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The effectiveness of smartphone applications as an effort to improve cardiopulmonary resuscitation (CPR) : Literatur review

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ABSTRAK

Latar Belakang : *Henti jantung merupakan kegawatdaruratan yang mengancam jiwa. Henti jantung harus segera mendapatkan penanganan cepat dan tepat melalui pemberian Resusitasi Jantung Paru (RJP). Dalam melakukan RJP dibutuhkan mental dan pengetahuan. Pengetahuan materi didapatkan dari media yang mudah diakses siapapun seperti aplikasi yang berisi tentang RJP pada smartphone.*
Tujuan : *Untuk melakukan analisis dan menilai kualitas artikel tentang efektivitas aplikasi smartphone sebagai upaya meningkatkan resusitasi jantung paru (RJP).*
Metode : *Pencarian artikel menggunakan database elektronik Pubmed dan Science Direct. Pencarian artikel yang digunakan yaitu 10 tahun terakhir dengan kata kunci "Telenursing OR Telehealth OR Smartphone", AND "Cardiopulmonary OR Cardiac Arrest".*
Hasil : *Hasil 6 dari 13 artikel menerapkan desain penelitian dengan RCT, artikel lainnya menerapkan jenis penelitian retrospektif, studi observasi prospektif, dan A mixed-methods evaluation study. Hasil telaah artikel didapatkan fungsi fitur smartphone meliputi laporan kasus henti jantung dan aplikasi berbasis pembelajaran mengenai RJP. 1 dari 13 artikel menjelaskan fungsi fitur laporan melalui SMS base system notification. Artikel lainnya membahas fitur pembelajaran RJP dengan instrument video conferencing audio telephone calls, Resusci Anne Skillreporter manikin, Laerdal skillreporting system V.2.2.1 software, penggunaan U-CPR, The VADSS software application, Laerdal resusci-anne simulator, A SimMan simulator (Laerdal, Stavanger, Norway) and cardiac arrest simulation test score, pedoman uji kesesuaian bantuan hidup dasar dan system usabillity scale (SUS), video instruksi Dispatcher-assisted CPR dan kualitas CPR, serta CPR manikins and resuscitation council (UK)-endorsed lifesaver VR.*
Kesimpulan : *Smartphone telah dikembangkan dan digunakan dengan baik dalam pemberian RJP oleh negara-negara yang telah terbangun sistem informasi. Selain itu, fitur smartphone mampu meningkatkan kualitas CPR, pemberikan CPR orang awam, dan mempercepat akses CPR. Namun demikian, diperlukan penelitian yang lebih lanjut dalam memastikan kualitas smartphone serta sistem sistem komunikasi yang mendukung agar tidak terjadi penundaan pemberian RJP.*

KATA KUNCI : *smartphone; resusitasi jantung paru; gagal jantung*

ABSTRACT

Background : *Cardiac arrest is a life-threatening emergency. Cardiac arrest must immediately get fast and appropriate treatment through the provision of Cardio Pulmonary Resuscitation (CPR). Doing CPR requires mental and knowledge. Material knowledge is obtained from media that is easily accessible to anyone, such as applications that contain CPR on smartphones.*

Objectives : *To analyze and assess the quality of articles about the effectiveness of smartphone applications as an effort to improve cardiopulmonary resuscitation (CPR).*
Methods : *Article search using the Pubmed and Science Direct electronic databases. The search for articles used was the last 10 years with the keywords "Telenursing OR Telehealth OR Smartphone", AND "Cardiopulmonary OR Cardiac Arrest".*
Results : *Results 6 of 13 articles applied the research design with RCTs, the other articles applied retrospective, prospective observation studies, and A mixed-methods evaluation study. The results of the article review show that smartphone feature functions include reports of cardiac arrest cases and learning-based applications regarding CPR. 1 of 13 articles describes the function of the report feature via SMS base system notification. Other articles discuss CPR learning features with video conferencing audio telephone calls instruments, Resusci Anne Skillreporter manikin, Laerdal skillreporting system V.2.2.1 software, use of U-CPR, The VADSS software application, Laerdal resusci-anne simulator, A SimMan simulator (Laerdal, Stavanger, Norway) and cardiac arrest simulation test score, guidelines for basic life support suitability test and system usability scale (SUS), video instructions for Dispatcher-assisted CPR and CPR quality, and CPR manikins and resuscitation council (UK)-endorsed lifesaver VR.*
Conclusions : *Smartphones have been well developed and used in providing CPR by countries that have developed information systems. In addition, the smartphone feature can improve the quality of CPR, provide layperson CPR, and speed up CPR access. However, further research is needed to ensure the quality of the smartphone and the communication systems that support it so that there is no delay in administering CPR*

