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**Review**

**Improving Cardiopulmonary Resuscitation skills for layperson in cases of heart attack: a scoping review**

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**Running title:** Improving CPR skills for layperson

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**Significance for public health**: Using technology as an educational medium offers numerous advantages, particularly its accessibility to the general populace. Employing technology to learn essential life support can enhance lay people's understanding of first aid; refining skills necessitates simulation-based learning. Thus, integrating technology and simulation-based learning approaches proves efficacious in enhancing lay individuals' knowledge and skills in administering essential life support during cardiac arrest.

**Abstract**

The proficiency of trained individuals in effectively administering Cardiopulmonary Resuscitation (CPR) is paramount in mitigating the impact of out-of-hospital cardiac arrest incidents. Inadequate CPR skills among laypersons can result in missed opportunities to save lives. Therefore, it is imperative to prioritize unified efforts to enhance CPR competencies within the general populace. This scoping review aims to consolidate literature discussing the enhancement of laypeople's CPR skills using various methodologies.

This scoping review employed the PRISMA methodology and encompassed an extensive search across four critical databases (Science Direct, Proquest, Pubmed, and Google Scholar) for literature published between 2013 and 2023. The search utilized the keywords "CPR Teaching," "Skill," and "Layperson." Out of 487 collected articles, 20 were deemed relevant. The findings of all relevant articles consistently indicated an improvement in laypeople's CPR skills following training.

Incorporating concise CPR instructional videos and smartphone applications has shown potential for enhancing CPR knowledge and improving emergency responsiveness. Nonetheless, integrating these modern technological approaches with traditional simulation methods has demonstrated greater efficacy in CPR training, resulting in enhanced compression quality and depth.

In conclusion, Integrating traditional and technology-based learning methodologies improves the capability of individuals without specialized medical training to administer CPR effectively.

**Introduction**

Cardiopulmonary Resuscitation (CPR) is a crucial component in the chain of survival for individuals experiencing out-of-hospital cardiac arrest.[1] Presently, nearly 80% of cardiac arrests occur outside of hospital settings, with 30-50% of victims in the United States receiving CPR directly from lay members of the public.[2] The active involvement of laypersons in delivering initial aid to out-of-hospital cardiac arrest (OCHA) victims has been demonstrated to elevate the rate of CPR administration before the arrival of emergency services at the scene. Multiple prehospital systems utilized by laypersons for treating out-of-hospital cardiac arrest victims globally, including in Indonesia, adhere to the guidelines established by the American Heart Association (AHA) and the Emergency Response Commander (ERC).[3] Laypersons hold a significant role as first aid providers in cases of out-of-hospital cardiac arrest. However, the current participation of laypersons in performing CPR remains low due to insufficient knowledge and skills in first aid.[4] Additionally, limited knowledge and skills can undermine the confidence of lay individuals in delivering CPR.[5]

The acquisition of CPR skills aims to sustain circulation and heart function, ultimately enhancing patient prognosis and reducing morbidity and mortality rates in cardiac arrest cases.[6] Various methods exist to enhance laypersons' CPR proficiency.[7] The simulation-based approach and instructor guidance stand out as a commonly employed technique.[8] While effective, this method demands face-to-face training, qualified instructors, and substantial equipment, presenting challenges such as limited instructor availability, high training costs, and the need for numerous props, including mannequins.[9,10]

In addition to simulation-based training, technology-based methods, such as videos and applications, offer an alternative for enhancing layperson CPR skills.[11] The development of CPR applications for smartphones opens up convenient and flexible learning opportunities, with the potential to significantly improve CPR education.[10] While its effectiveness in skill improvement remains to be determined, the integration of technological methods with conventional training, as advocated by international resuscitation guidelines, offers a hopeful future for CPR education.[12] This combined approach not only offers cost savings but also capitalizes on the prevalent use of

technology among laypersons, thereby increasing the potential for technology-based CPR education.[13,14]

Furthermore, study have shown that a combined approach involving technological and conventional methods yields comparable compression quality to traditional methods while enhancing laypersons' awareness and skill acquisition in delivering first aid during cardiac arrest incidents.[10] Given the documented low proficiency in layperson-performed CPR, a hybrid approach encompassing technological methods and conventional training is essential for skill enhancement and must be considered as a viable means to this end.[15]

Various research studies have indicated that integrating both technological and traditional methods can significantly improve the ability of non-professionals to perform cardiopulmonary resuscitation (CPR). Consequently, this approach is a valuable technique for enhancing the CPR proficiency of laypersons. This scoping review seeks to synthesize existing literature on improving non-professionals' cardiopulmonary resuscitation (CPR) proficiency through diverse methodologies.


