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Literature Review

The Effect of Android-Based Applications on First Aid Cardiopulmonary Resuscitation Skills: A Literature Review

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ABSTRACT

Background: Coronary Heart Disease (CHD) is a leading cause of sudden cardiac arrest, with many cases occurring outside hospitals, known as Out-of-Hospital Cardiac Arrest (OHCA). Prompt and effective Cardiopulmonary Resuscitation (CPR) is essential to increase survival. **Objective:** This study aims to assess the role of Android-based mobile applications in enhancing CPR skills as part of first aid response. **Methods:** A literature review was conducted using nine peer-reviewed articles published between 2021 and 2024. Articles were sourced from PubMed and Google Scholar using keywords such as health education, basic life support, cardiac resuscitation, smartphone, and Android. Inclusion criteria included full-text English articles focusing on Android-based applications in CPR training or performance. The selection process followed PRISMA guidelines. **Results:** All nine articles met the criteria, with findings showing that Android-based CPR applications are effective tools for improving users' CPR skills, especially in OHCA situations. These applications offer valid features that support both learning and practical implementation. **Conclusion:** Android-based applications significantly enhance first aid capabilities in cardiac and pulmonary resuscitation and serve as valuable tools for public health education and emergency readiness.

Introduction

Coronary Heart Disease (CHD) is the leading cause of death worldwide, accounting for 36% of all deaths[1]. In Indonesia, CHD accounts for 26.4% of deaths. CHD can lead to sudden cardiac arrest. Cardiac arrest more frequently occurs outside of hospitals, known as Out-of-Hospital Cardiac Arrest (OHCA). Cardiac arrest is a serious health problem that can be fatal if not treated quickly and appropriately. The administration of Cardiopulmonary Resuscitation (CPR) is the key intervention in the management of cardiac arrest[2].

In Indonesia, there is no clear data on the prevalence of cardiac arrest incidents in daily life or outside hospitals. However, it is estimated that approximately 10,000 people per year—or about 30 people per day—experience cardiac arrest. The majority of cases occur in individuals with coronary heart disease. Deaths caused by cardiovascular diseases, particularly coronary heart disease and stroke, are projected to continue increasing, reaching an estimated 23.3 million deaths by 2030. In Indonesia, 10 out of every 100,000 people under the age of 35 and around 300,000–350,000 people experience cardiac arrest annually[1].

Cardiac arrest victims can be saved through proper Cardiopulmonary Resuscitation (CPR). CPR provides the best outcome if performed within 5 minutes after the attack; otherwise, the chances of survival decrease significantly. Improving public knowledge, attitudes, and skills in performing CPR has a direct impact on increasing community participation in providing immediate assistance to cardiac arrest victims outside of hospitals[3]. The main reason for the lack of knowledge and skills is generally due

to respondents not being directly exposed to real cardiac arrest cases, which leads to forgetting the correct procedure[4].

Cardiopulmonary Resuscitation (CPR) must be administered immediately because when breathing and heartbeat stop, blood circulation and oxygen transport also cease. This condition can cause the body's organs, especially vital organs, to experience a lack of oxygen, resulting in fatal consequences and damage within a short time. The brain is the organ that is most quickly affected, as it can only survive with a continuous supply of oxygen and glucose. If the brain does not receive oxygen and glucose for more than 10 minutes, it will experience permanent death. Brain death can also signify the death of the victim. Therefore, victims who experience respiratory and cardiac arrest have a "golden period" — a very critical window of time for life-saving action [5–7].

Training using simulation methods alone is often insufficient to maintain retention of knowledge and skills; therefore, alternative efforts are needed — one of which is providing a procedure guide through a mobile application[3]. With the rapid development of mobile phones, many applications are now available that can be used for health purposes, including those related to CPR. Android-based applications are considered more effective and efficient as learning media, for delivering information, and as educational tools in this era because they are more engaging and practical[8]. The novelty of this study lies in its use of recent journal article references from 2021–2024, aiming to examine the effect of Android-based applications on the ability to perform cardiopulmonary resuscitation (CPR) as a first aid response.

Based on the background described, the research question is: Can Android-based applications improve the ability of the public to perform cardiopulmonary resuscitation (CPR) as a first aid response?

Materials and Methods

Research Design

The research design used in this study is a systematic review, which aims to examine the effect of Android-based applications on improving first aid skills in performing cardiopulmonary resuscitation (CPR). This review was conducted using a systematic approach to relevant literature within a specific time frame.

