



Enhancing Cardiopulmonary Resuscitation Training Through Virtual Reality Technology: Assessing Efficiency and Impact

Payam Emami¹, Mahsa Boozari Pour^{2*}

¹Department of Emergency Medical Sciences, Faculty of Paramedical Sciences, Kurdistan University of Medical Sciences, Sanandaj, Iran

²Department of Medical-Surgical Nursing, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran

*Corresponding author: Mahsa Boozari Pour

Department of Medical-Surgical Nursing, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Tel: +98 21 88202511
e-mail: m.boozari@sbmu.ac.ir

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Dear Editor

Cardiopulmonary resuscitation (CPR) training plays a crucial role in saving lives during medical emergencies. It involves a series of chest compressions and rescue breaths to maintain blood circulation and oxygen supply to the brain until medical help arrives. CPR has the potential to save lives; every minute without CPR decreases a person's chances of survival by 7-10% [1]. Besides, being able to identify cardiac arrest and notifying emergency medical services, the effectiveness of cardiopulmonary resuscitation is extremely important. One essential aspect of high-quality CPR is ensuring that chest compressions remain continuous to maintain circulation to vital organs. However, traditional methods of CPR training frequently fail to provide realistic and immersive experiences for trainees. Traditional methods of CPR training are often ineffective and fail to provide a realistic learning experience. These methods usually involve watching demonstrations on a screen or practicing chest compressions on a

lifeless mannequin. These procedures are not only tedious, but they also have limitations in terms of real-world application. Training on a mannequin, for example, cannot simulate the feeling of performing CPR on a real person [1-3].

Ongoing innovations in virtual reality CPR training can be expected to occur in the future. Artificial intelligence could be employed to create dynamic and intelligent virtual patients, with scenarios tailored to each trainee's performance and learning requirements. Gamification elements could also be incorporated to make the training experience more interesting and engaging, as well as boost retention and skill development [4]. Furthermore, with the advent of virtual reality headsets that track eye movements and facial expressions, trainees' responses and nonverbal cues could be analyzed and incorporated into the training assessments. This would provide a more comprehensive evaluation of trainees' performance and enhance their overall learning experience [5].

Virtual reality (VR) technology is a computer-generated experience that could immerse an

individual in a 3D world. By wearing a VR headset, we can step into a virtual world and interact with it as if it were real [2]. Virtual reality technology has rapidly developed as a transformative tool in various industries, altering our perception and interaction with virtual worlds. With its immersive and interactive characteristics, VR has now found its way into the realm of medical training, particularly in the context of cardiopulmonary resuscitation. Effective CPR training is crucial for increasing survival rates during cardiac emergencies, and virtual reality offers a great opportunity to enhance the training experience. VR provides a more immersive and interactive learning experience, turning the dull and detached into an engaging and memorable training session. With VR, trainees could put on a headset and find themselves in a simulated environment, where they could practice CPR on virtual patients who react and respond realistically [6].

The immersive nature of VR simulations makes the training more engaging and helps trainees develop muscle memory and critical decision-making skills. VR offers the unique ability to engage multiple senses simultaneously, resulting in a genuinely immersive training environment. VR provides a more authentic experience by incorporating sound effects, voice prompts, and even environmental factors such as temperature and humidity, allowing trainees to better prepare for the real challenges of performing CPR [7]. One promising advancement is the integration of haptic feedback into VR systems. Consider experiencing the resistance of a chest during CPR compressions, or the pulse of a simulated patient; this would further enhance the realism of the training experience and bridge the gap between the virtual and physical worlds. Virtual reality provides a safe and controlled environment for trainees to practice their CPR skills without endangering real patients. It gives students the opportunity to make mistakes, learn from them, and gain confidence in their abilities before confronting a real-life emergency situation [8].

Several studies highlighted the effectiveness of virtual reality in improving CPR performance. Researchers found that trainees who received VR CPR training had higher compression depths, better compression rates, and more overall skill retention than those trained using traditional methods. Therefore, virtual reality is more than just a fun gimmick, it's a powerful tool for improving life-saving skills [9].

Implementing VR for CPR training might appear to be a significant investment initially, but the long-term cost benefits need to be considered. Traditional CPR training often necessitates specific physical spaces, mannequins, and other equipment. However, VR could dramatically lower these expenditures, making it a more long-term viable option [2, 8].

However, it is not all rainbows and unicorns in the virtual world. VR CPR training comes with its share

of disadvantages. The initial cost of the equipment and software can be a barrier for some organizations. Additionally, VR training requires technical expertise to set up and maintain the system. Furthermore, there might be concerns about the transferability of skills learned in the virtual environment to real-world situations. Implementing virtual reality CPR training is more than just plugging in a headset. There are technical challenges to consider, such as the necessity for high-quality VR equipment and dependable software. Organizations must invest in appropriate hardware, maintain compatibility, and keep up with advancements in VR technology to stay relevant [10]. Virtual patients might respond differently compared to real patients, and trainees might develop a false sense of confidence due to the controlled nature of the virtual environment. It is important to remember that virtual reality is a tool, not a complete substitute for hands-on experience. Reinforcement and practice in real-world circumstances are essential to ensure the skills acquired in the virtual realm can be reliably applied when it matters most.

In conclusion, virtual reality technology holds great promise in revolutionizing CPR training. Through enhanced realism and immersion, virtual reality offers a safe and controlled environment for trainees to practice their skills, potentially leading to improved CPR performance [2, 8]. While challenges and limitations exist, advancements in virtual reality technology and ongoing research initiatives provide hope for addressing them. Incorporating virtual reality into existing CPR training programs can enhance the effectiveness of training, ultimately contributing to better outcomes in real-world cardiac emergencies [8].

Considering its benefits, it is recommended that healthcare institutions and CPR training providers investigate the integration of virtual reality into their curricula. By embracing technology, it is possible to work toward a future in which CPR training is more efficient, accessible, and capable of saving more lives.

Enhancing CPR training through VR technology provides an innovative approach to improve training outcomes in emergency response scenarios. Some insightful points and under-researched areas that could be considered for this topic are:

- Assessing whether those who have received VR training perform better during real cardiac events could provide practical insights into the applicability of this technology.
- Investigating the effectiveness of collaborative training in a virtual environment may shed light on optimizing team dynamics and coordination during resuscitation efforts.
- Conducting economic evaluations to compare expenses associated with VR setups versus traditional training infrastructure could help healthcare providers and educational organizations make informed decisions.

- Exploring how physiological metrics such as heart rate or stress levels affect learning efficacy and performance could provide a comprehensive understanding of skill development.
- Research exploring how immersive experiences in virtual environments influence neuroplasticity and cognitive processing could deepen insights into learning mechanisms.

Declaration

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