**Materials and Methods**

The research employed the scoping review analysis method to compile, synthesize, and report published research aimed at enhancing layperson CPR skills, a topic of great interest to our audience of researchers, educators, and healthcare professionals. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines, an online electronic search was conducted across four databases: ScienceDirect, PubMed, Proquest, and Google Scholar, using the keywords "CPR Teaching," "Skill," and "Layperson."

Selection criteria included:

- Studies published within the last ten years (2013 onwards) in Indonesian or English.

- Focusing on CPR learning methods for lay people.

- Being freely accessible.

Four hundred eighty-seven articles were found across the databases, with 220 articles screened based on their titles and abstracts. Following further evaluation, 20 research publications met the criteria, as depicted in Figure 1 of the review literature search approach.

*Data Extraction and Synthesis*

The researcher collected data from selected research articles to conduct a comprehensive analysis. Subsequently, the researcher organized this data by creating a table with information such as the author's name and year of publication, research objectives, research design, research methods, research samples, research location, and research results and conclusions. After compiling this information, the researcher independently analyzed the data from each article that met the necessary criteria. The findings were then thoroughly discussed, analyzed, and concluded. For your reference, Table 1 provides a concise overview of the literature investigating methods for teaching CPR to laypeople to improve their ability to perform CPR in instances of cardiac arrest.

**Results and Discussion**

The review incorporates research articles (n=20) sourced from a range of countries, including the United States (6), India (1), Brazil (1), Sweden (1), Germany (1), Taiwan (1), Korea (1), France (1), Netherlands (1), and Indonesia (5). The predominant research approach employed quantitative methods within a randomized controlled trial framework.[16-21] The study's participant numbers varied significantly, spanning from 24 to 50,000.

*Improving CPR skills using video/audiovisual*

Based on a comprehensive review of twenty studies, it has been established that CPR training utilizing video media can significantly enhance the skills of laypersons in performing CPR. Combining video-based CPR training with hands-on practice using a mannequin has proven to be particularly effective in improving the CPR skills of ordinary individuals. Furthermore, several studies have indicated that CPR training through video media increases laypersons' sensitivity and responsiveness in real-life CPR situations, thus improving the quality and effectiveness of their CPR delivery.

Additionally, evidence from four separate studies has shown that CPR training via video media enhances laypersons' knowledge and skills, particularly regarding the quality of chest compressions. However, it should be noted that sole reliance on video-based CPR training may only partially improve

CPR skills in ordinary individuals. Independent CPR training using video guidance may primarily enhance theoretical knowledge related to CPR implementation, as per the findings of one study.

Recent research has underscored the significant impact of providing Basic Life Support (BLS) health education through video on high school students' knowledge levels. The process of watching educational videos has been identified as an effective method to foster a more nuanced understanding of basic life support, especially among laypeople. Importantly, a study has indicated that CPR training using video media is a powerful tool for enhancing public knowledge and preparedness in delivering basic life support.

Based on are view of twenty studies, learning CPR using video media can improve layperson skills in performing CPR.[6,22] Apart from that, the results of other research conducted in the United States explain that CPR training using videos combined with practice using a mannequin has been proven to improve the skills of ordinary people in carrying out CPR.[23] In three studies, CPR training using video media can increase the sensitivity of layperson to carry out CPR in real incidents, one of which is the research,[20] explaining that CPR training form layperson using video media is proven to in crease sensitivity, ability, responsiveness, speed, and depth of compression. Four other studies show that CPR training using video media is proven to be able to increase CPR knowledge and skills in laypeople (increasing the quality of compressions), such as the research[10] that explains that CPR educational videos are proven to be able to increase laypeople's knowledge about CPR.CPR training using only video media can not fully improve CPR skills in ordinary people. This is in line with research·explaining that independent CPR training using video guidance can only increase theoretical knowledge related to the implementation of CPR.[20] Apart from that, another research project (Fauzan, Kahtan, and Herman 2021) explains that there is a significant influence on the provision of Basic Life Support (BHD) health education via video on the level of knowledge of high school students.[13] Additionally, video-viewing process provides a new nuance in efforts to understand the management of basic life support, especially for laypeople.[6] Furthermore, CPR training using video media can increase public knowledge in carrying out basic life support.[4]

