STUDY PROTOCOL

Effectiveness of Self-directed Virtual Learning on Retention of Cardiopulmonary Resuscitation Knowledge and Skills among Hospital Nurses in North-western Nigeria: Protocol Paper

Ahmed Saidu[1,2], Khuan Lee[1], Iskasymar Ismail[3,4], Arulogun Sola Oyedunni[5], Poh Ying Lim[6]

[1] Department of Nursing, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, UPM Serdang, Selangor Darul Ehsan, Malaysia
[2] Federal University Birnin-Kebbi, Kebbi -State Nigeria
[3] Department of Medicine, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, UPM Serdang, Selangor Darul Ehsan, Malaysia.
[4] RESQ Stroke Emergency Unit, Hospital Sultan Abdul Aziz Shah, Universiti Putra Malaysia, Serdang, Selangor, Malaysia
[5] Department of Health Promotion and Education, Faculty of Public Health, College of Medicine, University of Ibadan, Ibadan, Nigeria
[6] Department of Community Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, UPM Serdang, Selangor Darul Ehsan, Malaysia.

ABSTRACT

Introduction: The instructor-led CPR training method has been used for over 4 decades. However, nurses' knowledge and skills are still low. Instructor-led CPR training is an extremely capital-intensive programme that requires more time, workforce, and space, thus serving as an impediment to effective learning among the prospective nurses' trainees. Self-directed training method is suggested to improve the knowledge and skills of CPR among healthcare practitioners due to the low cost and flexibility. This study aims to evaluate the effectiveness of self-directed method in improving nurses' knowledge and skill retention from baseline to post-test, one, three-, and six months. **Method:** A two-arm double-blinded randomised controlled trial will be conducted in two referral hospitals. The control group training consists of a one-day session taught by AHA-certified instructors, whereas the intervention group training entails participants learning on computers in a simulation lab for seven days. A generalised estimated equation model will be used for statistical analysis. **Discussion:** Through the self-directed training method, participants will have significantly better knowledge and skills of CPR compared to the conversational training method across the time points. Self-directed training method is a simple, cost-effective and flexible method, which can facilitate the training of more nurses in the acquisition and retention of knowledge and skills, especially for those who prefer to learn at their own pace. **Trial Registration:** Registration Code: UDUTH/NHREC/30/012/2019 and NHREC/28/01/2020/AKTH/EC/2934
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Corresponding Author:
Poh Ying Lim, PhD
Email: pohying_my@upm.edu.my
Tel: +603-97692950

INTRODUCTION

Cardiopulmonary resuscitation (CPR) is "the use of therapeutic procedures intended mainly to restore spontaneous return to circulation (ROSC) after cardiac arrest" (1,2). Responding to a cardiac arrest in a hospital setting is a high-stress and high-anxiety event for all healthcare providers. CPR might be ineffective if is performed inaccurately and lately. Both CPR and Basic Life Support (BLS) are synonymous in terms of usage and action. BLS is simply another term for CPR, commonly used by healthcare providers. Despite millions of healthcare and unprofessional providers being trained in CPR annually worldwide, there is a significant gap in providing high-quality CPR intervention to patients in cardiac arrest (3-5). CPR educational designed curricula have not consistently achieved their intended outcomes, with some studies revealing a significant decline in both knowledge and skills within months of the learning activity (6). Likewise, the CPR guidelines update regarded as the "gold standard" produced by both the American Heart Association (AHA) and the European Resuscitation Council (ERC) in line with the International Liaison Committee on Resuscitation (ILCOR) have not achieved their desired objectives in the retention and acquisition of high-quality CPR skills among healthcare providers (5,7-8).

Studies conducted by some experts in the field of resuscitation educational sciences indicated that employing self-directed video instruction can be as effective, if not more, than the traditional method (instructor-led) training in terms of cost effect, mass CPR training, and willingness to attend cardiac arrest patients (9-13). The few studies conducted in Nigeria on CPR knowledge and skill levels among healthcare providers, including nurses, yielded inconclusive results with the majority indicating poor CPR knowledge and skills (14-16). Another study also reported nurses demonstrated lower CPR knowledge and skill scores compared to medical officers (17). Nevertheless, nurses are often the first to arrive at a cardiac arrest scene, thus their ability to provide resuscitative treatment is critical to the success of cardiac arrest management (18).