Sample

The sample in this study consists of nine scientific articles published between 2021 and 2024. These articles were selected based on predetermined inclusion criteria and underwent a rigorous selection process in accordance with systematic review protocols.

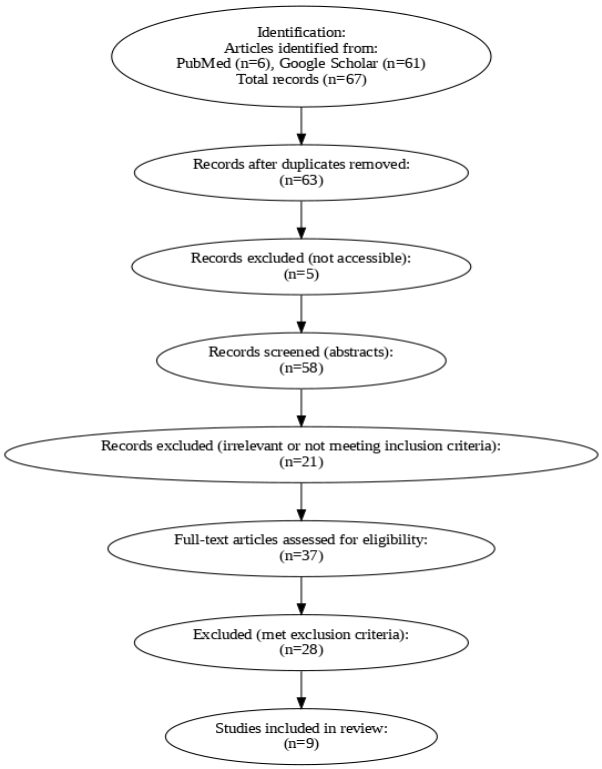

Figure 1 Article Selection for Literature Review Based on PRISMA

Data Collection Techniques

Data Collection Techniques were carried out by applying the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[9]. Articles were obtained

through two main databases, namely PubMed and Google Scholar. The search strategy used a combination of keywords: "smartphone" OR "mobile phone" OR "mobile application" AND "cardiopulmonary resuscitation" OR "CPR." Articles included had to meet the criteria of being published within the last three years (2021–2024), available in full-text form, and freely accessible (open access). The article selection process was conducted in four stages following the PRISMA flow: identification, screening, eligibility assessment, and inclusion in the review.

Data Analysis Techniques

The data analysis technique used was descriptive analysis. Each article that passed the selection was systematically reviewed to identify study characteristics, interventions conducted, and results demonstrating the effectiveness of using Android applications in CPR training and practice.

Ethical Consideration

Ethical clearance was not required for this study because it did not involve direct human subjects or primary experiments. This research only used secondary data from publicly published articles. Ethically, the entire process was conducted with attention to academic integrity, including proper citation and the use of valid sources.

Result

The literature search yielded a total of 67 articles, and after selection, 9 articles met the criteria set by the researchers. These are presented in Table 1.

Table 1. Results of Selected Article Reviews

Title / Author(s) / Year	Method	Results
Design of an Android-Based Cardiopulmonary Resuscitation (CPR) Application for Bystanders Amatiria, G., Handayani, R. S., & Rihiantoro, T. (2023)	This study combined research and development and qualitative methods. Participants included CPR experts, information technology experts, and laypeople. The result was an Android-based application design that underwent qualitative testing and validation by 6 participants.	Testing results showed all application features are valid and the app has been installed on Google Play Store. However, effectiveness testing will be conducted in phase 2 research, so it cannot yet be used directly for cardiac arrest victims.
The Effect of Health Education on Basic Life Support Using Audiovisual Media on Students' Knowledge Wiryansyah, O. A., & Musdiana, E. (2024)	Pre-experimental design with one-group pre-test and post-test. The population was all students at Pondok Pesantren Al Islah for the 2023-2024 academic year totaling 110 students. Purposive sampling resulted in 52 respondents. Data collected by questionnaire. Data analyzed using univariate and bivariate analysis with paired sample t-test.	Univariable analysis showed mean knowledge scores before health education was 54.706 and after was 79.225. Paired sample t-test showed a significant effect of basic life support education using audiovisual media on students' knowledge (p=0.000). Suggestion: Schools should collaborate with health workers or community health centers to conduct health education and training on basic life support.
Development of Basic Life Support Video to Improve Skills of Residents in Paya Bujuk Beuramo Village, Langsa Barat District, Langsa City Magfirah, M., Veri, N., Mutiah, C., Dewita, D., Ms, S. W., Madani, B., ... & Idwar, I. (2022)	Non-randomized post-test only with control group design. Sample consisted of 26 residents aged 20-45 years, selected by purposive sampling and divided into intervention and control groups (each 26 persons). BLS skills were assessed by observation. Data analyzed by independent sample t-test.	Results showed p = 0.0001, indicating a significant difference in BLS skills between intervention and control groups. It was concluded that BLS video development effectively improved residents' BLS skills.
Effect of Basic Life Support (BLS) Education Using	Quantitative pre-experimental study with one-group pretest-posttest design.	Statistical test showed significant effect of BLS education on students' knowledge