*Improved CPR skills by using the app*

Various research studies have underscored the effectiveness of CPR training facilitated through mobile applications in augmenting individuals' proficiency and capabilities in executing CPR. This approach has been shown to heighten the general public's preparedness to administer initial aid during instances of cardiac arrest. Moreover, it provides valuable insights into pioneering CPR training methodologies, the determinants impacting CPR performance, and its enduring influence on attitudes toward resuscitation. A study by Wirasakti in 2020 revealed that CPR training via applications substantially enhanced proficiency in chest compression speed and depth and minimized interruptions, thus ensuring the delivery of high-quality CPR. Users have expressed satisfaction with this method owing to its pragmatic nature and resource efficiency. This is consistent with previous study which showcased elevated satisfaction levels among participants in CPR training through applications. They found this learning mode to be productive without compromising the quality of chest compressions compared to traditional training methods.[5]

Metelmann recommended the use of applications as CPR training tools to enhance the CPR skills of laypersons for effective intervention during cardiac arrest. However, the study also stressed the inadequacy of relying solely on applications for CPR training. It advocated for a balanced approach that combines innovation with traditional training methods. This aligns with Blewer's research, which highlighted the need for innovative approaches, such as integrating digital systems with traditional learning methods, to address the lack of CPR skills among laypersons.[19]

Several other studies explain the effectiveness of application-based CPR training in increasing people's knowledge and skills in performing CPR. Application-based CPR training can increase awareness of lay people in providing first aid in cases of cardiac arrest. Apart from that, this training can also provide important insight into innovative CPR training methods, as well as factors that influence CPR performance and its impact on long-term attitudes towards resuscitation.[2.] Other research conducted by Wirasakti (2020) explains that training using the CPR application method affects increasing skills in performing chest compression speed, chest compression depth, and minimal interruptions of high quality[12.]

Furthermore, application-based CPR training provides satisfaction for its users due to its practical use and saving of resources required for training.This is in line with research conducted by Lee where, CPR training using the application has its own satisfaction for the training participants. This is because the learning method is effective, and in terms of training skills using the application, it is not inferior to conventional training methods in terms of the quality of chest compressions.[5] Another research was also conducted by Metelmann et al. explaining that the use of applications as a CPR learning medium is highly recommended in order to improve CPR skills in lay people so that they can provide assistance in cases of cardiac arrest.[24] Currently, using applications alone is not effective as a CPR training method. There needs to be innovation and a combination of conventional training with application-based training. This is in line with research conducted by Blewer, explaining that the skills of lay people in carrying out CPR are still low. Therefore, innovative methods are needed in the form of a combination of learning between digital systems and traditional learning (instructor's guide).[19]

***Improved CPR skills using mixed methods (simulation and technology)***

Currently, conventional training methods or simulation-based training with guidance from trained instructors are still the only standardized CPR training for both health workers and lay people. In its development, innovation in CPR learning or training is very important. This makes it easier for lay people to be able to learn easily and effectively. The role of technology in the form of applications and videos as a media for CPR learning will make it easier for people to increase their knowledge about CPR[10.] However, in improving skills, there needs to be a combination of simulation-based training with technology-based training, as explained in the previous research[9]. A combination of learning between digital systems and traditional learning (instructor guides and simulations)is needed to improve CPR skills in laypeople. Apart from that, the use of tools in the form of mannequins as training media is needed. This is in line with the previous researc·explaining that CPR training using mannequin aids can improve CPR skills and quality.[25] In addition, simulation-based training is an effective CPR learning method for lay people. The results of research conducted by Kuswanto and Suyanto explain that CPR learning using the demonstration method is effective in improving students' skills in performing basic life support[14.]