Despite nurses comprise 90% of hospital employees in Nigeria, no study has been undertaken to assess to compare the effectiveness of self-directed CPR training and instructor-led CPR training among nurses. As a result, this study will be relevant to both hospital administrators and nurse managers in elucidating if self-directed training among nurses is effective in acquiring and retaining CPR knowledge and skills.

MATERIALS AND METHODS

Study design

A randomized controlled trial (RCT) involving repeated assessment (pretest, posttest, and 1-, 3-, and 6-month follow-ups) and using two different educational approaches will be conducted among nurses in two hospitals. Two homogeneous hospital groups will be recruited in this study based on the cross-sectional data collected from the first phase. Specifically, both groups of nurses with similar knowledge of CPR level ($p>0.05$) will be selected. Consolidated Standards of Reporting Trials (CONSORT) Statement (19) and the recommendation for an interventional trial (SPIRIT) will be followed in this study (20-21).

Study sample size

A two-group mean sample size formula (22) was used in the sample size calculation based on the mean SD knowledge score of the post-test self-directed training (12.95 ± 2.26) of non-critical care nurses and the post-test of instructors-led training among non-critical care nurses (11.37 ± 2.70) (23). Assuming a 95% confidence level, study power of 80%, a response rate of 70%, and a design effect of 1.3, the final sample size was computed as 150, with 75 nurses to be recruited from each group (23).

Study Location, enrolment, and suitability criteria

This study will be conducted in north-western Nigeria, which is one of the six geopolitical zones in the country. Nigeria. The north-western zone comprises seven states, namely, Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto, and Zamfara states. The North-West and North-East zones had the lowest concentration of tertiary health facilities when compared to the South-West and South-South zones (24). The duration of the study will be six months, excluding the recruitment process. To ensure similar knowledge levels for both groups, a cross-sectional study will be conducted to determine the respondents' average knowledge level at all referral hospitals (n=7). Two homogeneous hospitals with similar mean knowledge levels of CPR among respondents will be selected into this cluster RCT, where one of the hospitals will be chosen as an intervention group. Cluster randomisation will be used to avoid the risk of contamination between intervention and control groups. A double-blinded method will be adopted, where neither the participants nor the AHA instructor who will assess both knowledge and skills will be aware of the randomisation group.

Stratified simple random sampling will then be utilised to recruit eligible nurses in the various wards/units of the selected referral hospitals. The hospital wards will be numbered from 1 to N, based on a ward/unit duty roster list of all registered nurses at the HOD nursing office in each of the seven referral hospitals. Each stratum (ward/unit) will be assigned based on a computer-generated random number, with the size proportionate to the staff composition (25). Eligibility for inclusion criteria includes working in any of the seven-hospital units, namely: intensive care unit, accident and emergency, outpatient department, and male and female medical and surgical wards. They must also be registered with the Nigerian Nursing Council, whereas exclusion criteria include having recently completed less than three months of BLS training.

Ethical approval

Ethical approval was received from Ethic Committee for Research Involving Human Subjects, Universiti Putra Malaysia (JKEUPM-2020-185) and two hospitals with reference numbers: UDUTH/NHREC/30/012/2019 and NHREC/28/01/2020/AKTH/EC/2934). Each participant will provide informed consent before participation. All the study data will be handled with strict confidence and privacy. Participants can withdraw from the study at any time without any penalty and their rights will not be unaffected.

Procedure

This study aims to differentiate the CPR knowledge and skills level retention following CPR training at baseline, post-test, 1-, 3-, and 6- month follow-ups among the nurses between and within self-directed training (intervention) and instructor-led training (control). Figure 1 depicts the SPIRIT flow diagram of the study. Participants will be at liberty to withdraw from the study without any consequences.