Title / Author(s) / Year	Method	Results
Video Media on Students' Knowledge About BLS at SMK Plus Bina Nusa Mandiri (BNM), Padang Pariaman District Resta, H. A., Nofia, V. R., Nengsih, C. C., & Manila, H. D. (2023)	Population of 55 and sample of 16 selected by purposive sampling. Video media was used for BLS education. Study conducted at SMK Plus BNM Pariaman. Data analyzed using paired sample t-test.	(p=0.000). Recommended teachers provide health education on BLS to increase student knowledge.
Si-Hajar: An App to Improve CPR Knowledge and Skills for Teenagers in Lubuklinggau City Soewito, B., Susmini, S., Wijaya, S., Wibowo, W. D. A., Ismiati, I., & Amelia, N. (2023)	Quasi-experimental design with pre- and post-test approach on CPR training using the Si-Hajar app. Purposive sampling of 40 teenagers in Lubuklinggau City, December 2021. CPR knowledge measured by questionnaire; skills assessed by standard CPR procedure checklist.	After using Si-Hajar, there was a statistically significant difference in knowledge and skills scores between Si-Hajar and control groups (P<0.001 for both). Group intervention related to knowledge (p=0.001), but no relation between knowledge and history of heart attack (p=0.0761) or willingness to perform CPR (p=0.0585). Skills related to intervention (p=0.001) but not to heart attack history or willingness to perform CPR.
Emergency Response Volunteers (WAGARU) Based on the Kreki Application in Coastal Tourist Areas of Bengkulu Susilawati, D., & Hasymi, Y. (2022)	Methods included lectures, discussions, and demonstrations. Participants divided into three groups. Training involved community emergency volunteers and third-year nursing students from UNIB. Conducted June, September, and November 2022. Success indicator: at least 75% of 10 emergency volunteers at Bengkulu coastal tourist area able to follow training, with minimum 80% success.	Activities conducted June 27, 2022 at Jenggalu tourist site and September 6 and November 4 via Zoom. Participants were 10 KREKI volunteers from Latun Bengkulu group. Participants showed high enthusiasm and active questioning during KREKI simulation. Knowledge increased significantly from 45% to 90%. The need to improve participant knowledge about KREKI app became a solution for partners.

Discussion

After the final selection process of the downloaded articles, 9 articles were obtained for review. The most recent article was published in 2024, while the oldest was published in 2021. A summary of the reviewed articles can be seen in Table 1. From the reviewed studies, the first article on the Design of an Android-Based Cardiopulmonary Resuscitation (CPR) Application for Bystanders stated that all application features are valid and it has been installed on the Google Play Store. However, the effectiveness test will only be conducted in the second phase of the study, so it cannot yet be used directly on cardiac arrest victims. This study found that the use of the developed application cannot replace the skills gained from standard training [8].

The second article about the effect of health education on basic life support using audiovisual media on students' knowledge stated that there was an effect of health education on basic life support using audiovisual media. Similarly, the third article on the development of a basic life support (BLS) video to improve the skills of residents in Paya Bujuk Beuramo Village, Langsa Barat District, Langsa City, stated that there was a significant difference in BLS skills between the intervention group and the control group. It was concluded that the development of the BLS video was effective in improving residents' skills in performing BLS. The fourth article on the effect of basic life support (BLS) education using video media on students' knowledge about BLS at SMK Plus Bina Nusa Mandiri (BNM), Padang Pariaman Regency, stated that there was an effect of BLS education on students' knowledge about BLS with a p-value = 0.000[10–12].