Video or audiovisual is an alternative that can be used by the public in learning CPR, this is because its use is practical and can be done anywhere. This is in line with research conducted by Panchal et al explaining that playing short CPR videos online has potential as a learning media that can be carried out in public places to help increase the response of ordinary people to performing CPR in cases of cardiac arrest.[20] Apart from that, CPR learning can be done using applications by utilizing smartphones. Developing applications on smartphones makes it easier for people to learn CPR at any time. However, this convenience does not necessarily improve the skills of ordinary people in performing CPR.[2]

The results of several studies explain that technology-based CPR training cannot fully improve the skills of ordinary people in performing CPR.In this case, innovation is needed in the form of combining conventional (simulation) and technology-based methods so that CPR learning becomes more effective and structured.[9] In addition, an alternative approach involves offering supplementary treatments such as butterfly hug therapy. Following simulated bystander CPR and butterfly hug therapy, there was a noticeable improvement in bystander CPR performance during specific cardiac arrest scenarios.[26]

Many studies have been conducted to see the effectiveness of mixed training methods (conventional and technological) in improving CPR skills. Training using a combination of technology with instructor guidance has been proven to improve CPR skills including the depth and quality of compressions. Apart from that, with the mixed method participants will be directed to simulate the implementation of CPR using assistive devices in the form of a mannequin.This can improve the quality and depth of compressions produced.[3,27]

**Conclusions**

In conclusion, it is evident that a combination of traditional and technology-based learning, known as mixed methods, can enhance the CPR skills of laypersons. Integrating technology into CPR education facilitates accessible learning, enabling individuals to acquire theoretical CPR knowledge conveniently. The technologies utilized encompass smartphones, televisions, and personal computers, with corresponding software such as applications, web platforms, and visual videos. These tools have

been developed as educational mediums for laypersons to learn CPR effectively. However, to truly enhance CPR skills, more than mere guidance from applications or videos is required; direct practice in the form of simulations is essential for proficiency in CPR implementation. When combined with technology, simulation-based methods represent an innovative approach to improving laypersons' CPR skills. Such an integration allows for assessing compression depth and quality, thereby contributing significantly to advancing CPR proficiency among laypersons.

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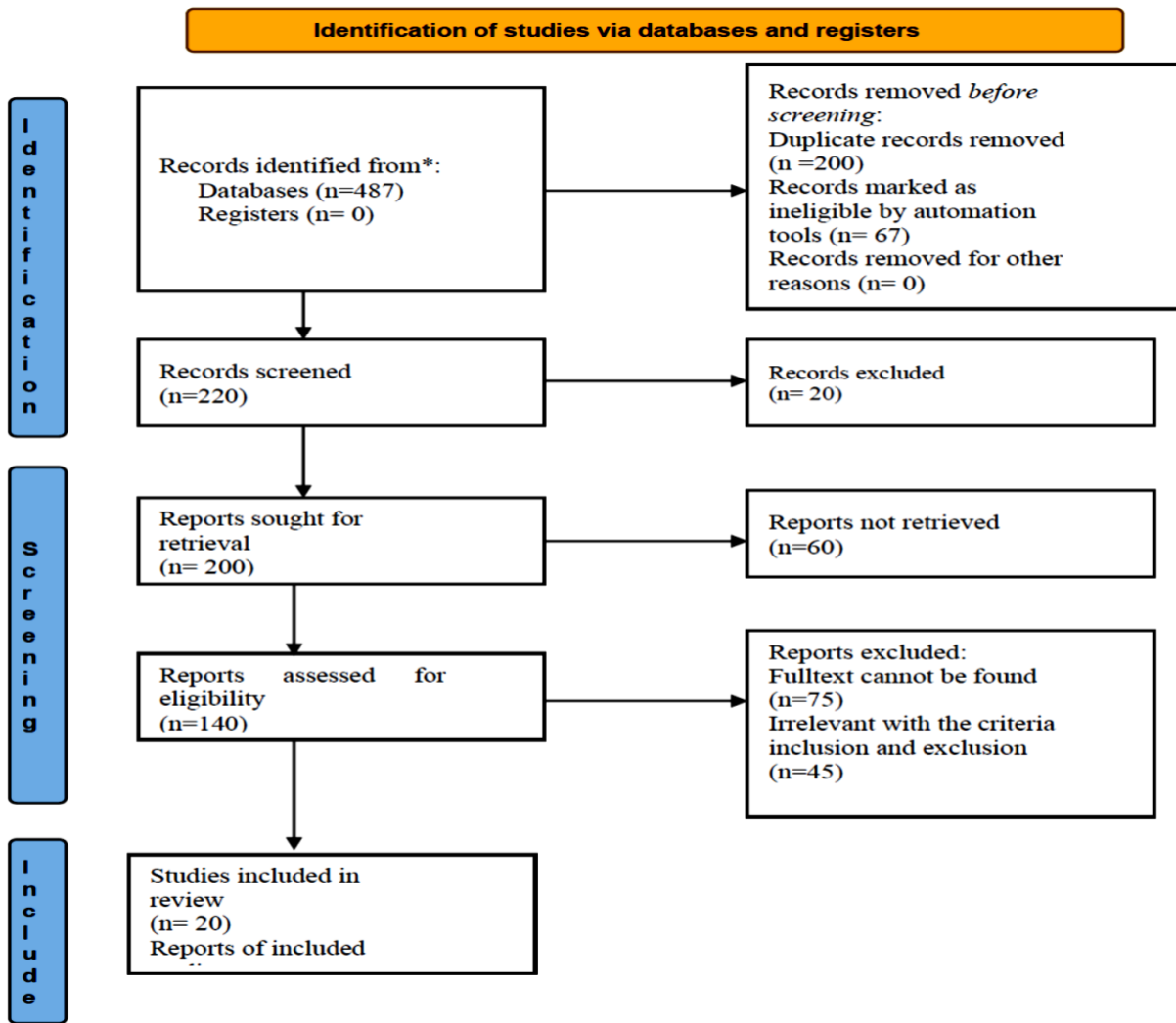
**Figure 1. PRISMA Chart**

