)."

An earlier study conducted by Lynn (1988) reviewed 40 research articles published in pediatric journals between January 1983 and December 1986. The purpose of the study was to determine the frequency of reliability and validity determination. Both established

(previously used and tested) and newly developed data collection instruments were reviewed.

Of the established data collection instruments, reliability estimates from previous uses were present in 47% of the articles. Previous validity determinations were present in only 20% of the articles. Current reliability estimates were available for 33% of the established data collection instruments and validity determinations for 13%. Lynn (1985) emphasized the fact that when using previously tested instruments, current reliability and validity must be obtained. Reliability and validity is not a property of the instrument itself and must be retested with each use of the instrument.

Of the new data collection tools reviewed, reliability estimation was present in 59% and validity determination was present in 42%. Lynn states that publication priority should be given to articles submitted which have adequate psychometric measurements reported. If a research study does not give enough information from which to judge the measures used in a study, the results are meaningless (Lynn, 1988).

Lamp, Price, and Desmond (1989) examined how often validity and reliability of measures were reported for research articles in three health education journals. Of 611 articles reviewed, reliability was reported for 17% and validity was reported for 61% of the articles reviewed. "Without proper attention to quality, results reported from a research article are open to criticism. Likewise, improper research techniques may mislead others if false results are given credence" (Lamp et al., 1989, p. 107).

Selby-Harrington et al. (1994) reviewed 55 randomly selected research articles published in 1989 in five research journals. They found that 47% of the research articles contained no evidence of validity determination for data collection instruments, 36% did

not contain estimated reliability, and 29% had no evidence of validity or reliability. The authors felt the results of their study are worrisome and that "neither reliability nor validity is a static property of an instrument. Each must be reassessed for each use of an instrument" (Selby-Harrington et al., 1994, p, 54).

In conclusion, reliability and validity measurements must be made in every research effort whether established or new data collection instruments are used. This is the only way the current research will have meaningful results.

Development and evaluation of the ACLS written examination

Billi et al. (1994) described the effort by a subgroup of the national ACLS subcommittee of the AHA that worked in collaboration with a group of educational professionals to develop five versions of a multiple choice written examination. The ACLS course content was divided into 11 areas. Each area was then weighted based on importance related to ACLS course objectives. The weightings were reviewed and approved by the national ACLS subcommittee. The group then constructed a blue-print for a 50 question, multiple choice written examination. For 40 of the questions, the content was distributed according to weight. The remaining 10 questions were randomly selected from different content areas in order to create different areas of emphasis among the five tests so the test may be selected based on appropriateness for different groups. Test questions were then created by the group and evaluated by the educational experts. The questions were then sorted into 11 content areas and five 50 question test versions were created, with some questions shared among the five versions.

The five ACLS examinations were field tested at one of five sites across the nation. Demographic data were obtained from test participants. Nine hundred and fifteen tests

were obtained (123 - 255 tests per version). Internal consistency was established for the five examinations with reliability coefficients ranging from .55 to .84. Demographic variables were analyzed as predictors of performance using analysis of covariance. To determine whether any differences in mean score among the test versions was due to difficulty of the test question versus the knowledge level of the participants, the performance of different groups taking the various versions was compared using only the questions that appeared in more than one version.

After the initial analysis was performed, the results were used to modify the tests in order to improve reliability coefficients and to minimize the variability of difficulty among the five versions. Item analysis was performed to identify questions that were poor discriminators. Replacement questions covered the same content area as the question it replaced and had a higher discrimination index than the replaced question. The replacement question also had to improve the equality of test difficulty across the five test versions. Using the data previously collected from the field testing of the five original versions, the difficulty of the modified versions were estimated by recalculating the mean score using the prior performance replacement questions. The estimated reliability of the five modified examinations ranged from .62 to .86.

It is interesting to note that since the development of ACLS in 1974, reliability and validity testing of the written examinations had not been performed until the study published by Billi et al. in 1994. This type of research is long overdue and is relevant to health care professionals from many disciplines that have a vested interest in the quality of ACLS education.

Research Questions

1. What is the reliability and validity of two of the ACLS written examinations?
2. Is there a difference in test performance according to professional discipline?
3. Which of the subjects' demographic variables predict the outcome of the ACLS written examination?

Definition of Terms

Reliability

The degree of consistency or dependability in which the examination measures what it is supposed to measure.

Validity

The degree to which an instrument measures what it is intended to measure.

Demographic Variables

Characteristics of ACLS participants.

Examination

A written tool used to assess learner cognitive knowledge.

Subjects

Participants who take an ACLS course.

ACLS Provider

A participant who is taking ACLS for the first time or has taken an ACLS course more than two years ago.

ACLS Retrainer

A participant who has taken ACLS within the past two years.

CHAPTER 3

METHODS

Study Design

This study was conducted using a descriptive research design to determine reliability estimates of two Advanced Cardiac Life Support written examinations. Hereafter, these tests will be referred to as "Test A" and "Test B". In addition, the relationships between demographic variables and subject performance on the written examination were examined.

The researcher recognizes that there were confounding variables that may have been threats to the internal validity of this study. These variables include the fact that ACLS providers, those taking ACLS for the first time or have previously taken ACLS but are not within the 2 year time frame, are required to attend approximately twelve hours of course time. Participants who are "retrainers" and have previously taken ACLS within the past 2 years attend only four hours of course time. The difference in the amount of class time may have had an effect on test score. The retrainer participants have the same faculty for the lecture portion, but those taking the twelve hours of course time have different faculty for all the lectures with the exception of the dysrhythmia lecture.

Physical setting may also have been a variable. The ACLS courses in which subjects were recruited for this study were held at four West Michigan hospitals, one outpatient surgery center, and one community college. The space, furniture, noise level,

and aesthetics vary between each institution. The physical surroundings could be distracting and therefore influence test performance. Course location was considered as a demographic variable in this study.

Class size and instructor-student ratio was another variable that must be considered. The class sizes ranged from 38 to 65. The instructor-student ratio varied from approximately 1:5 to 1:10. The amount of instructor attention each participant received may affect outcome on the written examination.

Weather conditions may also be a variable. Poor weather conditions may cause stress to participants and affect test score. Weather conditions may also be distracting to participants and have an influence on test score. The ACLS courses used to recruit subjects in this study were held between September 1997 and March 1998 in West Michigan.

Setting and Sample

This study took place at four West Michigan hospitals, one outpatient surgery center (OPSC) , and one community college (See Table 1). A convenience sample of 367 subjects were recruited from the attendance of ACLS courses. Participants were 40.1% ACLS providers (n = 147) and 59.9% ACLS retrainers (n = 220). Participants took either Test A (n = 177, 42.8%) or Test B (n = 190, 51.8%).

Table 1

Total Number of Participants, Test A Participants, and Test B Participants at Each Location (N = 367)

Location	Test A		Test B		Total	
	n	%	n	%	n	%
Hospital A	17	9.6	19	10.0	36	9.8
Hospital B	46	26.0	39	20.5	85	23.2
Hospital C[a]	56	31.6	54	28.4	110	30.0
Hospital D	17	9.6	25	13.2	42	11.4
OPSC	27	15.3	34	17.9	61	6.6
College A	14	7.9	19	10.0	33	9.0

$X^2 = 3.3$, df = 5, p = .64.

[a]Two courses were held at Hospital C, this accounts for the larger number of subjects at this location.

Table 2 shows the distribution of subjects by profession. Participants were health care professionals (nurses, doctors, paramedics, and respiratory therapists) who took the courses either because it was a job requirement or because they were motivated to learn the skills required to manage cardiopulmonary arrest. The "other" profession category consisted of exercise physiologists, physician assistants, medical assistants, and nursing or paramedic students. The number of years in the subjects' current job position ranged from 1 month to 39 years, with a mean of 7.55 years and a standard deviation of 6.99. The number of codes that subjects participated in per month ranged from 0 to 10, with a mean of 1.1 and a standard deviation of 1.58.

Only 86 of the participants were male (23.4%), while 281 were female (76.6%). Of the 366 subjects who revealed their age on the demographic information sheet, the age range was from 20 to 69 years, with a mean age of 37.7 years and standard deviation of 8.65.

Table 2

Sample Distribution by Profession (N = 367)

Profession	n	%
Emergency room or critical care nurse	124	33.8
Nurse in area other than emergency room or critical care	121	33.0
Resident or intern physician	7	1.9
Attending physician	30	8.2
Paramedic/emergency medical technician	42	11.4
Respiratory therapist	5	1.4
Other	38	10.4

Instruments

Two versions of the ACLS test were used along with a participant demographic information sheet (see Appendix A). Of the five ACLS tests developed by Dr. Billi et al. (1994), two tests were found to be most appropriate by two content experts who were qualified ACLS instructors. The two tests did not contain pediatric questions as the focus of the ACLS course content is primarily adult resuscitation. The two tests were referred to as "Test A" (see Appendix B) and "Test B" (see Appendix C). Billi et al. (1994)

reported estimated reliability coefficients of .62 for Test A and .67 for Test B. Each examination was composed of 50 multiple choice questions. There was one point per question on both examinations, with a scoring range of zero to 100%, reflecting the percentage of correct responses.

Subjects were asked to provide information regarding all of the following demographic variables: gender, age, numbers of previous ACLS courses, primary language, profession, years in that profession, and number of codes that they participated in per month.

Data Collection Procedure

Subjects were randomly selected using a table of random numbers to take either Test A or Test B. Of the 367 subjects recruited, 48.2% (n = 177) took Test A and 51.8% (n = 190) took Test B. Taking the written examination is a requirement of any ACLS course, however completing a demographic information sheet is not a course requirement. The study was explained to course participants and a consent form was distributed (see Appendix D). Subjects were informed of the confidentiality of the data and of their freedom not to participate if they objected. Those participants who agreed to participate in this study were given the demographic information sheet. Those who declined to participate in this study were not given the demographic information sheet. While the written examination was then taken by all participants, only the written examinations of those who consented to take part in the study were used.