	Enrolment	Allocation	Post-allocation				Time out
Time point	**$-t_1$**	**0**	**Baseline T_0**	**Training T_1**	**1-Month T_2**	**3-Month T_3**	**6-Month T_4**
ENROLMENT							
Eligibility criteria	x						
Informed consent	x						
Allocation		x					
INTERVENTION							
Self-directed training (Intervention group			←	—	—	—	→
Instructor-led training (Control. Group)			←	—	—	—	→
ASSESSMENT							
Socio-demographic			x				
Knowledge level			x	x	x	x	x
Skills level			x	x	x	x	x

Figure 1: SPIRIT flow diagram: Schedule of enrollment, interventions, and assessments. 1. AHA CPR knowledge questionnaire and 2. Berden/ Graham & Lewis BLS Skills assessment scoring system. These two instruments will be administered to determine the effectiveness of self-directed virtual learning on the retention of cardiopulmonary resuscitation knowledge and skills among hospital nurses in northern Nigeria.

Intervention group

In the self-directed method (intervention group), participants will use the HeartCode BLS video, which was developed by the American Heart Association. Copyright approval from AHA has been obtained for its usage in the selected hospitals. This HeartCode BLS integrates voice, animated visual imagery, and video to teach viewers the topics covered in traditional instructor-led CPR/BLS training. The training will be at the convenience of participants who are expected to complete the learning task by using the researcher-developed manual between 1 and 7 days (23).

Participants will have free access to a hospital training lab with a DVD player, a screen, and manikins for hands-on practice. Only participants in the study will be allowed inside the lab during the 1–7-day period; there will be no instructor or facilitator, only a research assistant who will prepare the manikins, Automated External Defibrillators (AED), and manage administrative procedures, such as logging in and out. The video player has rewind, forward, and pause buttons, allowing participants to learn each procedure in the proper order. The HeartCode BLS video programme is divided into 13 sections. However, a manual prepared for this research stud's participants' use was confined to only the adult BLS portions, namely: Section 4; rescue Adult BLS for one rescuer, section 5; rescue Adult BLS two rescuers including the use of Automatic External Defibrillator (AED) and bag-mask, section 12; mouth-to-mouth breathing for adult and child choking, and finally section 9; rescue breathing. This interventional method is designed so that both CPR beginners and anyone in need of refresher training can complete each segment in the appropriate order (26).

Control group

The instructor-led (control group) will use a standardised PowerPoint presentation and a manual designed by the researcher for this study, and it is also limited to only adult CPR training. The content information will be adapted from the American Heart Association's recommended CPR and AED AHA courses manual. The training duration will be between seven to eight hours for one day. The AHA recommends one manikin per 5-10 students. However, owing to its high cost in developing countries such as Nigeria, instructors often adopted the use of limited numbers. Therefore, this study will adopt the use of one manikin per 20-30 students.

Two instructors would cover the content in the CPR and AED manuals segmentally, similar to the deliberate practice methodology. It consists of breaking down the course content into digestible chunks and having students study and practise the subject until they acquire the mastery level of proficiency. The CPR/AED course begins with a brief talk in which the instructor refers to pertinent PowerPoint slides. To increase retention, instructors will follow up with a demonstration and skill practice. Stage one consists of a skill demonstration without any explanation. The second stage is a demonstration of the various actions to the learners. A repeat presentation led by one of the students constitutes stage three. Stage four involves all students practising the skill until they reach mastery level.

Questionnaire

The researcher adopted the questionnaire from the American Heart Association (AHA) sample for knowledge assessment, which has good internal consistency (Cronbach alpha = 0.8). This questionnaire will consist of 25 questions each, with four options from A to D. The correct answers will be scored "1", while wrong answers will be scored "0". The total score will be 25. The AHA used an 84% pass mark as a good knowledge benchmark for its BLS health provider course test (26). However, an average score level among the participants will be employed in this study to assess whether they have poor or good knowledge as reported in a similar study (27). Thus, a participant with a score of less than the mean (or median) will be considered to have poor knowledge, whereas those scoring above the mean or median will be considered to have good knowledge.