**Table 1. Summary of Articles**

| Authors | Aim of Study | Important Findings |
|---|---|---|
| Blewer et al. (2020) | To assess the efficacy of mobile application (mAPP) as a learning tool for laypersons in enhancing their CPR performance skills | Combining digital and traditional instructional techniques to enhance CPR training is crucial to improving layperson CPR proficiency. |
| Nas et al. (2019) | To investigate the efficacy of CPR training using the Life Saver guide application to enhance public knowledge and understanding of first aid procedures in cases of cardiac arrest. | The training offers valuable information on innovative CPR training techniques, the factors that affect CPR performance, and its lasting effects on attitudes toward resuscitation. CPR training that focuses on practical application has proven to significantly improve public awareness and readiness to provide first aid in cases of cardiac arrest. |
| Beskin et al. (2016) | To assess the comparative efficacy of short videos and traditional classroom instruction for CPR compression training focused on chest-only techniques in adolescent individuals. | Research has demonstrated that providing concise CPR video training can significantly improve the efficiency and speed at which high school students perform CPR techniques. Unlike traditional classroom training, which typically only improves compression depth, brief educational sessions effectively enhance CPR response. Nevertheless, this underscores the importance of hands-on psychomotor training to ensure the quality of CPR delivery. |
| Panchal et al. (2014) | To assess the effectiveness of ultra video as a learning medium for laypeople in enhancing their response and CPR skills. | When individuals undergo training using instructional videos, they may experience improvements in their ability to respond quickly, compress at the right speed, and deliver high-quality compressions. Brief CPR training videos can effectively serve as instructional tools in public spaces, potentially increasing the rate of bystander response in performing CPR during cardiac arrest emergencies. |

| Authors | Aim of Study | Important Findings |
|---|---|---|
| Galindo Neto et al. (2023) | To assess the efficacy of instructional videos in enhancing the knowledge and proficiency of individuals with hearing impairments in Cardiopulmonary Resuscitation (CPR). | Educational videos and live demonstrations on cardiopulmonary resuscitation (CPR) have been proven to be highly effective in improving the CPR knowledge and skills of both laypersons and individuals who are deaf. These instructional tools, which include practical CPR demonstrations and educational lectures, are widely recognized as valuable approaches for training and educating the public in CPR-related skills and knowledge. |
| Blewer et al. (2016) | To conduct a comparative analysis of CPR proficiency among laypersons, the study will assess individuals who have received CPR training solely through instructional videos without the use of a mannequin and those who have been trained through video instruction in combination with hands-on practice using a mannequin. | Training incorporating videos and mannequins produces better quality results than training using videos without mannequins. |
| Lin et al. (2021) | To assess the impact of synchronous online versus face-to-face cardiopulmonary resuscitation (CPR) training on the quality of chest compressions in a manikin model. | AVF devices can effectively replace in-person chest compression training during synchronous online training. This approach is feasible for delivering comprehensive bystander CPR chest compression training. |
| Nord et al. (2015) | To compare the practical proficiency in Cardiopulmonary Resuscitation (CPR) and the willingness to perform CPR after 30 minutes of mobile application (app)-based training versus 50 minutes of DVD-based training. | A comparative assessment showed that the group engaged in DVD-based CPR training for 50 minutes exhibited superior CPR skills compared to the group undergoing application-based training for 30 minutes. Nonetheless, both groups displayed a similar level of willingness to engage in life-saving endeavours. |
| Ali et al. (2019) | To compare the efficacy of video-based CPR training with traditional instructor-led CPR training for lay people. | Video-based CPR training has been found to reduce response to compression time by 35% compared to traditional instructor-based training. |