Human Subject Consideration

There were no risks to the subjects in this study. Subjects were not coerced, tricked, or intimidated to participate. A possible benefit of the study is an improved

ACLS written examination. Approval was obtained from the Grand Valley State University Human Subjects Review Committee.

CHAPTER 4

RESULTS

The purpose of this study was to examine the quality of two Advanced Cardiac Life Support written examinations. Reliability for internal consistency of the two ACLS written examinations was examined by computing the Kuder-Richardson formula. Difficulty and discrimination indices were also calculated for each question on both examinations. Two ACLS Instructors reviewed Test A and Test B to determine content validity. To determine which variables, such as profession or gender, predict subjects' performance on the written examination, t-tests, correlation coefficients, and multiple regression analyses were used. Data were analyzed using the Statistical Package for Social Sciences (SSPS) software. Significance level was set at $p < .05$ for all tests.

Reliability and Validity of Test A and Test B

Research question one requires the determination of the reliability of both Test A and Test B. Computation of the Kudur-Richardson formula revealed reliability coefficient of Test A to be .45 compared to Billi et al. (1994) who estimated Test A reliability at .62 (See Table 3). Test B reliability was found to be .54, while Billi et al. estimated Test B reliability at .67 (See Table 3). Content validity was examined by two ACLS Instructors who determined the content of the test questions to be appropriate. Factor analytic procedures were not performed due to the small amount of variance between responses of participants.

Table 3

Reliability Studies of Test A and Test B

	Test A		Test B	
	n	Coefficient	n	Coefficient
Billi et al., 1994	168	.62	221	.67
Borst, 1998	177	.45	190	.54

Item Analysis of Test A and Test B

Appendices E and F (Tables 4 and 5) show results of the item analysis of difficulty and discrimination which was performed as described by Layton (1985). Difficulty is the proportion of subjects who answered the question correctly. Discrimination is the difference in proportions of the upper and lower groups.

In order to perform the item analysis, the scores were divided into upper 27% and lower 27% for both Test A and Test B. To compute the difficulty index, the correct number of responses in both upper and lower groups were divided by the total number of participants in both groups and multiplied by 100. The higher the difficulty index, the easier the test item. The discrimination index was computed by subtracting the number of correct answers in the lower group from the number of correct answers in the upper group, divided by one-half the total in the two groups, then multiplied by 100. (Layton, 1985)

According to Layton (1985) the higher the discrimination index, the better the test question. The following are guidelines to judge a discrimination index:

40 – very good

30 – reasonably good

20 – marginal; needs improvement.

10 – poor

Table 6 shows the discrimination indices of Test A and Test B. On both tests the majority of the questions fell within the poor to marginal range (0 - 19.99). Test B appears to be slightly better in discrimination than Test A with 70% of it's questions in the poor to marginal range, as compared to 76% of the Test A questions in the poor to marginal range.

Table 6

Discrimination Indices of Test A and Test B Items (N = 367)

Discrimination Index	Test A (n = 177)		Test B (n = 190)	
	n	%	n	%
Negative number	1	2	3	6
0	13	26	7	14
1-10.99	16	32	13	26
11-19.99	9	18	15	30
20-29.99	7	14	5	10
30-39.99	1	2	2	4
> 40	3	6	5	10

A wide range of difficulty indices are acceptable (approximately 25 to 75), although because the ACLS test is a criterion referenced test, a higher difficulty index would be acceptable (less than 90).

Table 7 shows difficulty index results of Test A and Test B questions. The questions on Test A (60% of test questions with a difficulty index greater than 90) were found to be easier than the questions on Test B (52% of test questions with a difficulty index greater than 90). High difficulty index indicates that either the test item was easy or most participants performed well in the test item as expected in a criterion referenced test. This explains relatively low discrimination indices found in this study.

When reviewing the best questions on both tests, which would have a high discrimination index and a low difficulty index, visual inspection revealed no trends in the content of these items. However, it is interesting to note that the highest quality questions on both tests (Test A questions 7, 16, 24, 37; Test B questions 6, 17, 20, 24, 42, 47) did contain distractors (wrong answers) that were the most plausible as possible correct answers.

Table 7

Difficulty Indices of Test A and Test B Items (N = 367)

Difficulty Index	Test A (n = 177)		Test B (n = 190)	
	n	%	n	%
90.00 - 100.00	30	60	26	52
70.00 - 89.99	16	32	17	34
29.99 - 70.00	4	8	7	14

Characteristics of subjects in Test A and Test B

Chi square tests were performed to test significance of different proportions for nominal level demographic variables in Test A and Test B groups (gender, provider vs. retrainer, language, profession, and test site). Statistically significant differences were not found among these variables (See Table 8). The group of subjects taking Test A was very similar to the group of subjects taking Test B in regards to gender, provider vs. retrainer, language and profession. The primary language of subjects in both groups was English, although the primary language of one subject in the Test A group was German. In the Test B group, three had primary languages other than English (one Spanish, one Turkish, and one Chinese). Therefore, due to the small number of non-English speaking participants, when performing the Chi-Square test for language, the languages other than English were combined into one category. In addition, when performing the Chi-square test for profession, attending and intern/resident were combined as well as respiratory therapist and "other" due to the small number in those categories.

Relationships between demographic variables and test performance

To examine the relationship between gender and test performance, t-test procedures were performed for Test A and Test B participants. There was not a significant difference in test performance among men and women who took Test A. However, Test B scores of men were significantly higher than those of women ($p < .05$), although the sample consisted of 142 women and only 48 men in Test B group (Table 9).

Table 8

Characteristics of Sample

Characteristic	Test A (n = 177) n	%	Test B (n = 190) n	%	X^2	p
Gender						
Male	38	21.5	48	25.3	.73	.39
Female	139	78.5	142	74.7		
Course						
Provider	73	41.2	74	38.9	20.00	.65
Retrainer	104	58.8	116	61.1		
Profession					2.27	.68
Emergency Room/ Critical Care RN	58	32.8	66	34.7		
Other RN	63	35.6	58	30.5		
Intern/Resident/ Attending Physician	19	10.7	18	9.5		
Paramedic/Emergency/ Medical Technician	20	11.3	22	11.6		
Other	17	9.6	26	13.7		
Language						
English	176	99.4	186	97.9		.37*
Other	1	0.6	4	2.1		
Test Site						
Hospital A	17	9.6	19	10.0	3.35	.64
Hospital B	46	26.0	39	20.5		
Hospital C	56	31.6	54	28.4		
OPSC A	27	15.3	34	17.9		
College A	14	7.9	19	10.0		

* indicates Fishers'exact test

Table 9

Test Performance by Gender

Gender	n	M	SD	t	df	p
			Test A			
Female	139	86.27	5.68	1.77	175	.078
Male	38	88.16	6.29			
			Test B			
Female	142	86.50	6.41	3.98	188	.000
Male	48	90.58	5.21			

T-tests were performed to determine statistical differences in group means of Test A and Test B participants regarding age, prior number of ACLS courses, years in current profession, and number of codes participated in per month. Of the variables tested, only age was found to be statistically different between the two groups as seen in Table 10.

Table 10

Demographic Differences Between Test A and Test B Participants (N = 367)

Variable	t	df	p	Test A M	Test A SD	Test B M	Test B SD
Age	2.61	364	.009	38.94	9.08	36.60	8.09
Number of prior courses	1.74	360	.083	2.85	2.71	2.39	2.33
Years in current profession	0.04	357	.970	7.54	6.92	7.56	7.07
Number of codes/month	0.33	359	.741	1.14	1.54	1.08	1.62

To determine if there were differences in test performance by ACLS course type (provider vs. retrainer), mean tests scores were evaluated using t-tests. Although retrainers had higher scores on Test A (retrainers: M = 87.00, SD = .06; providers: M = 86.00, SD = .06), no significant differences were identified in test scores by ACLS course type (t = 1.29, df = 175, p = .197). Similarly, retrainers had higher scores on Test B (retainers: M = 8.00, SD = .05) than providers (M = 86.00, SD = .07), with no significant differences noted in the analysis (t = 1.87, df = 188, p = .62).

Analysis of variance procedures were conducted to explore the test scores by profession. The results of the ANOVA procedure for Test A indicated that there was a significant difference [(F (3, 153) = 2.67; p = .049]. However, when a post hoc Scheffe procedure was performed, there were no significant differences in Test A performance between any 2 pairs of profession.

In comparison, ANOVA procedures on Test B found a significant difference between test scores among profession [(F (3, 164) = 5.52; p = .001]. The post hoc Sheffe test revealed that registered nurses who work in areas other than critical care or the emergency room scored significantly lower on Test B than critical care/emergency room nurses, physicians, and paramedics/emergency medical technicians. Test B scores were found to be significantly lower in the "other profession" group than physicians and paramedic/emergency medical technician groups (Table 11).

Table 11

Test B Scores by Profession

Profession	n	%	M	SD
RN - Noncritical Care/ER	58	30.5	85.14	6.28
Other Professions	26	13.7	85.61	7.42
RN - Critical Care/ER	66	34.7	88.18	5.29
Physicians	18	9.5	91.11	4.83
Medic/EMT	22	11.6	91.27	5.37

The final research question for this study asks which of the participants' demographic variables, if any, could predict performance on the ACLS written examination. Correlation coefficients were computed to determine the degree of relationships between Test A and Test B scores and the interval level demographic variables (Table 12).

On Test A, a weak, but significant positive relationship was found between test score performance and the number of codes an individual participates in per month ($r = .15$). This indicates that the greater the number of codes participated in per month, the greater the Test A score. For Test B, correlation coefficients revealed a significant relationship between the number of previous ACLS courses an individual has taken and Test B score ($r = .30$). This indicates that the greater the number of previous courses, the greater the Test B score.

