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Original Articles

Development of Guide Basic Life Support (BLS) Application Based on Android to Increase Accuracy Compression Ritme And Ventilation to Handling of Out Hospital Cardiac Arrest

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Abstract

Introduction: Public health center as first-rate health facilities must be equipped with basic emergency services capability to support optimal health service systems. The ability of nurses in doing a heart massage or BLS is still below 50%. In the management of BLS, increasing the ability of nursing was important to reduce mortality due to cardiac arrest. The purpose of this research was to know the effect of Basic Life Support (BLS) based guide application in handling Out Cardiac arrest (OHCA) Nurse emergency departments Public health center. *Methods:* This research used the R & D method. Data of stage 1 was collected through a questionnaire of knowledge, attitude and Psychomotor BLS from 50 nurses for application development in stage 2, then conducted trials and evaluation. Phase 2 was conducted by a quasi-experiment method with a simple random sampling technique with 25 respondents in each group. The control group was given the BLS module and the treatment group was given Guide Basic Life Support (BLS) application for 2 weeks. The variables in phase 2 of were the accuracy and speed of resuscitation, measured by a checklist and stopwatch. *Results:* The result of the research was an application of basic life support (BLS) based on Android. The result for the treatment group showed the precision variable (p = 0,000) and speed (p = 0,000) for the Wilcoxon Test and the precision variable (p = 0,000) and speed (p = 0,000) for Mann U Whitney Test. *Conclusion:* Basic android basic life support (BLS) application can improve the accuracy and speed of nurses in doing BLS.

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INTRODUCTION

A sudden cardiac arrest may occur anywhere and at any time. A sudden cardiac arrest is a case with an emergency priority. Emergency conditions are a life-threatening condition, and if not treated promptly can result in death [1]. Patients with cardiac arrest should be promptly treated with CPR (cardiopulmonary resuscitation) and AED (automated external defibrillator) measures, either by healthcare or laypeople [2].

In the United States, nearly 360,000 cardiac arrest events occur outside the hospital (Out of Hospital Cardiac Arrest, OHCA), or nearly 1000 cases per day [3]. A research conducted by Chan et al. (2014) found that OHCA occurs annually in the United States, and about 92% of them died before reaching the hospital [4]. Patients who died of cardiac arrest were known to have ventricular fibrillation (VF) and pulseless ventricular tachycardia (pulseless VT), occurring in 40-50% of OHCA cases [5].

Data on patient visited the Emergency Room (ED) throughout Indonesia reached 11,719,015 (13.1%) of the total hospital visit. The higher number of ED visit needs considerable attention for emergency services. In Indonesia, the prevalence of coronary heart disease in 2013 was 0.5% or approximately 883,447 people, while based on a diagnosis of symptoms of 1.5% or an estimated 2,650,340 people. East Java Province was province with the highest prevalence of coronary heart disease with 375,127 people (1.3%) [6].

Cardiac arrest is a condition when heart suddenly stops and can't pump the blood. It causes decreasing of oxygen supply for the vital organs. If it happens more than 4 minutes, it can lead to death of brain cells and cause death in all vital organs of the body only in 10 minutes. OHCA is a mechanical cardiac arrest event which characterized by the absence of circulation signs and occurs outside of the hospital area [7].

Kronick et al., (2015) stated that to prevent death in OHCA patients, treatment of cardiac arrest should be done in the pre-hospital phase. The handling of cardiac arrest was known as the chain of survival [7]. AHA (2015) developed a revision for the management of cardiac arrest by separating management between cardiac arrest in the hospital (In-Hospital Cardiac Arrest-IHCA) and OHCA. Handling of OHCA patients in the acute phase should include the introduction and activation of emergency response systems, quality heart resuscitation (CPR), immediate defibrillation, basic and advanced emergency care services in the transport phase, as well as advanced post-cardiac stopping care [2]. In the management of OHCA version 2015, the role of common people and health workers in primary health care facilities were important in the cardiac arrest phase, CPR and defibrillation until a trained Emergency Medical Service (EMS) team came. All of these components were important links to make spontaneous circulation back [7]. The success of a chain depended on the effectiveness of previous step. Thus, an effective continuity system was needed between pre-hospital and hospital [8].

