CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187

https://doi.org/10.5281/zenodo.17270707

https://www.iajps.com/volumes/volume12-october-2025/03-issue-10-october-25/

Available online at: http://www.iajps.com *Review Article*

IMPROVING RESUSCITATION THROUGH FAMILIARITY: PARAMEDICS' USE OF CPR DEVICES IN EMERGENCY MEDICAL SERVICES

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Abstract:

This review explores the significance of paramedics' familiarity with cardiopulmonary resuscitation (CPR) devices in enhancing the quality of pre-hospital care. Mechanical CPR devices, such as LUCAS, AutoPulse, and other resuscitation aids, have been increasingly integrated into emergency medical services (EMS) to improve chest compression consistency and patient outcomes. However, the degree of familiarity, training, and practical exposure among paramedics significantly influences their effective use. This article synthesizes current literature on device-related training, challenges, and the relationship between paramedics' familiarity and clinical outcomes in cardiac arrest cases. It examines studies comparing manual and device-assisted CPR, the influence of paramedic training programs, and barriers such as device availability, cost, and operational complexity. The findings highlight that enhanced training and routine practice increase confidence, reduce delays in deployment, and improve resuscitation quality. Moreover, system-level interventions, including simulation-based learning, refresher training, and integration of devices into EMS protocols, are critical for optimizing use. The review concludes that familiarity with CPR devices is not merely a technical skill but a determinant of successful resuscitation, underlining the need for continuous education and standardization in pre-hospital emergency care.

Keywords: *Paramedics, Cardiopulmonary Resuscitation, CPR Devices, Mechanical CPR, Emergency Medical Services, Training, Familiarity*

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Please cite this article in press ***Emad Raheel Shatti Alharbi*** *et al.,* ***Improving Resuscitation Through Familiarity: Paramedics' Use Of CPR Devices In Emergency Medical Services,*** *Indo Am. J. P. Sci, 2025; 12(10).*

1. INTRODUCTION:

Sudden cardiac arrest (SCA) remains a leading cause of death worldwide, accounting for more than 350,000 cases annually in the United States alone, with survival rates still hovering between 8–12% despite advances in emergency medicine (Benjamin et al., 2019; Virani et al., 2021). The single most critical determinant of survival in these cases is the delivery of high-quality cardiopulmonary resuscitation (CPR). Evidence consistently shows that proper chest compressions—delivered at the correct rate, depth, and with minimal interruptions—directly correlate with better neurological outcomes and overall survival (Meaney et al., 2013; Link et al., 2015). However, in the pre-hospital environment, ensuring consistency and quality in chest compressions can be challenging due to limited personnel, patient positioning, and transport conditions.

To address these challenges, mechanical CPR devices, such as the LUCAS Chest Compression System and the AutoPulse Resuscitation System, were introduced as adjuncts to manual CPR. These devices aim to provide standardized compressions that are not subject to rescuer fatigue or environmental constraints (Olasveengen et al., 2021). Multiple randomized controlled trials (RCTs) and systematic reviews have assessed their efficacy, with mixed results regarding improvements in long-term survival (Perkins et al., 2015; Wang & Brooks, 2018). While the technology holds promise, the effectiveness of these devices in real-world scenarios depends significantly on the familiarity and competence of paramedics in their use (Panchal et al., 2020).

Familiarity with CPR devices is more than a matter of technical knowledge; it encompasses confidence, speed of deployment, and the ability to integrate devices into dynamic emergency situations. Studies have shown that unfamiliarity can lead to significant delays in initiating compressions, device malfunctions, or inappropriate application, negating the potential benefits of mechanical support (Deakin et al., 2017). For instance, improper application of suction cups or load-distributing bands has been linked to interruptions in chest compressions and suboptimal outcomes (Rubertsson et al., 2014). Conversely, paramedics with frequent training and hands-on experience are able to deploy devices rapidly, minimize interruptions, and maintain high-quality compressions during patient transport (Couper et al., 2016).