Table 12

Correlation Coefficients Between Test Scores and Selected Demographic Variables

Variables	# of codes participated in per month	Age	Years in profession	# of prior ACLS courses
Test A Score	.152*	-.136	.009	.085
Test B Score	.049	-.086	.129	.304***

*p < .05, **p < .01, ***p < .001.

Inasmuch as the correlational analysis for Test A only revealed one significant relationship and no other relationships were found among the nominal level demographic characteristics, regression procedures were not performed. Whereas, two variables found to have significant relationships with Test B score performance: gender and the number of prior ACLS courses. Gender, coded as a dummy variable was used in addition to the number of prior ACLS courses in a multiple regression analysis as possible predictors of Test B outcome.

The results of the multiple regression analysis [$F(2, 184) = 15.49$; $p = .0000$] indicated two significant predictors of Test B score: gender ($t = 3.339$; $p = .0010$) and the number of prior courses ($t = 3.799$; $p = .0002$) after controlling influence of other variables in the model. While both variables were identified as significant predictors, only 14% of the explained variance ($R^2 = .144$) was accounted for in Test B score performance.

CHAPTER 5

DISCUSSION AND IMPLICATIONS

Discussion

The purpose of this study was to examine the quality of two ACLS written examinations that are provided by the AHA and used in ACLS courses internationally. In addition, selected demographic variables were examined to determine if they predict subjects' performance on the two examinations used in this study.

Reliability coefficients of Test A and Test B were found to be .45 and .54 respectively. According to Polit and Hungler (1991), reliability coefficients greater than .70 are considered satisfactory, therefore the reliability coefficients of both tests were far below satisfactory. Construct validity was unable to be calculated in this study due to the small variance between answers. Item analysis performed on both tests found the majority of the questions to be easy in degree of difficulty and poor as discriminators. The ACLS examination is a criterion-referenced examination and the purpose is to determine mastery of the cognitive knowledge needed to manage cardiopulmonary arrest and not to "weed out" subjects. Therefore, one would expect to find that discrimination between high and low achievers is poor because ACLS participants would be able to answer most of the test questions.

It was found that the higher the number of codes (cardiac arrests) a subject participated in per month, the higher the Test A score. On Test B, it was found that the greater the number of previous ACLS courses an individual has taken, the higher the Test

B score. This suggests that previous experience, either actual (code participation), or simulated (previous ACLS courses) influences success on the ACLS written examination.

Profession was found to be a factor influencing Test B performance. Registered Nurses who work in areas other than critical care or the emergency room scored lower on Test B than critical care or emergency room RN's, physicians, or paramedics/emergency medical technicians. Those in the "other" profession group were found to have significantly lower Test B scores than physicians and paramedics/emergency medical technicians. There has been discussion within the AHA of creating an "advanced ACLS course"which would contain content appropriate for the ACLS expert. Participants could choose to attend the "advanced ACLS course" or the standard ACLS course which is currently offered based on their experience and knowledge level. A challenge for ACLS Instructors has been teaching to heterogenous groups, particularly individuals from a variety of professions. The concept of an "advanced ACLS course" would assist in meeting the needs of individuals from a variety of professions.

Course location did not appear to influence test outcome, therefore ACLS courses can be taught in a variety of settings. Gender was found to be a predictor of Test B score, although this may be indicative of the fact that the sample size was 76.6% female. Future research is needed to determine if gender is a predictor of ACLS examination score.

Relationship of Finding to Conceptual Framework

Malcolm Knowles Theory of Andragogy provided the conceptual framework for this study. Since the purpose of the ACLS written examination is to provide participants with individual feedback regarding areas needing improvement (or according to Knowles, the need to know), it is imperative that a quality examination be used.

According to Knowles, adults bring a diverse variety of experiences with them into educational settings. In this study the varied experiences which appear to influence ACLS test outcome include profession, the number of previous ACLS courses taken, and the amount of participation in actual codes. Age was also found to influence test outcome. The older an individual, the more he/she has experienced. One way to address the varied experiences of the adult learner is to provide the option of taking an "advanced ACLS course". This course would be offered for ACLS retrainers who are more experienced and would cover higher level information than the required core material. This would address Knowles' assumption of the learners' self-concept as well. Knowles states that adult learners need to be treated with respect and have a need to make their own decisions. Adults will feel respected when ACLS courses are tailored to their learning needs and they are given a choice as to which course to attend.

Relationship of Findings to Previous Research

The 1994 study performed by Billi et al. was the first documented analysis of the written examinations used in ACLS courses. Billi et al. estimated the reliability coefficients of Test A and Test B to be .62 and .67 respectively as compared to this study which found the reliability coefficients to be lower at .45 for Test A and .54 for Test B. The sample sizes are similar in both studies. Billi et al. recruited 168 subjects for Test A and 221 for Test B, as compared to 177 subjects for Test A and 190 for Test B used in this study. Billi et al. developed five versions of the ACLS written examination, calculated reliability and item analysis, then made revisions based on the results. The reliability of the revised versions was then estimated. The purpose of this study was to build on the work by Billi et al. and examine two of the five versions available, calculate actual reliability,

perform item analysis, and examine demographic variables as predictors of test performance. Based on the results of both studies, it is clear a better ACLS written examination is needed. Although the results of both studies are less than ideal, progress has been made educationally since ACLS was developed in 1974. Previously, ACLS written examinations were not scientifically developed or studied. This research, as well as the research by Billi et al. (1994) is a starting point for future improvement of the quality of ACLS written examinations that will lead to a more educationally sound ACLS course.

Limitations

There are several limitations that should be considered prior to any generalizations of the study findings. One limiting factor was the nature of the sample size used in this study. There were 177 subjects recruited to take Test A and 190 subjects who took Test B. Optimally, five to ten subjects per question are needed for item analysis (Layton, 1985). This study used two 50 question instruments, therefore a minimum of 250 subjects for each test would be ideal. Subjects were recruited from test sites which were limited to West Michigan, therefore, generalization of the findings from this study are limited. The aesthetic differences in the testing environments and the fact that differenct instructors taught at each course are also considered limitations of this study. Although gender was found to influence Test B performance, the population used in this study was 76.6% female. Therefore, a predominately female sample was a limitation of this study.

Implications

ACLS courses are taken by a variety of healthcare professionals, therefore the implications of this study are multidisciplinary. ACLS Instructors, course directors, and medical directors can use the findings of this study when planning and teaching ACLS courses. There are also implications for educators, managers, and researchers.

Experience, whether actual or simulated, appears to be a predictor of higher scores on the ACLS written examination. Therefore, providing such experience would be beneficial for healthcare professionals who are exposed to cardiopulmonary emergencies. Since actual code situations cannot be planned, simulated situations, such as mock codes should be offered by healthcare institutions to maintain proficiency of the code team. Knowles Theory of Andragogy also supports the use of simulated situations in education. It states that readiness to learn can be induced by simulated situations or experiences in which adults can assess the gap between where they are currently and where they would like to be.

An implication of this study for educators is to either revise the current ACLS examinations or develop new written examinations and continue to assess these instruments for their quality. Until instrument revisions are made, Test B should be chosen over Test A due to the fact that it had better reliability and item analysis results. According to the item analysis performed on both tests, the best test questions had distractors that could plausibly be the correct answer. Therefore, it would be beneficial to review the test questions that scored poorly on the item analysis and examine the distractors used in those questions. It would be better to have fewer quality tests than five poor tests.

There are policy implications for nurse managers. Registered Nurses who work in areas other than critical care or the emergency room performed significantly lower on Test B, perhaps RN's in those areas should not be required to take ACLS as a job requirement. Mandating ACLS for RN's who get minimal exposure to codes may be setting them up for failure. This would also support the concept of an "advanced ACLS course" which would stratify the novice from the expert.

There are many research implications of this study. Due to the limited research done in the area of ACLS education, more research is needed to assure quality courses. Specifically, research is needed to determine the quality of ACLS instruments.

Recommendations

Further ACLS research is needed to assure quality, educationally sound courses. The AHA Emergency Cardiac Care Committee (ECC) will meet again in the year 2000 to review the research of ACLS content and delivery and to make recommendations for changes. New ACLS tests will be constructed at that time. It is recommended that psychometric analysis be applied to the new tests and revisions made based on the results. The revised tests should be analyzed again to assess the quality improvement and the need for further modifications. The ECC also needs to examine the feasibility of developing an "advanced ACLS" course that would be more appropriate for experienced ACLS participants and would create more homogeneity among ACLS classes.

More research is needed in many other areas of ACLS education. Test reliability and item analysis should be re-examined using a larger sample size. Gender needs to be examined as a predictor of test outcome using a sample that is more equally distributed in terms of gender.

This study only examined the cognitive portion of the ACLS course, but the psychomotor portion of the course needs to be studied as well, such as factors influencing megacode performance. The affective portion of ACLS should not be overlooked. It would be interesting to study the attitudes and feelings of ACLS participants and examine how they affect performance.

In conclusion, since the inception of ACLS 24 years ago, it has evolved into a more learner-friendly, educationally sound course due to those who are invested in ACLS quality. A higher quality written examination will enhance the learning of those who take ACLS courses. Improved ACLS education will better prepare all disciplines to consistently manage their patients in cardiopulmonary arrest.