Another Android-based application in the

fifth article titled Si-Hajar: An App to Improve CPR Knowledge and Skills for Teenagers in Lubuklinggau City found a statistically significant difference in knowledge and skill scores between the Si-Hajar group and the control group ($P < 0.001$ for both). Regarding CPR skills, there was a correlation between the intervention group and skills ($p = 0.001$), but no correlation was found between skills and history of heart attack or willingness to perform CPR[12].

Similarly, the sixth article about Emergency Response Volunteers (WAGARU) based on the Kreki Application in the Coastal Tourism Area of Bengkulu Beach stated that the change in knowledge before and after was very significant after participants listened to the KREKI application, with an average change of 90% from a value of 45%. The need to increase participants' knowledge about the KREKI application became a solution for partners[13]. Assistance from ordinary community members increased after the implementation of a short message delivery system containing alerts about cardiac arrest incidents and their locations to those who received them. A mobile positioning system was also developed and used as an assignment function, where this system detects the location of trained laypersons in real time and sends alerts[14].

The seventh article, titled Smartphone-Derived Seismocardiography: Robust Approach for Accurate Cardiac Energy Assessment in Patients with Various Cardiovascular Conditions, validates the potential of SCG acquisition derived from smartphones in providing reproducible SCG metrics for telemedicine, thereby laying the foundation for future research to improve the accuracy of home-based cardiac data acquisition. This is supported by the eighth article, Effectiveness of Rescue Me CPR! Smartphone App Providing Real-Time Guidance to Untrained Bystanders Performing CPR (Heliyon). The study showed that for all metrics studied, except for the time to first compression, CPR performed by individuals using the RMC app was statistically equivalent or superior to CPR performed by certified CPR individuals, and in almost all metrics, superior to CPR performed by users of the most downloaded Android CPR guide app, PG-CPR. This is further strengthened by the ninth article, Effect of Smartphone Applications on Cardiopulmonary Resuscitation Quality Metrics in a Mannequin Study: A Randomized Trial. This study demonstrated that the average chest compression rate and the percentage of compressions with adequate depth increased with smartphone app usage, and these results persisted for up to 3 months[15–17].

Empowering laypeople to perform CPR is one of the efforts to shorten the time to receive basic life support for out-of-hospital cardiac arrest patients. However, not all ordinary people around the victim have the necessary skills[18]. Rapidly advancing technology allows the use of mobile phone features to help improve the speed and quality of first aid. Considering that cardiac arrest requires quick action to save the patient, the use of devices should not delay the initiation of CPR. Findings from several studies discuss the weaknesses of the applications or hardware used, causing users to experience difficulties in operating them, which leads to delays in providing first aid. There are also challenges related to device placement during CPR, which have been addressed by shifting the function to wearable devices such as smartwatches. Extension equipment and automatic sensors connected to smartphones need to be developed to facilitate CPR delivery. The use of location detection features has the potential to enhance CPR by trained lay volunteers.

However, existing research is still limited, making it difficult to determine its

effectiveness. The use of a nearest helper recruitment system becomes important, especially in areas that are difficult for emergency services to reach quickly. This aims to shorten the no-flow time. There are several limitations in this systematic review. The first limitation is that to understand the overall development of smartphone technology, we included quantitative studies, including non-experimental research. This selection impacts the quality of the articles reviewed.

Conclusion

An Android-based application enhances the ability to provide first aid for cardiopulmonary resuscitation (CPR). The functions of smartphones include improving the quality of first aid CPR provided by laypeople and accelerating the delivery of CPR. However, further research is still needed, particularly to ensure the quality of devices and supporting communication systems, so as to avoid delays in providing first aid CPR. In addition, the development of a trained responder assignment system using location detection is necessary. For future systematic reviews, it is important to examine the specific functions of Android-based first aid CPR applications to determine their effectiveness.

The development of Android-based application technology on smartphones to improve the ability to perform first aid CPR requires collective attention to ensure successful implementation. This includes: (1) the need for government policies to support the implementation of Android-based applications such as smartphone apps to assist with CPR efforts in order to improve the health of heart disease patients independently; (2) the readiness of human resources, not only healthcare workers but also the involvement of families and patients; (3) the provision of affordable, adequate Android-based application technology on smartphones that is accessible to all levels of society, easy to understand, and easy to implement; (4) the necessity of good cooperation between the government, technology providers, healthcare professionals, and the community.

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