KEYWORD *: smartphones; cardiopulmonary resuscitation; cardiac arrest*

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INTRODUCTION

Heart and blood vessel disease is one of the causes of death in Indonesia. One of the medical emergencies in heart disease is cardiac arrest or what is often called *Cardiac Arrest.* Cardiac Arrest or *Cardiac Arrest* (1). This can occur due to the sudden failure of the heart function in pumping blood throughout the body and brain. So that patients with a heart have *a golden time* of 10 minutes which must be immediately given action in the form of Cardiopulmonary *Resuscitation* (CPR) (2). There are several articles which state that there are several factors that can affect the quality of CPR administration such as the fatigue factor and the speed and accuracy of chest compressions by rescuers to patients. To help emergency cardiac arrest requires mental and material readiness. Therefore, a facility is needed to make it easier for helpers to deepen their knowledge of CPR, namely through a *smartphone application* (3). This is the author's interest in conducting *a literature review* with the formulation of the problem "how is the effectiveness of *smartphone applications* as an effort to improve cardiopulmonary resuscitation

(CPR)?".The general objective of this literature review is to analyze and assess the quality of articles on the effectiveness of smartphone applications as an effort to improve cardiopulmonary resuscitation (CPR). While the specific aim of this research is to synthesize articles related to procedures and explain the effectiveness of smartphones as an effort to improve cardiopulmonary resuscitation (CPR).

MATERIALS AND METHODS

Literature Search Strategy

The research design used was the *literature review method* with article selection referring to the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA). As a framework, the authors formulate a PICO before conducting *a literature review* to help make it easier to search for relevant clinical articles. The PICO formulation in this writing article is:

P	:	Patients who experience *cardiac arrest / Society*
I	:	Interventions used via cell phones or *smartphones*
C	:	-
O	:	Improved Cardio Pulmonary Resuscitation (CPR)

The article search stage was carried out systematically using keywords *and* Boolean Operators (OR, AND, NOT) which were written manually or using the search facilities available in each of the *PubMed and ScienceDirect databases .* The keywords used in the search for articles are ("Telenursing" OR Telehealth OR "Smartphone") AND ("Cardio-pulmonary" OR "Cardiac Arrest"). With the inclusion criteria in writing this *literature* review, namely articles that use cellphones or *smartphones* as intervention media, articles published in the last 10 years (from 2012 – 2022), and articles available in *full text form* . While the exclusion criteria in writing *a literature review* consisted of articles that could not be accessed and articles other than using English.

Study Selection (PRISMA)

Article search was carried out by following the PRISMA flow which consisted of the stages of identification, screening, article *eligibility* , and articles included in *the review.* The author conducted an article search on two databases, namely Sciencedirect and PubMed. All article search results were put together and identified as many as 1092 articles. After identifying the total number of articles, the author checks for duplicate titles automatically using the *Mendeley application.* The number of duplicate titles was 3 articles, so that the number of articles that entered the screening stage was 1089 articles. Furthermore, the authors perform manual checking and filtering. A total of 629 articles could not be accessed and then deleted in the search process so that the remaining 460 articles. Then, articles were screened again for abstract screening and

420 articles were found that were irrelevant and did not meet the inclusion criteria. The number of articles studied was 40 articles and re-checked based on exclusion criteria and the result was that 27 articles were excluded in screening and searching. Therefore, as many as 13 articles met the criteria for *review* . The article search flow can be seen as below :