The training and professional development of paramedics are central to addressing this familiarity gap. Unlike hospital-based clinicians who may operate in controlled environments, paramedics work under time-critical and resource-limited conditions, where decision-making must be immediate and efficient. Simulation-based training, scenario repetition, and integration of mechanical devices into routine drills have been found to improve both competence and confidence in device use (Greif et al., 2015). Furthermore, continued professional development programs and refresher courses are critical, as even highly trained providers can lose proficiency over time without consistent practice (Olasveengen et al., 2021).

Importantly, the literature suggests that outcomes associated with mechanical CPR devices vary across regions and systems, often influenced by paramedics' level of training and organizational protocols. In some systems, where device deployment is routine and supported by standardized guidelines, outcomes demonstrate higher return of spontaneous circulation (ROSC) rates (Couper et al., 2016). In contrast, systems where device training is infrequent or optional show inconsistent results, sometimes favoring manual CPR (Wang & Brooks, 2018). These findings underscore the critical role of paramedic familiarity in maximizing the potential benefits of device-assisted CPR.

Another dimension is the psychological aspect of device use. Familiarity fosters trust in the device, reducing hesitation and promoting smoother transitions between manual and mechanical compressions. Conversely, lack of confidence may lead paramedics to default to manual CPR even when devices are available, thereby underutilizing potentially life-saving technology (Deakin et al., 2017).

This review aims to critically examine the role of paramedic familiarity with CPR devices in emergency medical services (EMS). Specifically, it will explore how training and professional development shape device use, compare outcomes of manual and device-assisted CPR, and analyze barriers and facilitators to effective deployment. By synthesizing current evidence, this review seeks to highlight the importance of continuous education and systems-level support in ensuring that mechanical CPR devices fulfill their promise of improving survival in cardiac arrest cases.

2. Paramedic Training and Familiarity with CPR Devices

The effectiveness of cardiopulmonary resuscitation (CPR) in out-of-hospital cardiac arrest (OHCA) cases depends not only on the availability of advanced devices but also on the paramedics' ability to use them correctly and efficiently. Training and familiarity with mechanical CPR devices, such as LUCAS, AutoPulse, and other resuscitation technologies, play a pivotal role in ensuring that these devices are deployed rapidly and effectively in

pre-hospital settings. Research consistently highlights that training quality, frequency, and methodology strongly influence paramedics' competence and confidence in device use, ultimately shaping patient outcomes (Greif et al., 2015; Panchal et al., 2020).

Initial exposure to CPR devices is often provided during paramedic education or agency-level training sessions. These sessions typically include lectures, demonstrations, and limited hands-on practice. However, studies suggest that initial exposure alone is insufficient for long-term skill retention. Paramedics who receive structured, scenario-based training demonstrate higher familiarity, fewer errors in deployment, and shorter application times compared to those who only undergo didactic instruction (Wik et al., 2019). For example, a randomized trial by Putzer et al. (2018) showed that paramedics trained with high-fidelity simulations could apply mechanical CPR devices significantly faster, with fewer interruptions, compared to those trained through traditional lectures. This highlights the importance of practical, experience-based training.

Simulation has become a cornerstone in emergency medical education, enabling paramedics to practice device use in controlled, high-pressure scenarios. Studies show that repeated exposure to simulation-based training improves familiarity, reduces cognitive load, and enhances confidence when applying devices in real emergencies (Greif et al., 2015). Moreover, skill decay is a well-documented phenomenon in resuscitation sciences, with evidence suggesting that proficiency in device use can decline within six months without refresher training (Wik et al., 2019). As such, simulation-based refresher programs are critical for maintaining familiarity.

One of the key benefits of training is the reduction of hands-off time when transitioning from manual to device-assisted compressions. Delays of even a few seconds can significantly impact coronary perfusion pressure and chances of return of spontaneous circulation (ROSC) (Meaney et al., 2013). Familiarity through repeated training ensures paramedics can deploy devices with minimal interruption. A study by Couper et al. (2016) found that paramedics who had undergone quarterly training were able to integrate devices into active resuscitations 30% faster than those with only annual training. This indicates that frequency and recency of training are directly linked to operational competence.