| Authors | Aim of Study | Important Findings |
|---|---|---|
| Lee et al. (2023) | To assess the effectiveness of CPR training via conventional methods versus a smartphone application (Heros-Remote) in improving the quality of chest compressions. | CPR training using Heros' remote application has shown non-inferiority to conventional training methods regarding CPR quality. Participants in CPR training using the application have reported high satisfaction, indicating its effectiveness as a learning tool. |
| Ghazali et al. (2023) | To evaluate the impact of CPR training using simulation methods (with or without a mannequin) on improving CPR performance abilities and skills. | CPR training using a mannequin has been shown to improve CPR skills and quality. The simulation method has proven to be effective in teaching CPR to laypeople. |
| Soeli et al. (2023) | To investigate the effect of CPR training combined with simulation methods and butterfly hug therapy on enhancing individuals' abilities to provide first aid in heart attack cases resulting from disasters. | A marked improvement in bystander CPR performance during selected cardiac arrest scenarios following simulated bystander CPR and butterfly hug therapy. The median score showed a notable increase and further analysis revealed a significance value of 0.000 ($p<0.05$). |
| Wanner et al. (2016) | To appraise the effectiveness of CPR training using video media to enhance the public's CPR skills. | CPR training, in combination with practical experience using a mannequin, effectively enhances layperson CPR skills. |
| Chien et al. (2020) | To investigate the efficacy of CPR training methods; comparing traditional and mixed techniques about compression depth and overall CPR quality. | The utilization of mixed methods in CPR training has revealed that the quality of CPR remains consistent with traditional training methods. It was established that the mixed training approach and the conventional method in assessing layperson CPR skills, depth, and overall quality of CPR performance are equal. |

| Authors | Aim of Study | Important Findings |
|---|---|---|
| Metelmann et al. (2021) | To assess the potential utilization of smartphone CPR applications as instructional tools to enhance public CPR proficiency. | The use of CPR applications on smartphones has the potential to enhance the quality of CPR performance. Providing a guiding procedure for users is essential to facilitate the development of these applications. Utilizing CPR applications as instructional tools is strongly recommended for enhancing the CPR skills of laypersons, enabling them to offer assistance during instances of cardiac arrest. |
| Fauzan et al. (2021) | To examine the impact of providing Basic Life Support (BLS) health education through video on the knowledge level of junior high school students. | Research indicates that utilizing video-based Basic Life Support (BLS) training has a substantial impact on the knowledge acquisition of high school students |
| Kuswanto et al. (2022) | To assess the level of hand-only CPR skills among high school students before and after an intervention and to evaluate the effectiveness of educational demonstrations in improving these skills. | Using the demonstration method in CPR education has proven effective in enhancing students' proficiency in delivering essential life support. |
| Wirasakti et al. (2020) | To compare high-quality CPR with CPR training using multimedia learning methods.. | Using multimedia in CPR training has improved chest compression speed, depth, and overall quality with fewer interruptions. This method also helps increase community proficiency and knowledge in providing essential life support, promoting independence and the ability to offer appropriate assistance. Additionally, studies have found that CPR training videos can positively impact people's understanding of basic life support procedures. Using the multimedia CPR method for training can enhance skills in performing chest compressions and reduce interruptions, resulting in higher-quality CP |
| Maria & Wardhani (2023) | To assess the impact of BLS education through simulation methods on enhancing community knowledge and skills in performing essential life support | There is a noticeable increase in community knowledge and skills in providing essential life assistance, a testament to the community's progress and commitment to helping according to their competencie |

| Authors | Aim of Study | Important Findings |
|---|---|---|
| Maulidya et al. (2022) | To investigate whether providing Resuscitation with Jumpstart (RJP) training videos affects increasing adolescent knowledge. | Cardiopulmonary resuscitation training videos can influence respondents' knowledge of carrying out essential life support. |