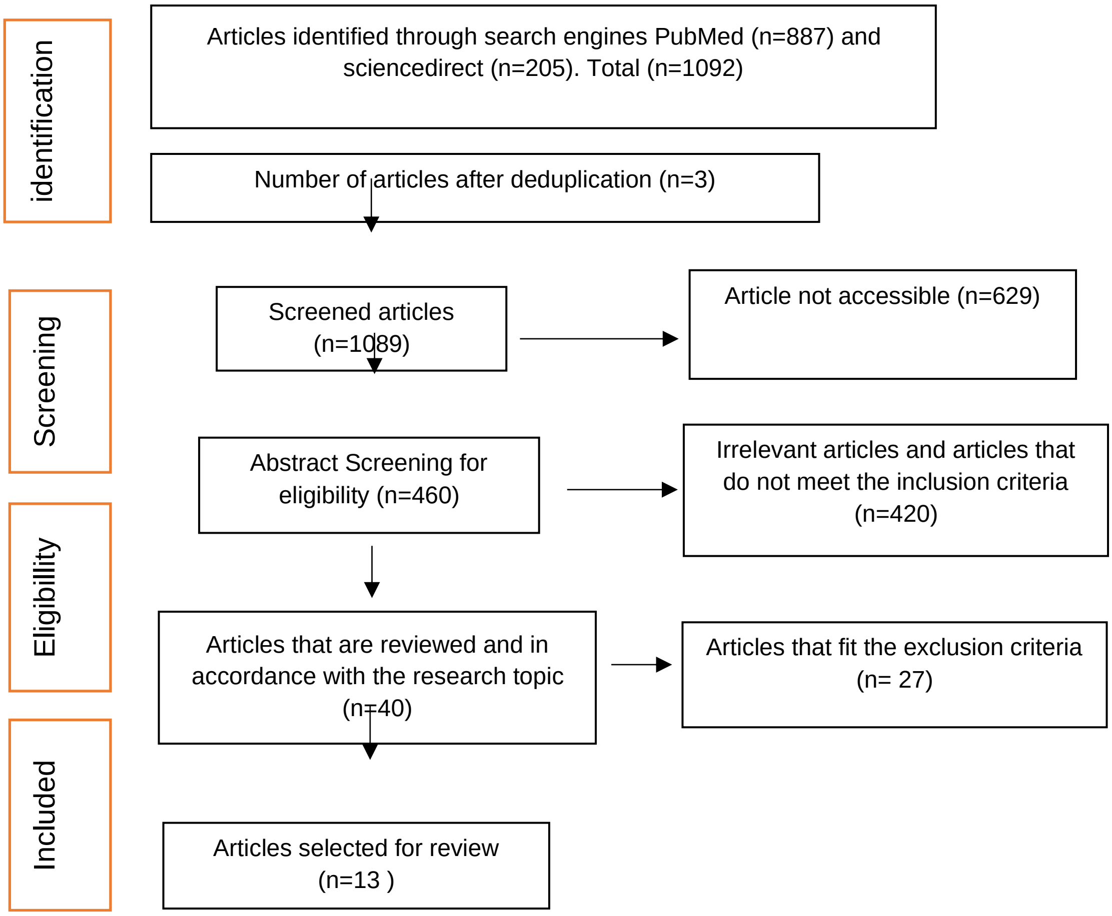

Figure 1. 1of article selection for *literature review* based on PRISMA

RESULTS AND DISCUSSION

RESULTS

The search results from various literatures obtained a total of 1092 articles, then through a series of selections, 13 articles were found that matched the criteria. It was found that 6 out of 13 articles applied the research design with RCT, then other articles applied this type of research in the form of retrospective, prospective observational studies, and *A mixed-methods evaluation study.* The results of the article review found that the *smartphone function* consisted of a cardiac arrest case report feature and learning-based features or applications regarding CPR 1 of 13 articles explained the function of the report feature via SMS base *system notification.* While other articles discuss the features of learning CPR with instruments such as *video conferencing audio telephone calls* , Resusci Anne Skillreporter manikin, Laerdal skillreporting system V.2.2.1 software, use of U-CPR, The VADSS software application, Laerdal resusci-anne simulator, A SimMan simulator (Laerdal, Stavanger, Norway) and cardiac arrest simulation test score, basic life support suitability test guide and system usability scale (SUS), Dispatcher-assisted CPR and CPR quality instructional videos, and CPR manikins and resuscitation council (UK)- endorsed lifesaver VR.