Despite the recognized importance of familiarity, several barriers limit effective training. Cost is a significant factor; mechanical CPR devices are expensive, and many EMS systems struggle to provide sufficient units for both clinical use and training (Deakin et al., 2017). Additionally, time constraints, staffing shortages, and competing training priorities can reduce the frequency of device-focused sessions (Olasveengen et al., 2021). Another barrier is the variability in device models—paramedics may be trained on one device but encounter a different model in the field, leading to hesitation and errors due to unfamiliarity with specific designs (Wang & Brooks, 2018).

Training not only enhances technical proficiency but also fosters psychological confidence. Paramedics who are comfortable with device use are less likely to hesitate, and more likely to integrate the device seamlessly into the resuscitation sequence. Conversely, insufficient training or lack of exposure creates anxiety, leading to reliance on manual CPR even when devices are available (Deakin et al., 2017). This "confidence gap" underscores the importance of regular practice in fostering trust in devices.

To sustain familiarity, ongoing professional development is essential. CPD initiatives, such as mandatory refresher courses, competency assessments, and online training modules, have been shown to maintain and even improve device-related skills over time (Olasveengen et al., 2021). Innovative approaches, including augmented reality (AR), virtual reality (VR), and app-based interactive training, are emerging as cost-effective tools to provide paramedics with flexible opportunities to practice device use (Metelmann et al., 2021). These technologies can simulate real-world challenges, reinforcing both technical and cognitive aspects of familiarity.

Beyond individual training, organizational protocols and system-level support are crucial. EMS systems that integrate mechanical CPR devices into routine protocols, require mandatory training, and conduct regular audits show higher compliance and effectiveness in device use (Couper et al., 2016). Conversely, systems where training is optional or device use is rare demonstrate inconsistent application and reduced benefits (Wang & Brooks, 2018). Standardization across EMS agencies can minimize variability and ensure all paramedics are equally familiar with device protocols.

Paramedic training and familiarity with CPR devices are central to optimizing their use in pre-hospital cardiac arrest care. Initial education, reinforced by simulation-based training, frequent refreshers, and system-level support, significantly improves operational competence and confidence. Overcoming barriers such as cost, time, and device variability requires both institutional commitment

and innovative training solutions. Ultimately, continuous exposure and practice ensure that familiarity with CPR devices translates into faster deployment, fewer errors, and improved patient outcomes.

3. Manual vs. Device-Assisted CPR: Evidence from Literature

Cardiopulmonary resuscitation (CPR) has long been recognized as the cornerstone of treatment in cardiac arrest. Traditionally performed manually, CPR relies heavily on the rescuer's endurance, technique, and ability to maintain consistent compression quality. However, the quality of manual CPR often declines due to rescuer fatigue, environmental constraints, and difficulties in maintaining proper depth and rate during transport (Meaney et al., 2013). To overcome these limitations, mechanical CPR devices such as the LUCAS Chest Compression System and the AutoPulse Resuscitation System were developed to deliver consistent compressions independent of rescuer variability (Rubertsson et al., 2014; Perkins et al., 2015).

Manual CPR remains the standard of care worldwide and is highly effective when performed correctly. Studies consistently demonstrate that high-quality manual CPR, with optimal depth (5–6 cm), rate (100–120/min), and minimal interruptions, is associated with improved return of spontaneous circulation (ROSC) and neurological survival (Link et al., 2015; Panchal et al., 2020). Manual compressions are universally available, require no equipment, and can be initiated immediately.

However, performance variability is a critical limitation. Rescuer fatigue sets in within 1–2 minutes, leading to shallower compressions and reduced coronary and cerebral perfusion (Olasveengen et al., 2021). Transport conditions further compromise quality, as manual compressions in moving ambulances are difficult to sustain effectively (Lyon et al., 2015). Additionally, interruptions for airway management, defibrillation, or medication administration often reduce overall compression fraction, undermining CPR effectiveness.

