

Development of Cardiopulmonary Resuscitation Pillows for Increasing Number of Bystanders CPR In Lubuklinggau City

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Abstract

Introduction: Cardiac arrest is a situation that can lead to death if CPR is not immediately assisted. The chances of survival increase if the victims are directly helped by people nearby or CPR bystanders rather than waiting for the medical team to arrive. Training CPR bystanders requires large resources, including expensive CPR mannequins as a simulation medium. Creativity is needed to create cheap CPR simulation media with good feasibility. **Objective:** The study aimed to construct and test the effect of the CPR Pillow to improve the CPR skill in Lubuklinggau, South Sumatra, Indonesia. **Method:** Research and Development (R&D) with experimental tests, pre-test, and post-tests were applied in this study. Forty people were given two meetings within two weeks. Skill was measured by how the subject performed hand's-only CPR using the CPR Operational Procedure checklist. **Result:** The result of this study is the creation of a low-cost CPR pillow design that meets the eligibility as a low-fidelity simulation medium for CPR skills. The data analysis using the paired t-test showed a significant effect of CPR training using CPR Pillows on the trainees' hand's-only CPR skills ($t=-37,749$) with a value of $p=0.000$. **Recommendation:** This CPR pillow can be used as a hand's-only CPR simulation medium. CPR simulation using this CPR pillow is a low-fidelity simulation. There is a positive influence related to CPR training using this CPR pillow on the hands-only CPR skills of the trainees.

Keywords: CPR; BLS; prehospital; cardiac arrest



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INTRODUCTION

Cardiac arrest is a condition of the heart that stops functioning suddenly and results in death if help is not given quickly and appropriately (1). Cardiopulmonary Resuscitation (CPR) is the first and fundamental aid that must be given to patients with cardiac arrest (2).

In the United States of America, more than 356,000 Out of Hospital Cardiac Arrests (OHCA) occur each year (1). 80% of OHCA died before getting help from health workers (3). With a survival rate below 8%, cardiac arrest is the world's primary cause of millions of premature deaths (3,4). OHCA is a severe problem with a global incidence of approximately 55 per 100,000 people yearly (5).

The high mortality rate for OHCA is because the victim was not immediately given CPR when the incident occurred. After all, no one was watching or could perform CPR, and the distance from the hospital was far. The OHCA mortality rate in South Korea is 97.7%, while in China is 90% (4,6). There will be a decrease in the chance of survival of about 7-10% every minute for victims of OHCA if no help is given (4). Witnesses are essential in helping before health workers appear or are known as CPR bystanders.

An estimated 30 people experience cardiac arrest in Indonesia daily (7). In Lubuklinggau, the incidence of cardiac arrest has not been recorded neatly, either at the Statistics Agency or the Government Health Office. Preliminary studies showed many deaths due to heart attacks are considered deaths due to cardiac arrest. This data indicates that there are still differences in perceptions about cardiac arrest and heart attack. Hence, the magnitude of the cardiac arrest problem outside the hospital is not statistically reflected.

The way to increase the chances of an OHCA victim's life is to be given help by eyewitnesses, commonly called CPR bystanders (5,8). Bystander CPR is an essential part of the survival chain and is closely related to increasing OHCA survival (9,10). Bystander CPR is someone who can perform CPR, at least hands-only CPR and is at the scene (11). There is an increased chance of survival for OHCA victims when helped by a person trained in CPR compared to being supported by an untrained person (12,13). This translation

means that the number of CPR bystanders needs to be increased so that the probability of an OHCA event being seen by CPR bystanders is also high.

The most effective way to increase the number of CPR bystanders is to conduct Basic Life Support (BLS) education and training in which CPR will be trained. BLS education and training aims to increase knowledge and skills about handling cardiac arrest, including OHCA. Febriana et al. 2018, said there was a significant effect on the understanding of high school students in Karanganyar Klaten after being given CPR training (14). BLS training for school students is a priority program internationally (15). Studies show that simulation is more fun than providing more technical skills training for all students and protects patients from the risks of this stage of learning (16)

BLS education and training require qualified simulation media to be able to simulate high-quality CPR activities, namely, having a compression depth of 5-6 cm, having an excellent recoil to support maximum chest recoil, and keeping compressions at a speed of 100-120 times in a minute (2). Simulation is an innovative method with learning centers on students and motivating students to actively participate in achieving learning goals, such as knowledge and skills in a clinical situation (17). The problem is that the CPR simulation media are limited and quite expensive, making it difficult to use outside educational facilities.