Table 1. The results of the review of the selected articles

Title	Instrument	Results
The use of dispatcher assistance in improving the quality of cardiopul-monary resuscitation: A randomized controlled trial (4)	Laedral resusci anne manikins	Most DA+ participants achieved proper compression levels (34.4% vs 18.1%, p<0.001). There was no difference in the other main results. A subgroup analysis revealed that health professionals in DA + had a higher proportion of correct hand locations compared to DA - (82.1% vs. 53.5%, p<0.05). There was no significant difference in CPR quality among laypeople with valid CPR certification regardless of whether they received DA
long-term effect of face to face vs virtual reality cardiopulmonary resus-citation (CPR) training on willingness to perform CPR, Retention of know-ledge, and dissemi-nation of CPR Awareness (5)	CPR manikins and resuscitation council (UK)-endorsed lifesaver VR smart-phone application with pillow to practice compressions	The overall proportion of participants willing to perform CPR on strangers was 77% (144 of 188): 81% (79 of 97) among face-to-face participants and 71% (65 of 91) among VR participants (P = 0.02) ; 103 participants (55%) reported being afraid to perform CPR (P = 0.91). Regarding retention of theoretical knowledge, the median of 7 (IQR, 6-8) of 9 questions was answered correctly in both groups (P = 0.81). Regarding CPR awareness raising, 65% of participants (123 of 188) told at least 1 to 10 family members

		or friends about the importance of CPR, and 15% (29 of 188) had participated in certified instructor-led training at the time of the survey, without distinction between groups.
live video from bystanders' smart-phones to improve cardiopulmonary resuscitation (6)	Dispatcher-assisted CPR instructional videos and CPR quality	CPR was delivered by live video streaming in 52 OHCA calls, with 90 bystanders performing chest compressions. Hand position was incorrect for 38 bystanders (42.2%) and improved for 23 bystanders (60.5%) after video-instructed DA-CPR. The compression rate was wrong for 36 viewers (40.0%) and increased to 27 viewers (75.0%). The compression depth was wrong for 57 observers (63.3%) and increased for 33 observers (57.9%). Adjusted odds ratios for increased CPR after video-instructed DA-CPR were; hand position 5.8 (95% CI: 2.8–12.1), compression degree 7.7 (95% CI: 3.4–17.3), and compression depth 7.1 (95% CI: 3.9–12.9). Hands-o time was reduced for 34 (37.8%) observers.
Smartphone apps for cardiopulmonary resus-citation training and real incident support: A mixed-methods evaluation study (7)	Two experts used eight test sessions. Ordinary users use the system usability scale (SUS)	Of the 61 applications, 46 were included in the expert evaluation. The consolidated list of 13 applications is followed by a layman's evaluation. Reliability between raters is quite large (kappa = 0.61). End users, namely lay people (n=14) had high interrater reliability (intraclass correlation [ICC1]=.83, P<.001, 95% CI 0.75-0.882 and ICC2=.79, P<.001, 95% CI 0.695-0.869). The final evaluation results show 5 recommended applications, namely CPR & Choking, FDNY Lofesaver Beta V1.0, Hands-Only CPR, Leben retten, and Reanimatie.
Evaluation of smartphone	15 medical experts and 15 lay people.	Of the 79 selected applications, five applications were included and analyzed. For

applications for cardiopulmonary resuscitation training in south korea (8)	Guidelines for basic life support suitability testing and system usability scale (SUS)	suitability (ICC, 0.95, p < 0.001), the average of all applications was greater than 12 out of 20 points, indicating that they were well designed according to current guidelines. Three out of five apps scored an acceptable level (greater than 68 out of 100 points) for learnability/usability
A randomized control trial to determine if use of the iResus application on a smart phone improves the performance of an advanced life support provider in a simulated medical emergency (9)	A SimMan simulator (Laerdal, Stavanger, Norway) and cardiac arrest simulation test score	The primary outcome measure was the overall cardiac arrest simulation test score; this was significantly higher in the smartphone group (median (IQR [range]) 84.5 (75.5–92.5 [64–96])) compared to the control group (72 (62–87 [52–95]); p = 0.02). Use of the iResus app significantly improves the performance of an advanced life support certified doctor during a medical emergency simulation.
Exploration of the impact of a voice activated decision support system (VADSS) with video on resuscitation performance by lay rescuers during simulated cardiopulmonary arrest (10)	The VADSS software application, Laerdal resuscitation simulator	31 subjects were enrolled (VADSS 16 vs control 15), with no significant differences in baseline characteristics. Study subjects at VADSS were more likely to direct observers to: (1) perform compressions to ventilations at the correct ratio of 30:2 (VADSS 15/16 (94%) vs control 15/4 (27%), p=<0.001) and (2) observer switch compressor urge versus ventilator role after 2 minutes (VADSS 16/12 (75%) vs control 2/15 (13%), p=0.001). The VADSS group took longer to start chest compressions than the control group: VADSS 159.5 (±53) seconds versus the control 78.2 (±20) seconds, p<0.001. Mean no-flow fraction was very high in both groups: VADSS 72.2% (±0.1) compared to control 75.4 (±8.0), p=0.35.
mobile-phone dispatch of laypersons for CPR	not explained	A total of 5989 lay volunteers trained in CPR were recruited initially, and a total of 9828