Ideally, when cardiac arrest happened outside of the hospital, hands-only CPR would be provided by common people in site until the EMS team arrived. In this case, the patient could be taken to primary health care facility

because the location was reachable [9]. To increase the survival rate of cardiac arrest victims, assistance of patient with OHCA must be began in the prehospital phase [7].

Assistance of cardiac arrest victims in this prehospital phase could be done in the public health centre. The public health centre is a technical implementation unit of District / Municipal Health Office which responsible for organizing health development in one or more districts. It is equipped with human resources, facilities, and infrastructure to support preventive, promotive, curative and rehabilitative activities in primary health care [6]. Public health centre as the first-rate health facility must be equipped with basic emergency services that can support optimal health service systems. In the management of OHCA, public health centre have an important role during the resuscitation process. The result of OHCA management would be influenced by the initial recognition of cardiac arrest signs and the resuscitation treatment that provided by public health centre officers. However, each of public health centres has different facilities and human resources. This could influence its capacity on providing services for cardiac arrest victims. Emergency cases were common occurring at home. Thus, a system was needed to raise awareness of an emergency-driven state of the local community. Video, the latest standard resuscitation module was embedded in the application, that could be learned any time. The development of this application was supported by monotonous of basic life support training modules and the maneuvering skills only shown as images in modules. In addition, resuscitation only could be learned and practiced during the training. Using this application was expected for doing CPR based on international standards [9]. However, there is no study that examines the development of application for Basic Life Support (BLS) based on handling Out Hospital cardiac arrest (OHCA).

METHODS

This study was research and development (R & D) study that consisted of two phases. Design and development research is a systematic study of how to design a product, develop/produce the design, and evaluate the performance of the product to obtain empirical data that can be used as a basis for forming products, tools, and models. The first phase was to evaluate the knowledge, attitude and psychomotor of emergency nurses in conducting basic life support. The number of samples was 50 nurses. The sampling method was using purposive sampling technique. Focus Group Discussion (FGD) was done with service coordinator, head of room, committee of nursing, and Patient Safety, and Emergency Room Nurses Representative for the evaluation. After the evaluation, there was an expert discussion activities in the field of cardiac emergency and anesthesia and Reanimasi and Information Technology (IT).

For the second phase, a quasi-experiment was used for the study design. There were two groups, the control group and the experiment group. The sampling method was using simple random sampling. Based on the calculation, the number of samples in each group was 25. To anticipate the drop out, the researcher added 10% in each group. Thus, there were 25 participants in the Android-

based Basic Life Support (BLS) Guide group and 25 participants in the control group. The total of participants in the second phase were 50 participants. The independent variable in this second phase was the Android-based Basic Life Support (BLS) Application. The Basic Life Support (BLS) Application has been designed and socialized based on the nurse's ability to operate the Basic Life Support (BLS) Application. The dependent variables in this second phase were the ability and speed in carrying out Basic Life support (BLS). The second phase was using the Basic Life Support (BLS) Guide Algorithm Application in the Android system based Out Hospital Cardiac Arrest (OHCA) handling and the evaluation sheet of the operational capability of the Basic Life Support Guide Algorithm Application (BLS) in the handling of Out Hospital cardiac Android-based Arrest (OHCA) and Nurse's ability and speed evaluation sheet in conducting Basic Life Support (BLS) as the instruments.

In the first phase, descriptive analysis was used to measure the frequency of knowledge, attitude, and psychomotor in doing Basic Life Support (BLS) and FGD activities. Data analysis for FGD activities was obtained based on the results of the audiovisual recording during the discussions. The results during the discussion copied and analyzed according to the themes. Researcher tried to increase observational persistence by repeating audiovisual recordings to analyze the context. The Inferential Analysis was consisted of assessing the validity of the content and/or construction of the application using an expert discussion and an existing AHA 2015 Guideline and an instrument of the questionnaire and a descriptive statistical test.

The second phase of univariate data analysis was performed on each study variable. The variables in the second phase were the accuracy and speed of resuscitation, which measured using a checklist and stopwatch. The results presented in the form of a frequency distribution table. Statistical test was done for before and after intervention for each groups. Mann Whitney test was used to know the difference between the treatment group and the control group with $p \leq 0.05$. The Wilcoxon test was performed to determine difference of post-test between the control group and treatment group using Wilcoxon with $p < 0.05$.