APPENDICES

APPENDIX A

Demographic Information Sheet

Please enter the appropriate information:

1. What is your gender?
   _____ male (1)
   _____ female (2)

2. What is your age in years? _____

3. At this ACLS course, are you a:
   _____ provider (1)
   _____ retrainer (2)

4. What is the number of times that you have taken prior ACLS courses (both certification and recertification)? _____

5. What is your primary language? _____

6. What is your profession? (Check appropriate item)
   _____ emergency room or critical care nurse (1)
   _____ nurse in area other than emergency room or critical care (2)
   _____ resident or intern physician (3)
   _____ attending physician (4)
   _____ paramedic/EMT (5)
   _____ respiratory therapist (6)
   _____ pharmacist (7)
   _____ other - please specify (8) _____

7. Number of years in your current position _____

8. What is the approximate number of codes you participate in per month?_____ (number of times per month).

APPENDIX B

"TEST A"

AMERICAN HEART ASSOCIATION
HEART AND STROKE FOUNDATION OF CANADA

ADVANCED CARDIAC LIFE SUPPORT
MULTIPLE CHOICE EVALUATION

Version 1.1-95

1995

Questions
Please do not mark on this test. Record the best answer on the separate answer sheet.

1. Which of the following rhythms is most commonly present in the first minute following the onset of cardiac arrest in adults?

   a. agonal
   b. asystole
   c. complete heart block
   d. ventricular fibrillation

2. Treatment with thrombolytic agents should be considered for patients with symptoms and ECG findings of acute myocardial infarction.

   a. true
   b. false

3. Drugs that may be useful in the emergency treatment of cardiogenic pulmonary edema in a patient with sinus tachycardia and a blood pressure of 110 mmHg systolic include:

   1. furosemide
   2. isoproterenol
   3. morphine
   4. propranolol
   5. oxygen

   a. 1, 2, 4
   b. 1, 3, 5
   c. 3, 4, 5
   d. all of the above

4. A 65 year old man (weight 75 kg) arrives at the emergency department with severe chest pain. His heart rate is 40 and blood pressure is 70/P mmHg. The monitor shows sinus bradycardia with an occasional premature ventricular complex. Which of the following drugs is indicated first?

   a. atropine 0.5 mg IV
   b. isoproterenol infusion at 2 - 10 μg/min
   c. lidocaine 75 mg IV bolus
   d. morphine 2-5 mg IV

5. Intubation with an endotracheal tube:

1. allows adjunctive ventilatory equipment to be used more effectively with less effort on the part of the rescuer
2. reduces the risk of aspiration of gastric contents
3. is the immediate priority in ventricular fibrillation
4. when improperly performed may result in only one lung being inflated

a. 1, 2, 4
b. 1, 2, 3
c. 2, 3, 4
d. all of the above

6. Bag-valve-mask devices:

1. should be used only by trained individuals
2. deliver close to 100% oxygen if reservoir and high oxygen flow rate are used
3. are often difficult for one person to use effectively
4. usually provide greater tidal volume than mouth-to-mask ventilation

a. 1, 2, 3
b. 1, 2, 4
c. 2, 3, 4
d. all of the above

7. Acidosis that occurs during cardiac arrest:

1. is usually both respiratory and metabolic
2. should initially be treated with increased ventilation regardless of the cause
3. should generally not be treated with sodium bicarbonate until more definitive therapy has proved unsuccessful
4. is usually self-limiting once perfusion is restored

a. 1, 2, 3
b. 1, 2, 4
c. 2, 3, 4
d. all of the above

8. Endotracheal suction:

1. should be limited to 10-15 seconds of suction
2. should be preceded by increased ventilation with supplemental oxygen
3. can result in hypoxia
4. should be performed without applying suction while inserting the catheter

a. 1, 3, 4
b. 1, 2, 3
c. 2, 3, 4
d. all of the above

9. Once an endotracheal tube is in place, ventilations should:

1. be performed at 10-15 breaths per minute
2. only be completed after the chest compressor has paused at the 5th compression
3. be performed asynchronously to cardiac compressions
4. be delivered with room air

a. 1, 2
b. 2, 3
c. 1, 3
d. 2, 4

10. Endotracheal intubation has just been completed. You are unable to hear breath sounds on either side of the chest. You have most likely:

a. intubated the esophagus
b. intubated the left mainstem bronchus
c. intubated the right mainstem bronchus
d. wedged the tube against the carina

11. The airway of choice for a deeply unconscious patient in shock is:

a. an endotracheal tube
b. an esophageal obturator airway
c. a nasopharyngeal airway
d. an oropharyngeal airway

12. An oropharyngeal airway:

a. eliminates the need for head positioning of the unconscious patient
b. eliminates the possibility of complete upper airway obstruction
c. is of no value once an endotracheal tube is inserted
d. may stimulate vomiting or laryngospasm in the semi-conscious patient

13. CPR is in progress for an unwitnessed cardiac arrest. Immediately upon diagnosing ventricular fibrillation, one should:

a. administer lidocaine 1 mg/kg IV
b. deliver a precordial thump
c. shock with 200 J synchronized
d. shock with 200 J unsynchronized

14. After two unsuccessful defibrillation attempts for an adult, the energy setting for the third defibrillation shock should be:

a. 100 - 200 J
b. 200 J
c. 200 - 300 J
d. 360 J

15. Greater defibrillating current flow (decreased resistance) is expected with which of the following?

1. successive countershocks
2. lighter paddle pressure
3. use of conductive medium
4. lower body weight

a. 1, 2
b. 3, 4
c. 1, 3
d. 2, 4

16. Atropine may:

1. be given via the endotracheal tube
2. exacerbate ischemia associated with an acute MI
3. result in undesirable tachycardia
4. increase the rate of sinus bradycardia

a. 1, 2, 3
b. 1, 3, 4
c. 2, 3, 4
d. all of the above

17. Present evidence indicates that the dose of epinephrine injected into the adult tracheobronchial tree should be:

a. 1.0 - 1.5 times the recommended IV dose in 10 ml of solution
b. 2.0 - 2.5 times the recommended IV dose in 20 ml of solution
c. 3.0 - 5.0 times the recommended IV dose in 20 ml of solution
d. 2.0 - 2.5 times the recommended IV dose in 10 ml of solution

18. Nitroglycerin:

1. may be given sublingually
2. may be useful in relieving pain in acute myocardial infarction
3. may produce hypotension
4. should not be repeated more than once

a. 1, 2, 3
b. 1, 2, 4
c. 2, 3, 4
d. all of the above

19. In contrast to other catecholamines, dopamine at low doses (1 - 2 μg/kg/min) can be expected to result in:

a. an increase in blood pressure
b. gangrene
c. renal vasodilation
d. tachycardia

20. In general sodium bicarbonate has not improved survival in cardiac arrest. However, it should be considered in arrests caused by:

1. hypoxic lactic acidosis
2. tricyclic overdose
3. hyperkalemia
4. pre-existing metabolic acidosis

a. 2, 3, 4
b. 1, 2, 3
c. 1, 3, 4
d. all of the above

21. Which of the following statements regarding epinephrine are true?

1. increases coronary perfusion pressure
2. standard IV bolus dose is 1mg q 3-5 minutes
3. should be used in hypotensive ventricular tachycardia
4. increases myocardial and cerebral blood flow during CPR

a. 1, 2, 3
b. 1, 2, 4
c. 2, 3, 4
d. 1, 3, 4

22. Which of the following are considered end points during the administration of a procainamide loading infusion in the non-arrest situation?

1. the QRS complex is widened by 50% of its pre-treatment width
2. hypotension develops
3. a total of 17 mg/kg drug has been injected at a rate of 20 mg/min
4. the dysrhythmia is suppressed

a. 1, 2, 3
b. 1, 2, 4
c. 2, 3, 4
d. all of the above

23. A 70 kg man is in ventricular fibrillation that has been refractory to defibrillation and lidocaine. Which of the following regimens for use of bretylium is correct?

    a. initial IV bolus of 5 mg/kg followed by 10 mg/kg IV bolus every 5 minutes if rhythm does not convert; to a maximum of 30-35 mg/kg
    b. initial IV bolus of 5 mg/kg; followed by additional boluses of 10 mg/kg at 15 - 30 minute intervals to a maximum dose of 30-35 mg/kg
    c. IV bolus of 5 mg/kg, repeated every five minutes, if rhythm does not convert; to a maximum dose of 30-35 mg/kg
    d. initial IV dose of 10 mg/kg diluted in 50 ml D_5W and infused over 8 - 10 minutes; additional doses of 10 mg/kg every 15 - 30 minutes if rhythm does not convert; to a maximum dose of 30-35 mg/kg

24. Which of the following drugs, when used in therapeutic doses, depresses the pumping function of the heart muscle?

    a. atropine
    b. lidocaine
    c. propranolol
    d. isoproterenol

25. A bolus of calcium chloride is clearly indicated in:

    a. asystole
    b. pulseless electrical activity
    c. unstable verapamil overdose
    d. all of the above

26. Expansion of circulating blood volume with ringer's lactate or normal saline is recommended in all cardiac arrests.

    a. true
    b. false

27. The vein for initial cannulation while external cardiac compression is still in progress is the:

    a. external jugular vein
    b. femoral vein
    c. internal jugular vein
    d. antecubital vein

28. Which of the following can occur as a result of accidental shock with AC current?

1. asystole
2. respiratory arrest
3. ventricular tachycardia
4. ventricular fibrillation

a. 1, 2, 3
b. 1, 2, 4
c. 2, 3, 4
d. all of the above

29. Life threatening emergencies caused by traumatic injuries may include all of the following except:

a. cardiac tamponade
b. hypokalemia
c. shock
d. tension pneumothorax

30. After determining that the patient has no pulse, which one of the following forms of treatment would you use initially for the patient with ventricular fibrillation?

a. intubation
b. defibrillation
c. epinephrine IV
d. lidocaine IV

31. While monitoring a patient admitted to the coronary care unit with an acute myocardial infarction, you notice the onset of multiformed ventricular extra systoles that rapidly progresses to ventricular fibrillation. Your assessment reveals a pulseless, apneic patient. Your next therapy should be:

a. a precordial thump
b. closed chest compressions
c. endotracheal intubation
d. lidocaine 1 mg/kg IV bolus