in Out-of-hospital cardiac arrest (11)		were recruited during the study. The mobile phone positioning system was activated in 667 out-of-hospital cardiac arrests: 46% (306 patients) in the intervention group and 54% (361 patients) in the control group. Bystander-initiated CPR rates were 62% (188 of 305 patients) in the intervention group and 48% (172 of 360 patients) in the control group (absolute difference for intervention vs. control, 14 percentage points; 95% confidence interval, 6 to 21;P<0.001).
patient plus partner trial: A randomized control trial of two interventions to improve outcomes following an initial implantable cardioverter defibrillator (12)	physical function (general health), psychological adjustment (anxiety and depression), dyadic adjustment, care giver burden, self-efficacy, and utilization of health services	For patients, P+P compared to P Only was more effective in improving symptoms (P=0.02), depression (P=0.006), self-efficacy (P=.02), outcome expectations (P=0.03), and knowledge (P = 0.07). For couples, P+P was more effective in increasing the burden on partner caregivers (P=0.002), self-efficacy (P=0.001) and ICD knowledge (P=0.04).
effectiveness of chest compression feedback during cardiopulmonary resuscitation in lateral tilted and semirecumbent positions: a randomized controlled simulation study (13)	use of U-CPR (a metronome application and visual feedback of chest compression depth and rate based on an android application), Laerdal medical UK (measuring compression depth)	Feedback devices do not affect the quality of chest compressions in the supine position, but improve performance aspects in the supine position. In the lateral lateral position, median chest compression rate (IQR [range]). is 99 (99–100 [96–117]) compressions.min 1 with and 115 (95–128 [77–164]) compressions.min 1 without feedback (p = 0.05), and the correct proportion of compressions is depth was 55 (0–96 [0–100])% with and 1 (0–30 [0–100])% without feedback (p = 0.03). In the semi-recumbent position, the proportion of true compression to depth was 21 (0–87 [0–100])% with and 1 (0–26 [0–100])% without

		feedback (p = 0.05). Female participants applied chest compressions at a more accurate rate using a feedback device in the oblique position but were unable to increase the depth of chest compressions, whereas male participants were able to increase the strength of chest compressions using a feedback device in the side-tilt and half-lying positions. . We conclude that the feedback device improves the application of chest compressions during simulated cardiopulmonary resuscitation when the chest is tilted.
comparison of the effectiveness of cardiopulmonary resus-citation with standard manual chest compres-sions and the use of TrueCPR and PocketCPR feedback devices (14)	effectiveness of chest compressions (compression depth, compression duration, hand position)	Comparison of SMCC, TrueCPR and PocketCPR shows differences in effectiveness of chest compressions (40.3%, 85.5% and 28.8%, respectively), compression depth (49.5, 56.5 and 50.3 mm, respectively)), and compression rate (118.5, 105.1, and 89.5 min-1, respectively).
lay persons alerted by mobile application system initiated earlier cardiopulmonary resus-citation: A comparisons with SMS-based system notification (15)	SMS or APP-based messaging	during the study period 539 OHCA had occurred. notifications to first responder networks were sent via sms in 198 cases and via mobile app in 134 cases. The median arrival time of first responders/lay responders at the scene is significantly reduced by the application-based system compared to the SMS-based system. the proportion of lay responders who arrived first on the scene increased significantly (70% vs 15%, p<0.01) with the application. earlier arrival of first responders or lay responders determines higher survival rates.