For this problem, simulation tools are needed at a more affordable price and still have the requirements to become high-quality CPR simulation media. CPR simulation tools are divided into three levels: high-fidelity, medium-fidelity, and low-fidelity (18). High-fidelity is a simulation method using mannequins with high anatomical and physiological similarities to the human body, medium-fidelity is more concerned with the technology, but there is no anatomical resemblance. At the same time, low-fidelity emphasizes that mannequins can be used to train psychomotor and are usually not superior in technology things (17,18).

Low-fidelity mannequins do not reduce the meaning of BLS education and training, namely improving the CPR skills of the simulation subjects and increasing their self-

confidence. Homemade low-fidelity mannequin CPR is similar to commercial CPR mannequins in improving CPR skills (19).

The advantage of low-fidelity simulation is the affordable cost of the simulation media. With a reasonable price, you can increase the number of simulation media so that the BLS education and training program can be implemented more massively with the initial goal of increasing the number of CPR bystanders. Previous studies concluded that there was an improvement in high-quality CPR parameters (Depth, Speed, Full chest recoil) after training using a low-cost simulated method (2).

Media use is not the most critical factor in health education, but learning media cannot be separated from health education (20). Arsyad (2015) also states that choosing suitable media for health education will be necessary because the media acts as a medium in thickening and reducing errors in information transfer. (21).

This study aims to develop affordable CPR simulation media that still have good quality in training the user's skills to perform hands-on CPR. In this study, the media was made as a pillow with a maximum compression thickness of 6 cm and good spring power to accommodate hands-only CPR simulation. CPR "pillow partners" can be a valuable and inexpensive tool for teaching CPR bystander skills and can reduce the need for expensive mannequins amid an increase in CPR training and education (22). Although it has some limitations, it provides a good alternative and is very useful in saving training costs.

OBJECTIVE

The study aimed to construct and test the effect of the CPR Pillow to improve the CPR skill in Lubuklinggau, South Sumatra, Indonesia.

METHODS

Design

A Research and Development (R&D) design was applied in this study. The R&D research process includes 5 (five) steps as follows: 1) Information gathering, 2) Model design, 3) Expert validation and revision, 4) Model testing, and 5) Model completion (23).

Sample

This study uses a small sample for model testing. Sampling This study used a purposive sampling technique with a sample of 40 people. The inclusion criteria for this research sample were male or female adolescents who had previously attended BLS training using factory-made mannequins. At the same time, the inclusion criteria for this study sample had physical limitations that prevented them from performing CPR.

Ethical Consideration

This study was conducted according to the guidelines of the Declaration of Helsinki. The ethical approval was issued by the Palembang Health Polytechnic Ethics Committee number 1154/KEPK/Adm2/VIII/2021. All participants were asked to fill out and sign a consent form after receiving information about the research, and they had the right to participate or not in this study. The researcher assures that the confidentiality of the information will be guaranteed.

CPR Pillow

The CPR pillow was built as a medium for carrying out CPR simulations, and Poltekkes Kemenkes Palembang developed the CPR pillow through the Diploma Nursing Program. The CPR pillow has all the attributes to perform a high-quality CPR simulation, with a maximum compression depth of 6 cm and fast spring recoil. On the back of the CPR pillow, a hands-only CPR algorithm is illustrated so that it is easy for responders to see at all times. A CPR pillow is a low-cost CPR simulation medium that emphasizes skills or is called low-fidelity.

CPR PILLOW CONSTRUCTION

Information Collection

In this initial step, we interviewed experts and completed a literature review regarding high-quality CPR. We interviewed two emergency service experts and certified CPR trainers to learn more about the requirements for low-fidelity CPR simulation media. This CPR simulation media aims to accommodate high-quality hands-only CPR as it should. According to the literature review, high-quality hands-only CPR has several requirements,

namely a depth of 5-6 cm, compressions rate of 100-120 x/minute, and perfect chest recoil (24).