32. A 34 year old woman with a history of supraventricular tachycardia is brought into the emergency department. She is lethargic, pale, and diaphoretic. Her heart rate is 190 beats per minute and her blood pressure is 70 mmHg palpable. Her ECG reveals recurrence of her supraventricular tachycardia. Supplemental oxygen is applied. Your intervention should be:

a. procainamide infusion of 2 mg/min
b. propranolol 1 mg IV bolus
c. synchronized cardioversion at 50-100 J
d. verapamil 5 mg IV bolus

33. A 55 year old woman with a history of angina has a complaint of chest pain for 45 minutes. She was initially alert but is now drowsy, her skin is cool and moist and her heart rate is 45 beats/min. Her blood pressure is 86/60 mm Hg, and her ECG shows sinus bradycardia. The first drug and dose to administer is:

a. atropine 0.5 mg IV
b. dopamine IV infusion 5 μg/kg/min
c. epinephrine 0.5 mg IV
d. isoproterenol IV infusion at 2μg/min

34. While you are performing synchronized cardioversion, the patient suddenly develops ventricular fibrillation. Which immediate action is most appropriate?

a. administer lidocaine 75 mg IV bolus
b. begin external chest compressions
c. deliver an unsynchronized countershock at 200 J
d. repeat synchronized shock at 200 J

35. A 70 kg patient with a recent myocardial infarction is in the Coronary Care Unit. He develops ventricular tachycardia and immediately loses consciousness. He is pulseless and not breathing. Which should be done first?

a. administer bretylium 350 mg IV bolus
b. administer lidocaine 100 mg IV bolus
c. call for help and deliver a synchronized shock
d. call for help and deliver an unsynchronized shock

36. You have arrived at the bedside 4 minutes after the cardiac arrest of a 50 kg woman. An IV line is in place. The ECG shows fine ventricular fibrillation. There is no pulse. Two rescuers are performing adequate CPR. You should:

a. confirm pulselessness while preparing for immediate defibrillation
b. administer epinephrine, 10 ml of 1:10,000 solution, and then defibrillate
c. administer sodium bicarbonate 50 meq IV bolus, and then defibrillate
d. administer sodium bicarbonate 50 meq IV bolus, epinephrine 1:10,000 5 ml IV bolus, and then defibrillate

37. A 67 year old woman arrives in the emergency department complaining of "severe" chest pain radiating to the neck and left arm. She is awake, anxious, and complaining of shortness of breath. Her blood pressure is 85/50 mmHg and her respiratory rate is 35 per minute. The ECG monitor reveals a wide complex tachycardia at 160 beats/min and dissociated P waves. Oxygen by mask and an intravenous have been started. The next intervention should be:

a. carotid massage
b. lidocaine 1 mg/kg IV
c. sedation, then synchronized cardioversion
d. verapamil 5 mg IV

38. The paramedic unit reports a patient with pulseless electrical activity. While considering treatable causes, an IV is started and a saline infusion begun. The first medication you should give is:

a. calcium chloride 5 ml of 10% solution IV bolus
b. epinephrine 1 mg IV
c. isoproterenol 4 μg/min IV infusion
d. sodium bicarbonate 1 meq/kg IV

39. The three most treatable causes of pulseless electrical activity are:

1. massive pulmonary embolism
2. cardiac tamponade
3. hypovolemia
4. tension pneumothorax
5. myocardial rupture

a. 1, 3, 4
b. 1, 4, 5
c. 2, 3, 4
d. 3, 4, 5

40. Ventricular fibrillation:

1. can be mimicked by artifact on the monitor
2. may produce a peripheral pulse
3. produces no cardiac output
4. should be treated with early defibrillation

a. 1, 3, 4
b. 1, 2, 4
c. 2, 3, 4
d. all of the above

41. A patient in ventricular fibrillation is successfully shocked to sinus rhythm with a pulse. The patient should receive:

1. lidocaine 1.0 mg/kg bolus followed by an infusion
2. atropine 0.5 mg IV bolus
3. supplemental oxygen
4. epinephrine 1 mg IV bolus

a. 1, 2
b. 1, 3
c. 2, 4
d. 3, 4

42. An intubated patient has a narrow complex tachycardia, at a rate of 110 beats per minute and with P waves preceding each QRS complex. There is no pulse, no blood pressure, and no spontaneous respirations. CPR is in progress. The most important actions are:

1. determine the cause of the arrest
2. give 1.0 mg epinephrine IV
3. give verapamil 5 mg IV bolus
4. perform synchronized cardioversion at 50-100 J

a. 1, 2
b. 3, 4
c. 1, 4
d. 2, 3

43. The patient's heart rate is 35 beats/min with a systolic blood pressure of 70 mmHg following resuscitation. Your unit does not have a transcutaneous pacemaker. List the following treatments in order of priority.

1. give dopamine 5 - 20 μg/kg/minute
2. give epinephrine 2 - 10 μg/min
3. give atropine
4. evaluate adequacy of oxygenation

a. 1, 2, 3, 4
b. 3, 1, 2, 4
c. 4, 1, 3, 2
d. 4, 3, 1, 2

44. Which of the following are routine for the management of an acute uncomplicated MI?

1. lidocaine
2. oxygen
3. nitroglycerin
4. pain relief

a. 1, 2, 3,
b. 1, 2, 4
c. 1, 3, 4
d. 2, 3, 4

45. If no contraindications exist, thrombolytic therapy should be given to patients with:

1. chest pain for 4 hours with clear ST elevation
2. presentation more than twenty-four hours after symptom onset
3. 6 hours of typical pain and bundle branch block
4. 6 hours of typical pain, ST elevation, and age greater than 75 years

a. 1, 2, 3
b. 1, 2, 4
c. 1, 3, 4
d. 2, 3, 4

46. Potentially treatable causes of asystole include:

1. hypoxia
2. acidosis
3. hyperkalemia
4. tension pneumothorax

a. 1, 2, 3
b. 1, 3, 4
c. 2, 3, 4
d. all of the above

47. Transcutaneous cardiac pacing is appropriate for the following situations:

1. sinus bradycardia
2. sinus bradycardia with hypotension and shock
3. complete heart block with pulmonary edema
4. prolonged asystole

a. 1, 2
b. 2, 3
c. 3, 4
d. 1, 4

48. A bad outcome, such as brain damage, after resuscitation is of itself evidence of negligence:

a. true
b. false

49. An automated defibrillator can accurately analyze ventricular fibrillation/rapid ventricular tachycardia during chest compressions.

a. true
b. false

50. When a student is issued an Advanced Cardiac Life Support card, this implies:

a. expertise in ACLS according to the guidelines of the Heart and Stroke Foundation of Canada and the American Heart Association
b. licensure to perform the procedures taught in the course
c. qualification to perform the procedures in a hospital or pre-hospital setting
d. successful completion of a course in ACLS according to the guidelines of the Heart and Stroke Foundation of Canada and the American Heart Association.

APPENDIX C

"TEST B"

AMERICAN HEART ASSOCIATION
HEART AND STROKE FOUNDATION OF CANADA

ADVANCED CARDIAC LIFE SUPPORT
MULTIPLE CHOICE EVALUATION

Version 4.1-95

1995

Questions

Please do not mark on this test. Record your best answer on the separate answer sheet.

1. Which of the following rhythms is most commonly present in the first minute following the onset of cardiac arrest in adults?

   a. agonal
   b. asystole
   c. complete heart block
   d. ventricular fibrillation

2. A 52 year old man with a history of angina is diagnosed with an acute anterior myocardial infarction. He is experiencing severe chest pain and nausea. He has taken three sublingual nitroglycerin tablets without relief of pain. The cardiac monitor shows sinus tachycardia with a rate of 106; blood pressure is 120/80 mmHg. After starting him on oxygen via nasal cannula, your first choice of drug and dosage is:

   a. atropine 0.5 mg IV
   b. diazepam 5 mg IV
   c. furosemide 20 - 40 mg IV
   d. morphine sulfate 2 - 3 mg IV

3. Drugs that may be useful in the emergency treatment of cardiogenic pulmonary edema in a patient with sinus tachycardia and a blood pressure of 110 mmHg systolic, include:

   1. furosemide
   2. isoproterenol
   3. morphine
   4. propranolol
   5. oxygen

   a. 1, 2, 4
   b. 1, 3, 5
   c. 3, 4, 5
   d. all of the above

4. A 65 year old man (weight 75 kg) arrives at the emergency department with severe chest pain. His heart rate is 40 beats/minute and blood pressure is 70/50 mmHg. The monitor shows sinus bradycardia with an occasional premature ventricular complex. Which of the following drugs is indicated first?

   a. atropine 0.5 mg IV
   b. isoproterenol infusion at 2 - 10 μ/min
   c. lidocaine 75 kg IV bolus
   d. morphine 2 - 5 mg IV

5. Select the advantages of endotracheal intubation?

   1. it protects the airway from aspiration
   2. it provides an alternative route for administration of certain drugs
   3. it diminishes the probability of gastric distention
   4. it eliminates the need for a 100% oxygen source

   a. 1, 2, 3
   b. 1, 2, 4
   c. 1, 3, 4
   d. 2, 3, 4

6. When selecting a bag-valve-mask device, which of the following are desirable features?

   1. self-expanding bag
   2. a reservoir attachment
   3. a transparent mask
   4. a non-rebreathing valve

   a. 1, 2, 3
   b. 1, 2, 4
   c. 1, 3, 4
   d. all of the above

7. CPR has been in progress for 8 minutes for a 50 kg patient in the Coronary Care Unit. The patient is being ventilated by bag-valve-mask unit. The results of an arterial blood sample drawn 5 minutes earlier are PaO_2 52 mmHg, $paCO_2$ 62 mmHg, and pH 7.16. Which of the following are appropriate?