Interactive video conferencing versus audio telephone calls for dispatcher-assisted cardiopulmonary resuscitation using the ALERT algorithm: A randomized trial (16)	Resusci Anne Skillreporter manikin, Laerdal skillreporting system V.2.2.1 software	The mean rate of chest compressions was higher in the v-CPR group (v-CPR: 110 ± 16 vs. t-CPR: 86 ± 28; P < 0.0001), whereas depth was comparable between the two groups (v-CPR: 48 ± 13 vs. t-CPR: 47 ± 16 mm; P = 0.64). Hand positioning was correct in 91.7% with v-CPR, but only 68% with t-CPR (P = 0.001). There were almost no 'hands off' periods in the v-CPR group [v-CPR: 0 (0–0.4) vs. t-CPR: 7 (0–25.5) seconds; P < 0.0001], but the mean no-flow time was increased in the v-CPR group [v-CPR: 146 (128–173.5) vs. t-CPR: 122 (105–143.5) seconds, P < 0.0001]. The overall score of CPR Performance improved in the v-CPR group (P < 0.001).

DISCUSSION

According to *the World Health Organization* (2017) Cardiac arrest is one of the biggest causes of death in the world. 85% of people with cardiovascular disease die from heart attacks and strokes (17). Cardiac arrests that often occur outside health facilities require immediate action to save lives (18). So first aid is very important to do to prevent brain damage , considering that *the golden period* is done within 6-10 minutes. Quick and appropriate assistance greatly affects the safety of the victim's soul.

One of the simple skills in an effort to provide help for those who are having a heart attack is BLS, a basic training that everyone must have in order to be able to perform Cardio Pulmonary Resuscitation (CPR) immediately when they see or find someone who has a cardiac arrest before medical assistance arrived (19). Along with the times and technology, BLS training is growing by utilizing multimedia in providing knowledge. Providing education through certain media has its own influence on a person's ability to absorb information, especially *Android*-based *mobile appli-cations*. *Android*-based *mobile* appli-cations can provide information quickly and easily because they can be used anywhere and can be accessed at any time (19).

Rapidly developing technology allows the use of mobile phone features to help increase the speed and quality of first aid. 1 of 13 articles describes the function of the feature or application in the form of a cardiac arrest case report, namely research conducted by Caputo et al. (2017) (21) that using features on *smartphones* in the form of an SMS *base system notification* can determine a high survival rate because layman respondents arrive early to help patients with cardiac arrest. This is in accordance with research conducted by Simangunsong & Herawati (2021) (22) which states that *smartphones* have functions including being able to improve CPR quality, provide CPR by lay people, and speed up CPR administration. While the other 12 articles explain the function of the application for learning about how to apply good and correct CPR. This is in accordance with the results of a review of articles regarding the applications used during the research conducted by Kalz et al. (2014) (7) such as the CPR & Choking application, FDNY Lofesaver Beta V1.0, Hands-Only CPR, Leben retten, and Reanimatie. In addition, other learning applications include The VADSS software application and the Laerdal resuscitation simulator (10).

Mobile learning is a learning method with *a smartphone* as a device *device* main. Android *(smartphone)* is a media that is quite easy to use because it is more interesting seen from various aspects, namely aspects of images, videos and colors, writing on Android media that is easier to read, language that is easy to understand even though the amount of material is smaller compared to *websites* (3). This material can be in the form of giving chest compressions and breathing assistance. Cardiopulmonary resuscitation is useful for maintaining blood oxygenation and tissue perfusion which aims to repair the heart so that it can increase the patient's chance of survival. Important components in performing CPR are compression depth, compression rate, ventilation, *return of spontaneous circulation* (ROSC) and minimizing interruptions (23). In addition, material can be added and loaded in a *smartphone application* , which is a simu-lated action regarding *the chain of survival.* The first chain is to immediately detect the patient's condition and ask for help *(early access), the second chain is early* cardiopulmonary resuscitation(CPR), the third chain is *early defibrillation,* the fourth chain is immediate advanced cardiac life support. *(early advanced cardiovascular life support),* and the fifth chain is *post cardiac arrest care* (24). Therefore, the use of this *smart-phone application* is very effective when used to disseminate information on handling *out of hospital cardiac arrest* (OHCA) through cardiopulmonary resuscitation performed by lay people.