According to the conclusions of expert interviews, the most crucial aspect of low-fidelity media simulation is how the simulation media can accommodate media users' psychomotor abilities, implying that the simulation media must be able to accommodate the requirements of high-quality CPR. The two experts interviewed also said that the production budget had to be affordable and easy to find to be created again elsewhere.

Model Design

Data obtained from expert interviews and literature reviews were collected to become material for making CPR pillows. In practice, the essential factors of hands-only CPR are hard and fast compressions. The design of the CPR pillow model emphasizes a maximum compression depth of 6 cm and a capable spring so that full chest recoil can be described. The shape of the CPR pillow is made simple, with a rectangular shape of 40 cm x 25 cm. The most important thing about low-fidelity mannequins is training participants' psychomotor skills (18).

Expert Validation

Expert validation is approximate, based on analysis and logical reasoning by certified researchers, emergency specialists, and CPR trainers. The expert validation aims to determine whether the CPR pillow produced fulfills the mannequin's low fidelity criteria, as explained by the expert during the initial interview. We are sending the CPR pillow we made to test its ability to accommodate high-quality CPR exercises and its suitability.

Table 1. Expert Validation

No	Validated aspects	Expert Validation		Properness to use	
		Expert 1	Expert 2	Expert 1	Expert 2
1	CPR Pillow Design	Good	Good	Proper	Proper
2	CPR Pillow Thickness	Good	Good	Proper	Proper
3	Clarity of CPR instructions	Good	Good	Proper	Proper
4	Able to accommodate a compression	Good	Good	Proper	Proper

	depth of 5-6 cm				
5	Able to accommodate compression speeds of 100-120x/minute	Good	Good	Proper	Proper
6	Able to accommodate full recoil of the chest	Good	Good	Proper	Proper

The expert assessment uses four levels, namely less, sufficient, good, and very good, and the properness assessment uses two reviews, proper and not proper. From Table 1 above, it can be illustrated that this CPR pillow has received a good rating and is suitable for use as a CPR training medium.

Model Testing

The following are the results of research on the characteristics of respondents obtained through questionnaires filled out by research subjects.

Table 2. Respondent Carracteristic

Respondent Carracteristic	Freq	%	
Gender	Male	28	70 %
	Female	12	30 %
Age	15	1	2.5 %
	16	10	25 %
	17	7	17.5 %
	18	7	17.5 %
	19	8	20%
	20	7	17.5 %
BLS Training History	Ever	40	100 %
	Never	0	0 %
OHCA Viewing History	Ever	5	12.5 %
	Never	35	87.5 %
Willingness to do CPR	Yes	31	77.5 %
	No	9	22.5 %
Performing CPR History	Ever	1	2.5 %
	Never	39	97.5 %

Demographic data in this study indicate that respondents are 16-20 years old. Level of all respondents had attended BLS training (100%). In the table above, it can also be concluded that the majority of respondents had never performed CPR (97.5%)

Table 3. Comparison of mean scores of skill

Variable	Pre-test	Post-test	Difference	t	p*
	M ± SD	M ± SD	M ± SD		
Hand's-Only CPR Skill	8.73 ± 1.753	20.6 ± 1.127	-11.88 ± 1.989	-37.749	.0001

The data in Table 3 shows an increase in the average value of the skills variable before and after the intervention with a statistical significance of 0.0001. The use of low-fidelity mannequins is prioritized to improve psychomotor, meaning hands-only CPR skills are assessed here.

Final Model

From the series above, a pillow is produced to practice CPR skills called a CPR pillow. This mannequin is low-fidelity and meets the eligibility requirements to be used as a CPR simulation medium by experts in the field of emergency who are BLS trainer certified.

CPR Product

The development of this CPR pillow resulted in the production of a low-fidelity CPR simulation medium called the CPR pillow. The shape of the CPR pillow is made simple, with a rectangular shape of 40 cm x 25 cm, as seen in Figure 1.