1. assure that delivered oxygen is at 100%
2. increase ventilation rate
3. maintain ventilation as is
4. repeat arterial blood gases

a. 2, 3, 4
b. 1, 3, 4
c. 1, 2, 3
d. 1, 2, 4

8. Endotracheal suction:

1. should be limited to 10 - 15 seconds of suction
2. should be preceded by increased ventilation with supplemental oxygen
3. can result in hypoxia
4. should be performed without applying suction while inserting the catheter

a. 1, 3, 4
b. 1, 2, 3
c. 2, 3, 4
d. all of the above

9. Once an endotracheal tube is in place, ventilations should:

1. be performed at 10-15 breaths per minute
2. only be completed after the chest compressor has paused at the 5th compression
3. be performed asynchronously to cardiac compressions
4. be delivered with room air

a. 1, 2
b. 2, 3
c. 1, 3
d. 2, 4

10. Endotracheal intubation has just been completed. You are unable to hear breath sounds on either side of the chest. You have most likely:

a. intubated the esophagus
b. intubated the left mainstem bronchus
c. intubated the right mainstem bronchus
d. wedged the tube against the carina

11. The airway of choice for a deeply unconscious patient in shock is:

a. an endotracheal tube
b. an esophageal obturator airway
c. a nasopharyngeal airway
d. an oropharyngeal airway

12. Complications of endotracheal intubation include:

1. injury to the vocal cords
2. damage to the teeth
3. esophageal intubation
4. placement in the right main bronchus of the lung

a. 1, 3, 4
b. 1, 2, 3
c. 2, 3, 4
d. all of the above

13. CPR is in progress for an unwitnessed cardiac arrest. Immediately upon diagnosing ventricular fibrillation, one should:

a. administer lidocaine 1 mg/kg IV
b. deliver a precordial thump
c. shock with 200 J synchronized
d. shock with 200 J unsynchronized

14. Synchronized cardioversion is the treatment of choice for:

a. pulseless electrical activity
b. symptomatic sinus tachycardia
c. unstable supraventricular tachycardia
d. ventricular fibrillation

15. Delivered current during defibrillating is expected to increase with which of the following?

1. consecutive countershocks
2. lighter paddle pressure
3. use of conductive medium
4. increasing shock energy

a. 1, 2, 3
b. 1, 2, 4
c. 1, 3, 4
d. 2, 3, 4

16. Atropine 0.5 mg IV may:

1. accelerate the rate in sinus bradycardia
2. decrease vagal reflexes
3. be useful in atrioventricular block
4. increase myocardial ischemia

a. 1, 2, 4
b. 1, 2, 3
c. 2, 3, 4
d. all of the above

17. Epinephrine:

1. increases peripheral vascular resistance
2. may restore electrical activity in asystole
3. may enhance defibrillation in ventricular fibrillation
4. increases myocardial contractility

a. 1, 2, 4
b. 1, 3, 4
c. 2, 3, 4
d. all of the above

18. Nitroglycerin:

1. may be given sublingually
2. may be useful in relieving pain in acute myocardial infarction
3. may produce hypotension
4. should not be repeated more than once

a. 1, 2, 3
b. 1, 2, 4
c. 2, 3, 4
d. all of the above

19. In contrast to other catecholamines, dopamine at low doses (1 - 2 μg/kg/min) can be expected to result in:

a. an increase in blood pressure
b. gangrene
c. renal vasodilation
d. tachycardia

20. In general sodium bicarbonate has not improved survival in cardiac arrest. However, it should be considered in arrests caused by:

1. hypoxic lactic acidosis
2. tricyclic overdose
3. hyperkalemia
4. pre-existing metabolic acidosis

a. 2, 3, 4
b. 1, 2, 3
c. 1, 3, 4
d. all of the above

21. In the initial treatment of a 75 kg adult in ventricular tachycardia with a pulse, which of the following schedules of lidocaine is preferred?

a. 75 mg IV bolus followed by an infusion at 2 - 4 mg/min
b. 150 mg IV bolus every 5 minutes up to a total of 400 mg
c. 150 mg IV bolus followed by an infusion at 4 - 6 mg/min
d. 300 mg IV bolus followed by an infusion at 1 - 2 mg/min

22. In stable ventricular tachycardia, all of the following are end points for stopping a procainamide loading infusion except.

a. a total of 17 mgm/kg has been given
b. the patient becomes hypotensive
c. heart rate increases by more than 50%
d. the rhythm converts to normal sinus rhythm

23. A 70 kg man is in ventricular fibrillation that has been refractory to defibrillation and lidocaine. Which of the following regimens for use of bretylium is correct?

a. initial IV bolus of 5 mg/kg followed by 10 mg/kg IV bolus every 5 minutes if rhythm does not convert; to a maximum of 30-35 mg/kg
b. initial IV bolus of 5 mg/kg; followed by additional boluses of 10 mg/kg at 15 - 30 minute intervals to a maximum dose of 30-35 mg/kg
c. IV bolus of 5 mg/kg, repeated every five minutes, if rhythm does not convert; to a maximum dose of 30-35 mg/kg
d. initial IV dose of 10 mg/kg diluted in 50 ml D_5W and infused over 8 - 10 minutes; additional doses of 10 mg/kg every 15 - 30 minutes if rhythm does not convert; to a maximum dose of 30-35 mg/kg

24. Which of the following drugs, when used in therapeutic doses,for adults, depress the pumping function of the heart muscle?

a. atropine
b. lidocaine
c. propranolol
d. isoproterenol

25. A bolus of calcium chloride is clearly indicated in:

a. asystole
b. pulseless electrical activity
c. hyperkalemia
d. all of the above

26. One should attempt to prevent infectious complications of intravenous cannulas by:

1. using careful aseptic technique during insertion whenever possible
2. using systemic antibiotics in almost all patients
3. removing or replacing the cannula after 3 days
4. keeping a cap on the stopcock when not in use

a. 1, 2, 3
b. 1, 3, 4
c. 2, 3, 4
d. all of the above

27. Potential complications of transcutaneous pacing include all of the following except:

a. delay in recognizing VF
b. failure to mechanically capture
c. skin burns
d. injury to operator by electric shock

28. A 17 year old woman fell through the ice on a frozen lake. She was pulled out by rescue personnel and CPR was begun. Total submersion time was 9 minutes. Upon arrival in the Emergency department, the patient has a core temperature of 27°C (81°F) and the ECG rhythm is asystole. What is the therapy for this patient?

a. continue resuscitation attempts and perform a pericardiocentesis
b. continue resuscitation attempts until core temperature is near normal
c. place an external pacemaker and if no capture, then pronounce the patient dead
d. pronounce the patient dead without further attempts to resuscitate

29. In the initial resuscitation of the near drowning victim, the rescuer should use the Heimlich maneuver before starting rescue breathing:

a. true
b. false

30. Which of the following forms of treatment would you use initially for a pulseless patient with ventricular fibrillation?

a. bretylium 5 mg/kg IV
b. defibrillation with 200 J
c. epinephrine 1.0 mg IV
d. lidocaine 1 mg/kg IV

31. While monitoring a patient admitted to the coronary care unit for an acute myocardial infarction, you notice the onset of ventricular fibrillation. The patient is conscious and has a pulse. Your next action would be to:

a. administer lidocaine 1 mg/kg IV
b. assess monitor leads
c. defibrillate at 200 J
d. sedate and perform synchronous cardioversion

32. A 34 year old woman with a history of supraventricular tachycardia is brought into the emergency department. She is lethargic, pale, and diaphoretic. Her heart rate is 190 beats/minute and her blood pressure is 70 mmHg palpable. Her ECG reveals recurrence of her supraventricular tachycardia. Supplemental oxygen is applied. Your intervention should be:

a. procainamide infusion of 2 mg/min
b. propranolol 1 mg IV bolus
c. synchronized cardioversion with 50-100 J
d. verapamil 5 mg IV bolus

33. A 60 year old man is brought to the emergency department. He complains of fainting spells for the past hour. He has an irregular pulse. His ECG shows normal sinus rhythm at 95 with frequent multiformed premature ventricular complexes and prolonged runs of ventricular tachycardia. Oxygen by mask and nitroglycerin are administered and an IV inserted. The next drug to consider is:

a. bretylium 5 - 10 mg/kg IV bolus
b. lidocaine 1.0 mg/kg IV bolus
c. lidocaine 2 - 4 mg/min IV drip
d. procainamide 20 - 30 mg/min IV

34. While you are performing synchronized cardioversion, the patient suddenly develops ventricular fibrillation. Which immediate action is most appropriate?

a. administer lidocaine 75 mg IV bolus
b. begin external chest compressions
c. deliver an unsynchronized shock at 200 J
d. repeat synchronized shock at 200 J

35. A 70 kg patient with a recent myocardial infarction is in the Coronary Care Unit. He develops ventricular tachycardia and immediately loses consciousness. He is pulseless and not breathing. Which should be done first?

a. administer bretylium 350 mg IV bolus
b. administer lidocaine 100 mg IV bolus
c. call for help and deliver a synchronized shock
d. call for help and deliver an unsynchronized shock

36. You have arrived at the bedside 4 minutes after the cardiac arrest of a 50 kg woman. An IV line is in place. The ECG shows fine ventricular fibrillation. There is no pulse. Two rescuers are performing adequate CPR. You should:

a. confirm pulselessness while preparing for immediate defibrillation
b. administer epinephrine, 10 ml of 1:10,000 solution, and then defibrillate
c. administer sodium bicarbonate 50 meq IV bolus, and then defibrillate
d. administer sodium bicarbonate 50 meq IV bolus, epinephrine 1:10,000 5 ml IV bolus, and then defibrillate