CONCLUSIONS AND RECOMMENDATION

Smartphones have been developed and widely used in administering CPR, especially in countries with well-developed information systems. In addition, *smartphones* also have functions that include improving the quality of CPR, providing CPR by lay people, and speeding up CPR administration. Besides that, further research is still needed, especially in ensuring the quality of *smartphones* and communication systems that support it so that there is no delay in giving CPR.

REFERENCES

1. Hidayati R. Tingkat Pengetahuan Masyarakat Tentang Penanganan Henti Jantung di Wilayah Jakarta Utara. NERS J Keperawatan. 2020;16(1):10.
2. Buston E, Putri AADP, Ikhwan M, Pitaloka M. Pengaruh Poster Terhadap Peningkatan Pengetahuan Jantung Jurusan Keperawatan , Poltekkes Kemenkes Bengkulu , Jalan Indragiri Nomor 03 Henti jantung (Cardiac Arrest) merupakan keadaan dimana hilangnya fungsi jantung untuk memompa darah yang terjadi secar. Mahakam Nursing Journal. 2020;2(7):279–285.
3. Eko LD, Setianingsih. Peningkatan Pengetahuan Orang Awam Tentang Penanganan Out Of Hospital Cardiac Arrest Melalui Aplikasi Resusitasi Jantung Paru Pada Smartphone Improvement Of Knowledge People About Handling Out Of Hospital Cardiac Arrest Through The Application Of Lung Hea. Jurnal Ilmiah STIKES Kendal. 2020;10(1):97–102. DOI: https://doi.org/10.32583/pskm.v10i1.620
4. Teo MHN, Wong WEJ, Daniel PC-YN, Kweh RHC, Ho RYJ, Koh JH, et al. The use of dispatcher assistance in improving the quality of cardiopulmonary resuscitation: A randomised controlled trial. Resuscitation [Internet]. 2019;138:153–9. Available from: https://www.sciencedirect.com/science/article/pii/S0300957219300668
5. Nas J, Thannhauser J, Konijnenberg LSF, van Geuns R-JM, van Royen N, Bonnes JL, et al. Long-term Effect of Face-to-Face vs Virtual Reality Cardiopulmonary Resuscitation(CPR) Training on Willingness to Perform CPR, Retention of Knowledge, and Dissemination of CPR Awareness: A Secondary Analysis of a Randomized Clinical Trial. JAMA Netw open. 2022 May;5(5):e2212964. DOI: 10.1001/jamanetworkopen.2022.12964
6. Linderoth G, Rosenkrantz O, Lippert F, Østergaard D, Ersbøll AK, Meyhoff CS, et al. Live video from bystanders' smartphones to improve cardiopulmo-

nary resuscitation. Resuscitation. 2021;168:35–43. DOI: 10.1016/j.resuscitation.2021.08.048