RESULTS

Research First Phase

Results and analysis of first phase at the emergency room in public health center in Surabaya Health Service Area. Table 1 shows that the majority of participants were in the age range 26 - 30 years (46%) and 60% male. Based on the working period, 54% participants were working > 5 years. Around 68% of participants got nursing degree and 52% had BLS certificate.

Table 2 shows knowledge, attitude, and psychomotor of BLS among the ER nurses. For the knowledge, 48% of participants were in moderate level. For the attitude, 60% of participants had negative attitude. For the psychomotor, 62% of participants were in unskilled level.

Recommendations from FGD on Guide Basic Life Support (BLS) application form based on the Android system are: (1) Creating

instrument for BLS training that could be easily accessed anytime and everywhere; (2) Guide Basic Life Support (BLS) based on the android system prepared based on the needs of nurses at the public health center emergency room in improving the knowledge, attitude and psychomotor BLS; (3) Guide Basic Life Support (BLS) based on the Android system was expected to meet the needs of nurses at emergency departments on public health center to update skill in providing BLS.

Research Second Phase

Results and analysis second phase in emergency room nurse at public health center in Surabaya City Health Department. Table 4 shows the distribution and homogeneity. Age (0.188), gender (1.00), and work period (0.152) were homogeneous data, while education (0.009) was not homogeneous.

The table 5 shows the normality of data distribution for each variable. Pre and post data distribution on each variables were not normally distributed with p-value <0.05. Delta data distribution in the intervention group and the control group each variables were not normally distributed with a p-value <0.05.

Table 6 shows the changing of the value of BLS nurse accuracy in the public health center. In the treatment group, results were significant with p ≤ 0.000, while in the control group was not significant with p = 1.000. Mann Whitney test results' showed significant effect on the nurses ability in BLS after intervention in both groups with p = 0.000.

Table 7 shows the changing in velocity value of BLS nurse in the public health center. In the treatment group, the Wilcoxon test showed significant result with p = 0.000, while in the control group was not significant with p = 0.157. The Mann Whitney test results' showed significant effect on nurse speed and accuracy in doing BLS after intervention with p = 0.000 in both the treatment group and the control group

Table 1
Distribution of respondent characteristics Phase I

No	General Data	Parameters	Distribution	
			Σ	%
1	Age (in years)	20 – 25	10	20
		26 – 30	23	46
		31 – 35	12	24
		36 – 40	5	10
2	Gender	Male	30	60
		Female	20	40
3	Work Period (in years)	< 1	4	8
		1 – 3	7	14
		3 – 5	12	24
		> 5	27	54
4	Education	Nursing diploma	16	32
		Nursing degree	34	68
5	Skill Certificate	BLS	26	52
		PPGD *)	18	36
		BTCLS	6	12

*)PPGD (training license for the Prevention of Emergency Patients in Indonesia)

Table 2
Evaluation of knowledge, attitude and psychomotor BLS of ER nurses

No	Variable	Parameter	∑	%
1	Knowledge	Good	7	14
		Moderat	24	48
		Less	19	38
2	Attitude	Positive	20	40
		Negative	30	60
3	Psychomotor	Skilled	19	38
		Unskilled	31	62

Table 3
FGD results of knowledge, attitude, and psychomotor evaluation of BLS nurses

No	Strategic Issues	Cause	FGD Result	Researcher's Review
1	Nursing knowledge on questionnaire results 38% less and 48% enough about BLS	Lack of exposure to BLS scientific update	Needs to make media that help nurses get updates on the BLS easily	Create learning media that easy to access anytime and involving multidisciplinary science
2.	The attitude of the nurse was negative (60%) in the questionnaire.	Lack of self-esteem and ability to do BLS	Need to provide regular training in order to increase the nurse confidence in giving BLS.	Create media to upgrade nurse's skills in providing BLS
3.	Psychomotor nurse majority (62%) are not skilled in simulation giving BLS	Nurses did not get a regular update on the BLS technique.	Media was needed to be developed in order to provide regular perform BLS interventions	Creating media to improve psychomotor nurse in public health center about BLS

Table 4
Distribution and homogeneity of the respondent characteristic of phase II