37. A 55 year old man is in ventricular tachycardia with a rate of 120 beats/min and has a blood pressure of 106/68 mmHg. He does not have dyspnea or angina. You administer oxygen and start an intravenous. Your next action should be to:

a. administer bretylium 5 mg/kg IV
b. administer lidocaine 1 mg/kg IV
c. administer procainamide 20 mg/min IV
d. sedate and perform synchronized cardioversion

38. The paramedic unit reports a patient with pulseless electrical activity. While considering treatable causes, an IV is started and a saline infusion begun. The first medication you should give is:

a. calcium chloride 5 ml of 10% solution IV bolus
b. epinephrine 1 mg IV
c. isoproterenol 4 μg/min IV infusion
d. sodium bicarbonate 1 meq/kg IV

39. In addition to CPR and problem solving, important steps in the management of a patient with pulseless electrical activity are:

1. consider a rapid fluid challenge with normal saline
2. check breath sounds on both sides
3. give epinephrine 10 ml of 1:10,000 solution IV bolus
4. give lidocaine 1.0 - 1.5 mg/kg IV bolus

a. 2, 3, 4
b. 1, 2, 3
c. 1, 3, 4
d. all of the above

40. Ventricular fibrillation:

1. can be mimicked by artifact on the monitor
2. may produce a peripheral pulse
3. produces no cardiac output
4. should be treated with early defibrillation

a. 1, 2, 3
b. 1, 2, 4
c. 1, 3, 4
d. 2, 3, 4

41. A patient in ventricular fibrillation is successfully shocked to sinus rhythm with a pulse. The patient should receive:

1. lidocaine 1.0 mg/kg bolus followed by an infusion
2. atropine 0.5 mg IV bolus
3. supplemental oxygen
4. epinephrine 1 mg IV bolus

a. 1, 2
b. 1, 3
c. 2, 4
d. 3, 4

42. During cardiac arrest from pulseless electrical activity the most practical way to evaluate the presence of cardiac tamponade in a patient with distended neck veins is to:

a. attempt a trial of external pacing
b. obtain an electrocardiogram
c. order a portable chest x-ray
d. perform pericardiocentesis

43. The patient's heart rate is 35 beats/min with a systolic blood pressure of 70 mmHg following resuscitation. Your unit does not have a transcutaneous pacemaker. List the following treatments in order of priority.

1. give dopamine 5 - 20 μg/kg/minute
2. give epinephrine 2 - 10 μg/min
3. give atropine
4. evaluate adequacy of oxygenation

a. 1, 2, 3, 4
b. 3, 1, 2, 4
c. 4, 1, 3, 2
d. 4, 3, 1, 2

44. Which of the following are routine for the management of an acute uncomplicated MI?

1. lidocaine
2. oxygen
3. nitroglycerin
4. pain relief

a. 1, 2, 3
b. 1, 2, 4
c. 1, 3, 4
d. 2, 3, 4

45. If no contraindications exist, thrombolytic therapy should be given to patients with:

1. chest pain for 4 hours with clear ST elevation
2. presentation more than twenty-four hours after symptom onset
3. 6 hours of typical pain and bundle branch block
4. 6 hours of typical pain, ST elevation, and age greater than 75 years

a. 1, 2, 3
b. 1, 2, 4
c. 1, 3, 4
d. 2, 3, 4

46. Potentially treatable causes of asystole include:

1. hypoxia
2. acidosis
3. hyperkalemia
4. tension pneumothorax

a. 1, 2, 3
b. 1, 3, 4
c. 2, 3, 4
d. all of the above

47. Transcutaneous cardiac pacing is appropriate for the following situations:

1. sinus bradycardia
2. sinus bradycardia with hypotension and shock
3. complete heart block with pulmonary edema
4. prolonged asystole

a. 1, 2
b. 2, 3
c. 3, 4
d. 1, 4

48. A bad outcome, such as brain damage, after resuscitation is of itself evidence of negligence:

a. true
b. false

49. An automated defibrillator can accurately analyze ventricular fibrillation/ventricular tachycardia during chest compressions.

a. true
b. false

50. When a student is issued an Advanced Cardiac Life Support card, this implies:

a. expertise in ACLS according to the guidelines of the Heart and Stroke Foundation of Canada and the American Heart Association
b. licensure to perform the procedures taught in the course
c. qualification to perform the procedures in a hospital or pre-hospital setting
d. successful completion of a course in ACLS according to the guidelines of the Heart and Stroke Foundation of Canada and the American Heart Association.

APPENDIX D

Consent Form

I understand that this is a study which examines the reliability of an Advanced Cardiac Life Support (ACLS) test. Test scores will be compared with demographic data. I also understand that all information, including my identity, test scores, and demographic data will be kept confidential. My completion of the ACLS test and demographic sheet indicates my consent to participate in this project.

I acknowledge that:

"I have been given an opportunity to ask questions regarding this research study, and that these questions have been answered to my satisfaction."

"In giving my consent, I understand that my participation in this study is voluntary and that I may withdraw at any time."

"I hereby authorize the investigator to release information obtained in this study to scientific literature. I understand that I will not be identified by name."

"I have been given the phone numbers of the researcher (616-774-7567) and the chairperson of Grand Valley State University Human Research Review Committee (616-895-2472). I may contact them at any time I have questions."

I acknowledge that I have read and understand the above information, and that I agree to participate in this study.

_____

Participants signature

_____

Date

_____ I am interested in receiving a summary of the results.

APPENDIX E

Table 4

Item Analysis of Test A

Item					Difficulty Index	Discrimination Index
Item 1	A	B	C	D*		
Upper Group	0	0	0	24	100.00	0
Lower Group	0	0	0	24		
Item 2	A*	B	C	D	93.75	4.20
Upper Group	23	1	0	0		
Lower Group	22	2	0	0		
Item 3	A	B*	C	D	89.50	12.50
Upper Group	0	23	12	0		
Lower Group	0	20	0	4		
Item 4	A*	B	C	D	93.70	4.20
Upper Group	23	0	0	0		
Lower Group	22	0	0	2		
Item 5	A*	B	C	D	97.90	4.20
Upper Group	24	0	0	0		
Lower Group	23	0	0	1		
Item 6	A*	B	C	D	77.10	12.50
Upper Group	20	2	0	2		
Lower Group	17	2	0	5		
Item 7	A	B	C	D*	55.30	66.70
Upper group	2	0	1	21		
Lower Group	5	4	9	5		

* indicates correct response

(table continues)

Item Analysis of Test A (continued)

Item					Difficulty Index	Discrimination Index
Item 8	A	B	C	D*	91.60	8.30
Upper Group	2	0	0	22		
Lower Group	1	1	2	20		
Item 9	A	B	C*	D	89.58	4.16
Upper Group	1	1	22	0		
Lower Group	2	0	21	1		
Item 10	A*	B	C	D	91.60	4.16
Upper Group	22	1	1	0		
Lower Group	20	0	2	2		
Item 11	A*	B	C	D	91.60	0
Upper Group	22	1	0	1		
Lower Group	22	0	0	2		
Item 12	A	B	C	D*	93.75	2.50
Upper Group	0	0	0	24		
Lower Group	0	2	1	21		
Item 13	A	B	C	D*	89.58	4.16
Upper Group	0	0	0	24		
Lower Group	0	0	3	21		
Item 14	A	B	C	D*	100.00	0
Upper Group	0	0	0	24		
Lower Group	0	0	0	24		
Item 15	A	B	C*	D	91.60	8.33
Upper Group	1	0	23	0		
Lower Group	0	0	0	24		
Item 16	A	B	C	D*	70.80	33.33
Upper Group	0	3	0	21		
Lower Group	3	8	0	13		

* indicates correct response

(table continues)

Item Analysis of Test A (continued)

Item					Difficulty Index	Discrimination Index
Item 17	A	B	C	D*	75.00	25.00
Upper Group	0	3	0	21		
Lower Group	0	9	0	15		
Item 18	A*	B	C	D	100.00	0
Upper Group	24	0	0	0		
Lower Group	24	0	0	0		
Item 19	A	B	C*	D	100.00	0
Upper Group	0	0	24	0		
Lower Group	0	0	24	0		
Item 20	A*	B	C	D	75.00	25
Upper Group	21	1	1	1		
Lower Group	15	0	1	8		
Item 21	A	B*	C	D	68.75	29.16
Upper Group	0	20	4	0		
Lower Group	6	13	3	2		
Item 22	A	B	C	D*	93.75	12.50
Upper Group	0	0	0	24		
Lower Group	0	2	1	21		
Item 23	A*	B	C	D	91.60	8.33
Upper Group	22	2	0	0		
Lower Group	20	4	0	0		
Item 24	A	B	C*	D	72.90	29.16
Upper Group	0	2	21	1		
Lower Group	0	8	14	2		
Item 25	A	B	C*	D	89.50	20.83
Upper Group	0	0	24	0		
Lower Group	0	4	19	1		

Item Analysis of Test A (continued)

Item					Difficulty Index	Discrimination Index
Item 26	A	B*	C	D	29.16	16.66
Upper Group	15	9	0	0		
Lower Group	19	5	0	0		
Item 27	A	B	C	D*	100.00	0
Upper Group	0	0	0	24		
Lower Group	0	0	0	24		
Item 28	A	B	C	D*	79.16	16.66
Upper Group	0	1	2	21		
Lower Group	0	5	32	17		
Item 29	A	B*	C	D	93.75	4.16
Upper Group	0	23	1	0		
Lower Group	1	22	1	0		
Item 30	A	B*	C	D	97.91	-4.16
Upper Group	0	0	24	0		
Lower Group	0	24	0	0		
Item 31	A*	B	C	D	75.00	25.00
Upper Group	21	3	0	0		
Lower Group	15	6	2	1		
Item 32	A	B	C*	D	89.58	20.83
Upper Group	0	0	24	0		
Lower Group	0	1	19	4		
Item 33	A*	B	C	D	97.91	4.16
Upper Group	24	0	0	0		
Lower Group	23	1	0	0		
Item 34	A	B	C*	D	100.00	0
Upper Group	0	0	24	0		