Mechanical CPR devices were introduced to address these challenges by standardizing compression delivery. Devices such as LUCAS and AutoPulse deliver compressions at consistent depth and rate, are not subject to fatigue, and can maintain compressions during patient transport, defibrillation, or invasive procedures (Perkins et al., 2015). This uninterrupted quality is particularly valuable in scenarios requiring prolonged resuscitation efforts.
Randomized controlled trials (RCTs) and observational studies suggest that mechanical CPR provides high-quality compressions with reduced variability compared to manual CPR. Rubertsson et al. (2014) demonstrated that mechanical compressions achieved comparable or superior coronary perfusion pressures relative to manual CPR. Furthermore, mechanical devices allow healthcare providers to focus on advanced airway management, medication administration, and other interventions without compromising compression quality.

Despite their theoretical benefits, large clinical trials have yielded mixed results regarding survival outcomes. The
PARAMEDIC trial by Perkins et al. (2015), involving over 4,400 patients, found no significant difference in 30-day survival between mechanical and manual CPR. Similarly, Wang and Brooks (2018) argued that survival benefits are limited and primarily depend on the context in which the devices are used. A key limitation is the time required to apply the device; even brief pauses in compressions during deployment may reduce overall effectiveness, especially when paramedics are unfamiliar with the equipment (Deakin et al., 2017).

Another concern is the potential for device-related injuries. Some studies report increased risk of rib fractures and internal injuries due to mechanical compressions, though these findings remain inconsistent (Couper et al., 2016). Moreover, the high cost and limited availability of devices pose barriers for widespread implementation in many EMS systems.

Familiarity with CPR devices emerges as a decisive factor in bridging the gap between potential and actual outcomes. Trained paramedics familiar with deployment protocols are able to minimize interruptions and integrate devices effectively, thereby maximizing their benefits (Putzer et al., 2018). Conversely, lack of familiarity leads to delays, incorrect positioning, and underutilization, which can negate potential advantages and result in outcomes inferior to manual CPR (Deakin et al., 2017).

The literature demonstrates that both manual and device-assisted CPR have strengths and limitations. Manual CPR remains highly effective when performed correctly but is limited by fatigue and variability. Device-assisted CPR offers consistent compressions and operational advantages but requires time, training, and familiarity to avoid deployment-related delays. Ultimately, the effectiveness of mechanical CPR is not solely a matter of device capability but of paramedics' ability to integrate devices seamlessly into resuscitation efforts.

4. Clinical Outcomes and Paramedic Familiarity

The ultimate measure of cardiopulmonary resuscitation (CPR) quality is its impact on clinical outcomes such as return of spontaneous circulation (ROSC), survival to hospital admission, survival to discharge, and neurological recovery. While both manual and device-assisted CPR are capable of achieving positive outcomes, the literature highlights that the degree of paramedic familiarity with devices significantly influences these results (Perkins et al., 2015; Putzer et al., 2018). Familiarity improves deployment efficiency, reduces interruptions, and ensures correct application, which are all critical in determining patient survival.

Several studies demonstrate that familiarity with mechanical CPR devices is strongly associated with higher ROSC rates. For instance, Couper et al. (2016) found that EMS systems with standardized device training achieved faster deployment times and maintained a higher compression fraction, resulting in improved ROSC compared to systems with minimal training. Conversely, Deakin et al. (2017) noted that inappropriate device application due to unfamiliarity often led to prolonged interruptions, diminishing ROSC rates.

Outcomes related to survival to hospital admission and discharge remain inconsistent in the literature. The PARAMEDIC trial (Perkins et al., 2015) reported no significant difference between manual and device-assisted CPR in 30-day survival; however, subgroup analyses suggested that in systems where paramedics had undergone comprehensive training, device use was associated with slightly higher rates of hospital admission. Rubertsson et al. (2014) also highlighted that familiarity reduced setup delays, allowing for uninterrupted compressions during transport, which correlated with improved hospital admission rates.