No	General Data	Parameters	Group I		Group II		Test of Homogeneity (sig)
			∑	%	∑	%	
1	Ager (in the year)	20 – 25	3	12	1	4	0.188
		26 – 30	9	36	11	44	
		31 – 35	8	32	10	40	
		36 – 40	5	20	30	12	
2	Gender	Male	14	56	11	44	1.00
		Female	11	44	14	56	
3	Work period (in a year)	< 1	3	12	1	4	0.152
		1 – 3	3	12	4	16	
		3 – 5	3	12	9	36	
		> 5	16	64	11	44	
4	Education	Nursing diploma	14	56	19	76	0.009
		Nursing degree	11	44	6	24	

I: Intervention Group
II: Control Group

Table 5
Data variable normality

Variable		p-value
Accuracy	*Pre-test* Group I	0.025
	Post-test Group I	0.032
	Pre-test Group II	0.047
	Post-test Group II	0.027
	Delta Group I	<0.001
	Delta Group II	<0.001
Speed	*Pre-test* Group I	0.033
	Post-test Group I	0.048
	Pre-test Group II	0.049
	Post-test Group II	0.042
	Delta Group I	<0.001
	Delta Group II	<0.001

I: Intervention Group
II: Control Group

Table 6
Accuracy of BLS Nurse Emergency at Public health center

		BLS Accuracy				Statistical test
		Skilled		Unskilled		
		∑	%	∑	%	
I	**Pre**	11	22	39	78	*Wilcoxon,* p=<0,001
	Post	44	88	6	12	
II	**Pre**	18	36	32	64	*Wilcoxon,* p=1,000
	Post	18	36	32	64	
Mann U Whitney, p=<0,001						

I: Intervention Group
II: Control Group

Table 7
BLS Speed of Emergency Room at Public health center

		BLS Speed				Statistical test
		Reached		Not achieved		
		∑	%	∑	%	
I	**Pre**	12	24	38	76	*Wilcoxon,* p=<0,001
	Post	43	86	7	14	
II	**Pre**	18	36	32	64	*Wilcoxon,* p=0,157
	Post	16	32	34	68	
Mann U Whitney, p=<0,001						

I: Intervention Group
II: Control Group

DISCUSSION

Nurse Knowledge

Based on the results in the first phase, knowledge about BLS among emergency department nurses in the health centre in Surabaya were 14% knowledgeable, 48% enough, and 38% less. Although the majority of participants had sufficient knowledge, there were still many ER nurses whose had less knowledge about BLS. It gave picture about nurse's knowledge in the community health centre and it was quite worrying. The ER nurses are first line of health care provider in providing basic life support in the emenrgency situation. Nevertheless, nurses' knowledge about BLS was not good enough. This result is in line with a previous study which found around 45.25% of health care workers in a hospital in India had inadequate knowledge about BLS. Another research conducted by Chew et al., (2011) found no more than 50% of young doctors in two hospitals in Malaysia could not answer 10 questions about BLS correctly [10]. This study also found the prevelance of ER nurses who got BLS training were 52% BLS training, PPGD 36%, and BTCLS 12%. However, this training did not guarantee that the ER nurses would have adequat knowledge about BLS and

implement the knowledge when they take care patient with cardiac arrest. Therefore, effective and efficient media to renew knowledge about BLS for the ER nurses were needed. The development of technology had proven to be used as an instrument in increasing knowledge, such as the iCPR [11]. The iCPR feedback tool can significantly improve the performance of chest compression in a simulated cardiac arrest scenario. Participants' knowledge was increased after learning the iCPR and helping them achieve the correct chest compression level. They also felt the device was easy to use.

Nurse Attitude

Around 60% of the ER nurses in the public health centre in Surabaya City Health Service had negative attitude towards BLS. Negative attitude was meaning the participants had lack response when faced emergency conditions occurred outside hospital. Attitude is a reaction or response from someone to a stimulus or object [12]. Attitude is a response to social stimuli that have been conditioned [13]. Negative attitudes in this study could be influenced by the knowledge and behavior change.