BLS skill test

Each participant will be examined using a Laerdal Resusci Anne® manikin. The assessor will utilise the Graham & Lewis and Berden et al. scoring methodologies to grade the participants' CPR and BLS skills (0 = correct, 5 = incorrect, and 10 = not performed). Participants will act as they would in real life, assuming a manikin is a person who has collapsed. Participants will halt resuscitation efforts after two minutes. A score of good or poor rationing ranging from 0 to 100 will be assigned (Table 1). Thus, those who scored less than 10 were regarded as having good skills, while those who scored 11 and above were considered to have poor skills (28-29). To minimise the inter-rater bias, during the skills test among the participants, the researcher will determine a specific value of the inter-rater reliability (Cohen's kappa) (30).

Data analysis

For data analysis, the Statistical Package for the Social Sciences (SPSS) version 27.0 will be used. In this study,

the missing data error will be investigated to eliminate any key error. The variables for categorical data will be displayed as percentages and frequencies. The mean and standard deviation (SD) will be used to describe normally distributed data, whereas the median and interquartile range (IQR) will be used for normally distributed data. Data normality will be assessed using the Kolmogorov-Smirnov test. Chi-Square and Fisher and exact tests will be employed to investigate the association between the dependent variable (knowledge of CPR) and independent variables (age, gender, professional status, academic qualification, formal CPR training, and survival outcome). Factors with $p < 0.25$ will be further tested in the multiple logistic regression model to determine the factors associated with the knowledge level. Finally, a generalised estimated equation (GEE) will be used to compare the differences in knowledge and skills between the intervention and control groups across the time points, adjusted with covariates. Variables with $p < 0.05$ were considered statistically significant.

Communicating the protocol changes

Whether the RCT data are conclusive, inconclusive, or favourable to the study hypothesis, they will be submitted to an international, peer-reviewed journal for publication. Any important protocol changes will be disclosed to the hospitals and the Ethics Committee at Universiti.

DISCUSSION

The greater demand for better-equipped healthcare professionals, including nurses with competent knowledge and skills in CPR who can give high-quality care to cardiac arrest patients, justified the need for this study. Poor CPR performance, as previously reported among participants in Nigeria, is worrisome (15-16). As a strategy to improve CPR performance among healthcare providers, including nurses, government/ hospital policymakers should enact a policy that makes CPR training mandatory for all healthcare providers in our tertiary hospitals.

In this present paper, the researcher describes the protocol for RCT to differentiate the CPR knowledge and skills level retention following CPR training at baseline, post-test, 1-, 3-, and 6- month follow-ups among the nurses between and within self-directed training (intervention) and instructor-led training (control). The anticipated expected outcomes of this study will emphasize the significance of self-directed as an alternative method of CPR training that is simple, cost-effective, and trains more nurses in the acquisition and retention of knowledge and skills.

To date, no study comparing the effectiveness of self-directed versus instructor-led CPR training has been conducted in Nigeria. The few studies reported used cross-sectional designs among different healthcare providers. Moreover, the results were inconsistent with the majority reporting poor knowledge level. Therefore, the RCT component of this interventional study is pertinent in Nigeria. The authors project that self-directed training is more cost-effective and the intervention can facilitate the training of more nurses. In addition, the intervention will be effective for CPR knowledge and skill retention teaching methods, similar to instructor-led intervention. In providing knowledge, competency, and confidence in training for both basic life support (BLS) and AED, self-directed training is reported to be as good as instructor-led (traditional training) (10,22). The results of this study could increase hospital and policymakers' confidence levels in improving nurses' CPR knowledge and skills through self-directed training.

CONCLUSION

Participants in the self-directed training group are anticipated to have higher levels of CPR knowledge and skills than those in the instructor-led training group. Self-directed learning may be a low-cost solution for those who desire to learn at their own speed and keep their knowledge and skills for as long as feasible.

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