7. Kalz M, Lenssen N, Felzen M, Rossaint R, Tabuenca B, Specht M, et al. Smartphone apps for cardiopulmonary resuscitation training and real incident support: A mixed-methods evaluation study. Journal Medical Internet Research. 2014;16(3):1–15. DOI: 10.2196/jmir.2951
8. Ahn C, Cho Y, Oh J, Song Y, Lim TH, Kang H, et al. Evaluation of Smart-phone Applications for Cardio-pulmonary Resuscitation Training in South Korea. Biomed Research International. 2016;2016. DOI: 10.1155/2016/6418710
9. Low D, Clark N, Soar J, Padkin A, Stoneham A, Perkins GD, et al. A randomised control trial to determine if use of the iResus© application on a smart phone improves the performance of an advanced life support provider in a simulated medical emergency. Anaesthesia. 2011;66(4):255–62. DOI: 10.1111/j.1365-2044.2011.06649.x
10. Hunt EA, Heine M, Shilkofski NS, Bradshaw JH, Nelson-McMillan K, Duval-Arnould J, et al. Exploration of the impact of a voice activated decision support system (VADSS) with video on resuscitation performance by lay rescuers during simulated cardiopulmonary arrest. Emerg Med J. 2015;32(3):189–94. DOI: 10.1136/emermed-2013-202867
11. Ringh M, Rosenqvist M, Hollenberg J, Jonsson M, Fredman D, Nordberg P, et al. Mobile-phone dispatch of laypersons for CPR in out-of-hospital cardiac arrest. New England Journal of Medicine. 2015 Jun;372(24):2316–25.DOI: 10.1056/NEJMoa1406038
12. Dougherty CM, Thompson EA, Kudenchuk PJ. Patient plus partner trial: A randomized controlled trial of 2 interventions to improve outcomes after an initial implantable cardioverter-defibrillator. Hear Rhythm. 2019 Mar;16(3):453–9. DOI: 10.1016/j.hrthm.2018.10.011
13. Ahn C, Lee J, Oh J, Song Y, Chee Y, Lim TH, et al. Effectiveness of feedback with a smartwatch for high-quality chest compressions during adult cardiac arrest: A randomized controlled simulation study. PLoS One. 2017;12(4):e0169046.
14. Kurowski A, Szarpak Ł, Bogdañski Ł, Zaško P, Czyzewski Ł. Comparison of the effectiveness of cardiopulmonary resuscitation with standard manual chest compressions and the use of True CPR and Pocket CPR feedback devices. Kardiol Pol. 2015;73(10):924–30. DOI: 10.5603/KP.a2015.0084
15. Caputo N, Azan B, Domingues R, Donner L, Fenig M, Fields D, et al. Emergency Department use of

Apneic Oxygenation Versus Usual Care During Rapid Sequence Intubation: A Randomized Controlled Trial (The ENDAO Trial). Academic Emergency Medicine. 2017 Nov;24(11):1387–94. DOI: 10.1111/acem.13274
16. Stipulante S, Delfosse AS, Donneau AF, Hartsein G, Haus S, D'Orio V, et al. Interactive videoconferencing versus audio telephone calls for dispatcher-assisted cardiopulmonary resuscitation using the ALERT algorithm: A randomized trial. European Journal Emergency Medicine. 2016;23(6):418–24. DOI: 10.1097/MEJ.0000000000000338
17. Barbara L. Penggunaan Smartphone Dalam Upaya Peningkatan Resusitasi Jantung Paru: Sebuah Systematic Review. Jurnal Keperawatan Widya Gantari Indonesia. 2019;3(2):45.
18. An M, Kim Y, Cho WK. Effect of smart devices on the quality of CPR training : A systematic review. Resuscitation [Internet].2019;144(July):145–56. Available from: https://doi.org/10.1016/j.resuscitation.2019.07.011
19. Maghfirah, Veri N, Mutiah C, Dewita, Wahyuni S, Madani B, et al. Pengembangan Video Basic Life Support Terhadap peningkatan Keterampilan Warga Desa Paya Bujuk Beuramo, Kecamatan Langsa Barat, Kota Langsa. Jurnal Penelitian Kesehatan 2022;13(April):562–7. DOI: http://dx.doi.org/10.33846/sf13254
20. Caputo ML, Muschietti S, Burkart R, Benvenuti C, Conte G, Regoli F, et al. Lay persons alerted by mobile application system initiate earlier cardio-pulmonary resuscitation: A comparison with SMS-based system notification. Resuscitation. 2017;114:73–8. DOI: 10.1016/j.resuscitation.2017.03.003
21. Simangunsong W, Herawati T. Efektifitas Aplikasi Smartphone Dalam Upaya Peningkatan Resusitasi Jantung Paru. Jurnal Inovasi Penelitian. 2021;2(7):2221–9.
22. Kusumawati PD, Jaya AWD. Efektifitas Simulasi Resusitasi Jantung Paru Terhadap Kemampuan Penatalaksanaan Resusitasi Jantung Paru Anggota Brimob. Jurnal Ilmiah Ilmu Keperawatan Indonesia. 2019;9(04):667–72. DOI: https://doi.org/10.33221/jiiki.v9i04.355
23. Riskesdas. Laporan Nasional Riskesdas. Badan Penelitian dan Pengembangan Kesehatan. 2018. p. 674. http://labdata.litbang.kemkes.go.id