A study of nurses in Sweden on CPR-D found that changing in CPR-D education and involving multidisciplinary teams were needed to encourage individual nurses to do defibrillate and to improve organizational attitudes. Nurses were needed more encouragement and more information about early defibrillation. Pessimistic attitudes towards CPR-D might be influenced by the nurse's attitude toward resuscitation and implementation of the guidelines [14]. Another study conducted by Shibahashi, Sugiyama, & Hamabe, (2018) found less satisfactory results in the health worker attitude when faced with emergency conditions, lack of confidence to self-ability in doing action were factors related to negative attitude of nurses towards BLS [15].

Psychomotor

Around of 62% of the ER nurses were unskilled in performing BLS. A person's skill in performing actions was influenced by the individual's behavior and experiences. Even though, the ER nurses had BLS training, there were still a lot of nurses were not good enough in performing BLS. Following research conducted by Fathoni, (2014), the emergency training had nothing to do with the implementation of the primary survey [16]. The study also found that the difference between emergency training between PPGD and BTCLS did not affect the nurses' work or the implementation of the primary survey. Research conducted by Smith, Gilcreast, & Pierce, (2008) found that the ability of certified nurses to maintain basic and advanced life support psychomotor skills and knowledge would decrease if nurses were unable to perform ACLS and BLS skills based on standard [17].

In this study, the psychomotor assessment of nurses in performing BLS was based on the latest Standards of AHA [18] and around 62% nurses were unskilled in performing BLS. More training is needed to increase skill of nurses. It is consistent with a previous study conducted by Keenan, Lamacraft, & Joubert, (2009) that training should be done every 6-12 months to maintain BLS skill [19]. It is because skills

about BLS, especially CPR would decrease after 2 weeks of training.

Accuracy of Nurses Emergency Room

The result of this study showed that the accuracy of the ER nurses in the experiment group was increasing after the intervention compared to the control group. It showed the application of BLS in the Android system was more effective and efficient for nurses to update their skill and knowledge continuously. The application was easy to access everywhere and anytime through smartphone.

This study was in line with a study which in 31 trained medical personnel using Android-based applications called iResus. iResus was developed to improve the performance of medical personnel in performing basic and advanced life support in emergency life simulations. The result showed that iResus applications could significantly improve the performance medical personnels in performing basic and advanced life support during medical emergency simulation [20]. Another study found that visual and audio instruction during training could bring significant results on the ability to provide BLS, particularly in giving recovery position, airway management and quality of CPR (cardiopulmonary resuscitation) with PDAs (personal digital assistants) [21].

Media education using Android-based mobile learning is more interesting and applicable to use. Furthermore, mobile devices becomes more popular and easy to access. Learning by mobile is a new approach for education, and offers learning opportunities anywhere and anytime [22]. Guide Basic Life Support (BLS) applications becomes more important in the educational environment for nurses. This study determined theoretical and technical foundations for designing and developing effective learning media and illustrates new approaches to develop learning application for the cellular technology.

The Basic Life Support (BLS) application could improve the nursing capacity in community health centers for conducting basic life support through simulations for cardiac arrest scenario. Participants in this study felt that the application was easy to use and helped them increasing their self-confidence in doing BLS in emergency situation.

Speed of Nurse Emergency Room

In this study, the speed of nurses in performing BLS in intervention group showed an improvement after the intervention. It happened because the application provided detailed picture through video and learning materials. So, participants could easily learn and practice.

Around 76% of participants in this study could achieve the targets from the training. It means that learning BLS from Android application could be considered as effective and efficient way, particularly in cost and time. Following the results of research conducted by (Krogh et al., 2015), using the method of e-learning Pediatric Basic Life Support in providing education to professional nurses showed that e-learning BLS could increase self-confidence in nurses during emergency situation [23].

CONCLUSION

Nurses at the public health center in the Surabaya City Health Office showed their knowledge about BLS in enough level (48%). In addition, most of the ER nurses (60%) had negative attitude towards BLS. For the psychomotor, around 62% of participants were unskilled in BLS.

The application of Basic Life Support (BLS) was developed based on FGD result and expert discussion. Socialization and trial of the Basic Life Support (BLS) Application have been done on 25 June 2018 followed by 25 nurses at the Public health center emergency room. Implementation of the Guide Basic Life Support (BLS) application showed a positive result in improving nurse's ability and speed in performing BLS. The head of public head centre in this study helped to provide an assessment of nurses' resuscitation skills.

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