DISCUSSION

This CPR pillow is intended to increase the training on handling OHCA, which still needs to be improved due to the high cost of simulation media, difficult transportation, and limited resources (22). This CPR pillow aims to make access to training with the simulation method easier, especially for training laypeople as CPR bystanders



Figure 1. CPR Pillow

The simulation method is the best choice for improving CPR knowledge and skills for ordinary people (25). Tiger and Glow (2015) said that the problem given during the simulation would make the subject analyze it, increasing knowledge and skills (26). The CPR training method using a simulation process will make it easier for participants to understand the CPR actions provided with the help of a facilitator who understands CPR (27).

CPR education and training using appropriate simulation media can increase participants' knowledge and skills in managing cardiac arrest victims. The position of the trainees here is essential because they are positioned as CPR bystanders or people who first respond to OHCA.

CPR bystanders' implementation of CPR on OHCA victims focuses on chest compressions, with the term hand's-only CPR. The quality of good chest compressions is that it meets the requirements for a depth of 5-6 cm, a speed of 100-120 x/minute, and maximum chest recoil (2,24). This CPR pillow is made to meet the above requirements at an affordable production cost.

Production cost is one of the factors that is highly considered in this CPR pillow design project while still not ruling out the feasibility of CPR pillows to be used as a simulation medium. Nearby tools can be used as CPR simulation media to carry out compression (19). Several previous trials used toilet paper and drinking water bottles as homemade CPR simulation media with satisfactory results (19,28).

This CPR pillow is built using affordable materials, such as using sofa foam as the primary pillow material. To accommodate

maximum chest depth and recoil, a simple spring that has been measured at a low price is placed, then these materials are arranged and covered with cloth. To look presentable, function like a pillow, and accommodate hand's-only CPR training.

Using the above materials is cheap, and the design is simple so that any artisan in the sewing field can make it. The ease of design makes this CPR pillow available anywhere at an affordable price and short work time. This CPR pillow adopts the concept of low-fidelity simulation. The concept of low-fidelity simulation is a simulation concept that uses an instructor and a manikin who cannot respond. Low-fidelity simulation is carried out to train skills (29). This type of simulation is commonly used to prepare the psychomotor abilities of trainees.

The use of low-fidelity simulation based on previous research improved the subject's skills in performing CPR. In conducting training using the simulation method, simulation media is one of the determining factors for the success of any type of training, apart from the response from the trainer (17).

The simulation method used in the CPR training process will allow participants to carry out CPR actions directly, accompanied by a direct guidance and evaluation process from the trainer throughout the training process (30,31). The training process will also benefit trainees in mastering skills in performing CPR actions. In this study, the simulation process has identical characteristics to research using the previous simulation method, namely the educational process, and demonstrations during the training accompanied by a trainer using CPR pillows as a medium for conducting the simulation. Training using a simple mannequin can improve overall CPR skills (32).

The increase in skill is also influenced by the direct feedback from the trainer during the CPR training process so that the subject can find out and immediately correct the procedure errors performed. In line with the previous description, Everett-Thomas et al. (2016) also said that the feedback provided by the trainer would make it easier for participants to correct mistakes made during the training process. (27). simulation is a better method for improving CPR skills and is the method most frequently used (25,33).

The results for skills assessment experienced a significant increase in this study, where the post-test scores for skills in performing CPR were more significant than the scores for pre-test skills before the training was carried out. Skills result from an exercise accompanied by increased changes by people who learn these skills due to specific activities (34).

The simulation method using CPR pillows is considered suitable for improving the skills of trainees, where CPR pillows have characteristics that can be used for quality hand's-only CPR simulations. The simulation method is regarded as one of the most suitable and frequently used methods in training (35,36). Skill variables in this study include compression depth, compression rate, and full chest recoil.

The study's findings could help support CPR training programs in schools severely limited by a lack of appropriate media to simulate CPR actions. This CPR pillow can facilitate skill transfer from trainer to trainee.

With affordable production expenses, it is hoped that every school can employ it as a training medium for general students and specific students such as scouts or nature lovers.

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The researcher suggests that this CPR pillow can be developed by adding several sensors related to high-quality CPR to improve the quality of the CPR pillow as a simulation medium.

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