* indicates correct response

(table continues)

Item Analysis of Test A (continued)

Item					Difficulty Index	Discrimination Index
Lower Group	0	0	24	0		
Item 35	A	B	C	D*	97.91	4.16
Upper Group	0	0	0	24		
Lower Group	0	0	1	23		
Item 36	A*	B	C	D	100.00	0
Upper Group	24	0	0	0		
Lower Group	24	0	0	0		
Item 37	A	B	C*	D	62.50	50.00
Upper Group	0	3	21	0		
Lower Group	6	8	9	1		
Item 38	A	B*	C	D	100.00	0
Upper Group	0	24	0	0		
Lower Group	0	24	0	0		
Item 39	A	B	C*	D	93.75	12.50
Upper Group	0	0	24	0		
Lower Group	3	0	21	0		
Item 40	A*	B	C	D	95.80	8.33
Upper Group	24	0	0	0		
Lower Group	22	1	0	1		
Item 41	A	B*	C	D	91.66	16.66
Upper Group	0	24	0	0		
Lower Group	0	20	0	4		
Item 42	A*	B	C	D	76.59	42.55
Upper Group	23	0	1	0		
Lower Group	13	4	4	23		

* indicates correct response

(table continues)

Item Analysis of Test A (continued)

Item					Difficulty Index	Discrimination Index
Item 43	A	B	C	D*	83.30	25.00
Upper Group	0	1	0	23		
Lower Group	1	5	1	17		
Item 44	A	B	C	D*	100.00	0
Upper Group	0	0	0	24		
Lower Group	0	0	0	24		
Item 45	A	B	C*	D	91.40	12.76
Upper Group	0	1	23	0		
Lower Group	3	0	20	0		
Item 46	A	B	C	D*	70.80	0
Upper Group	7	0	0	17		
Lower Group	6	0	1	17		
Item 47	A	B*	C	D	70.80	16.66
Upper Group	1	19	4	0		
Lower Group	4	15	2	3		
Item 48	A	B*	C	D	95.80	0
Upper Group	0	23	1	0		
Lower Group	0	23	0	1		
Item 49	A	B*	C	D	91.66	8.33
Upper Group	1	22	1	0		
Lower Group	3	20	0	1		
Item 50	A	B	C	D*	100.00	0
Upper Group	0	0	0	24		
Lower Group	0	0	0	24		

*indicates correct response

APPENDIX F

Table 5

Item Analysis of Test B

Item					Discrimination Index	Difficulty Index
Item 1	A	B	C	D*	100.00	0
Upper Group	0	0	0	26		
Lower Group	0	0	0	26		
Item 2	A	B	C	D*	100.00	0
Upper Group	0	0	0	26		
Lower Group	0	0	0	26		
Item 3	A	B*	C	D	80.76	0
Upper Group	0	21	3	2		
Lower Group	2	21	3	0		
Item 4	A*	B	C	D	94.23	3.85
Upper Group	25	0	0	1		
Lower Group	24	0	1	1		
Item 5	A*	B	C	D	96.10	7.69
Upper Group	26	0	0	0		
Lower Group	24	2	0	0		
Item 6	A	B	C	D*	71.15	42.31
Upper Group	2	0	0	24		
Lower Group	8	2	3	13		
Item 7	A	B	C	D*	92.30	7.69
Upper Group	0	1	0	25		
Lower Group	0	2	1	23		
Item 8	A	B	C	D*	90.38	11.54

* indicates correct response

(table continues)

Item Analysis of Test B (continued)

Item					Discrimination Index	Difficulty Index
Upper Group	1	0	0	25		
Lower Group	0	2	2	22		
Item 9	A	B	C*	D	78.85	3.85
Upper Group	5	0	21	0		
Lower Group	3	2	20	1		
Item 10	A	B	C	D	90.38	19.23
Upper Group	26*	0	0	0		
Lower Group	21	3	1	1		
Item 11	A*	B	C	D	94.23	3.85
Upper Group	25	0	0	1		
Lower Group	24	1	0	1		
Item 12	A	B	C	D*	84.61	7.69
Upper Group	0	3	0	23		
Lower Group	1	4	1	21		
Item 13	A	B	C	D*	86.54	11.54
Upper Group	0	0	2	24		
Lower Group	0	2	3	21		
Item 14	A	B	C*	D	80.77	23.08
Upper Group	0	2	24	0		
Lower Group	0	7	18	1		
Item 15	A	B	C*	D	92.30	7.69
Upper Group	0	1	25	0		
Lower Group	0	1	23	2		
Item 16	A	B	C	D*	55.77	26.92
Upper Group	4	4	0	18		
Lower Group	11	3	1	11		

* indicates correct response

(table continues)

Item Analysis of Test B (continued)

Item					Discrimination Index	Difficulty Index
Item 17	A	B	C	D*	55.77	42.31
Upper Group	2	3	1	20		
Lower Group	6	7	4	9		
Item 18	A*	B	C	D	100.00	0
Upper Group	26	0	0	0		
Lower Group	26	0	0	0		
Item 19	A	B	C*	D	96.15	7.69
Upper Group	0	0	26	0		
Lower Group	2	0	24	0		
Item 20	A*	B	C	D	71.15	50.00
Upper Group	25	0	0	1		
Lower Group	12	3	4	7		
Item 21	A*	B	C	D	88.46	15.38
Upper Group	25	1	0	0		
Lower Group	21	3	1	1		
Item 22	A	B	C*	D	75.00	19.23
Upper Group	0	1	22	3		
Lower Group	0	1	17	8		
Item 23	A*	B	C	D	84.61	23.08
Upper Group	25	1	0	0		
Lower Group	19	6	1	0		
Item 24	A	B	C*	D	59.61	50.00
Upper Group	0	1	22	3		
Lower Group	0	10	9	7		
Item 25	A	B	C*	D	90.38	11.54
Upper Group	0	0	25	1		
Lower Group	0	1	22	3		

* indicates correct response

(table continues)

Item Analysis of Test B (continued)

Item					Discrimination Index	Difficulty Index
Item 26	A	B*	C	D	92.30	15.38
Upper Group	0	26	0	0		
Lower Group	0	22	0	4		
Item 27	A	B	C	D*	61.54	23.08
Upper Group	7	0	0	19		
Lower Group	7	2	4	13		
Item 28	A	B*	C	D	90.38	11.54
Upper Group	0	25	0	1		
Lower Group	1	22	3	0		
Item 29	A	B*	C	D	94.23	-11.54
Upper Group	2	23	0	1		
Lower Group	0	26	0	0		
Item 30	A	B*	C	D	73.08	15.38
Upper Group	0	21	4	1		
Lower Group	0	17	9	0		
Item 31	A	B*	C	D	80.77	15.38
Upper Group	0	23	1	2		
Lower Group	3	19	1	3		
Item 32	A	B	C*	D	90.38	11.54
Upper Group	0	1	25	0		
Lower Group	0	0	22	4		
Item 33	A	B*	C	D	88.46	15.38
Upper Group	0	25	1	0		
Lower Group	0	21	4	1		
Item 34	A	B	C*	D	94.23	3.85
Upper Group	0	1	25	0		
Lower Group	1	0	24	1		

* indicates correct response

(table continues)

Item Analysis of Test B (continued)

Item					Discrimination Index	Difficulty Index
Item 35	A	B	C	D*	94.23	-3.85
Upper Group	0	0	2	24		
Lower Group	0	0	1	25		
Item 36	A*	B	C	D	96.15	7.69
Upper Group	26	0	0	0		
Lower Group	24	2	0	0		
Item 37	A	B*	C	D	88.46	23.08
Upper Group	0	26	0	0		
Lower Group	0	20	2	4		
Item 38	A	B*	C	D	100.00	0
Upper Group	0	26	0	0		
Lower Group	0	26	0	0		
Item 39	A	B*	C	D	90.38	19.23
Upper Group	0	26	0	0		
Lower Group	1	21	3	1		
Item 40	A	B	C*	D	98.08	3.85
Upper Group	0	0	26	0		
Lower Group	0	1	25	0		
Item 41	A	B*	C	D	76.92	38.46
Upper Group	1	25	0	0		
Lower Group	1	15	0	10		
Item 42	A	B	C	D*	65.38	30.77
Upper Group	1	0	4	21		
Lower Group	2	3	8	13		
Item 43	A	B	C	D*	82.69	11.54
Upper Group	1	1	1	23		
Lower Group	0	5	1	20		

* indicates correct response

(table continues)

Item Analysis of Test B (continued)

Item					Discrimination Index	Difficulty Index
Item 44	A	B	C	D*	94.23	-3.85
Upper Group	1	0	1	24		
Lower Group	0	1	0	25		
Item 45	A	B	C*	D	86.54	11.54
Upper Group	0	1	24	1		
Lower Group	2	2	21	1		
Item 46	A	B	C	D*	57.69	15.38
Upper Group	9	0	0	17		
Lower Group	12	0	1	13		
Item 47	A	B*	C	D	53.85	61.54
Upper Group	2	22	2	0		
Lower Group	9	6	2	9		
Item 48	A	B*	C	D	96.15	0
Upper Group	0	25	1	0		
Lower Group	1	25	0	0		
Item 49	A	B*	C	D	92.31	7.69
Upper Group	0	25	1	0		
Lower Group	3	23	0	0		
Item 50	A	B	C	D*	100.00	0
Upper Group	0	0	0	26		
Lower Group	0	0	0	26		

*indicates correct response

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