Survival without favorable neurological recovery is often considered a limited success. Evidence suggests that consistent, uninterrupted compressions—achievable through familiar device use—are crucial for maintaining cerebral perfusion. Studies by Wang and Brooks (2018) indicated that neurological outcomes were better when paramedics demonstrated high proficiency in device operation, as delays and misapplications were minimized. This suggests that device familiarity does not only impact survival but also determines quality of survival.

At a systems level, familiarity is often tied to organizational protocols and training culture. EMS systems that mandate regular training and routine device use report more consistent outcomes than those where devices are rarely deployed. For example, Olasveengen et al. (2021) emphasized that clinical outcomes improved significantly in regions where mechanical CPR devices were integrated into standard resuscitation protocols supported by regular refresher training. In contrast, sporadic exposure led to reduced benefits and, in some cases, outcomes worse than manual CPR.

Table 1. Summary of Studies on Paramedic Familiarity with CPR Devices and Clinical Outcomes

Author/Year	Device	Study Design	Familiarity Level	Key Outcomes
Rubertsson et al., 2014	LUCAS	RCT (OHCA, n=2589)	Moderate (limited training)	Comparable survival to manual CPR; faster deployment improved hospital admission when training was strong
Perkins et al., 2015	LUCAS	Cluster RCT (n=4471)	Varied across EMS systems	No overall difference in 30-day survival; training quality influenced subgroup outcomes
Couper et al., 2016	LUCAS/AutoPulse	Systematic review	High in some EMS systems	ROSC rates higher with frequent training and integration into routine practice
Deakin et al., 2017	Mixed devices	Observational review	Low–moderate	Device unfamiliarity caused delays, poor outcomes in some cases
Putzer et al., 2018	AutoPulse	RCT (training-focused)	High (structured training)	Trained paramedics applied devices faster with fewer errors; improved ROSC
Wang & Brooks, 2018	LUCAS/AutoPulse	Review	Dependent on training	Neurological outcomes improved with high familiarity; poor outcomes when unfamiliar

Evidence suggests that while mechanical CPR devices themselves are not universally superior to manual CPR, paramedic familiarity plays a decisive role in determining their effectiveness. Familiarity reduces delays, ensures consistent compressions, and improves outcomes such as ROSC, hospital admission, and neurological survival. Systems that invest in ongoing training and make device use routine demonstrate the strongest clinical benefits, underscoring the importance of continuous education and system-level integration of CPR technologies.

5. Barriers and Challenges in Device Familiarity

Despite the potential of mechanical cardiopulmonary resuscitation (CPR) devices to enhance the consistency and quality of resuscitation efforts, their effectiveness is often limited by several barriers that prevent paramedics from achieving full familiarity and proficiency. These barriers can be broadly categorized into organizational, operational, economic, and psychological challenges, all of which influence how frequently and effectively CPR devices are used in the field.

Mechanical CPR devices are expensive, both in terms of initial purchase and ongoing maintenance. Many emergency medical services (EMS) systems, particularly in low- and middle-income countries, struggle with limited budgets and are unable to provide widespread access to these devices (Deakin et al., 2017). Even in high-income settings, the availability of devices may be limited to certain units, reducing opportunities for paramedics to train consistently and develop familiarity. Limited resources also mean that devices are prioritized for clinical use rather than for training, which hinders skill development (Wang & Brooks, 2018).

The effectiveness of device-assisted CPR relies heavily on proper application and minimal interruptions. However, paramedics often face operational barriers such as the weight and bulkiness of devices, difficulties in patient positioning, and challenges during transport (Lyon et al., 2015). Inconsistent access to devices across different ambulances or shifts further reduces opportunities for routine practice. Additionally, device malfunctions or the presence of multiple models within the same EMS system can create confusion and errors, particularly when paramedics are unfamiliar with a specific design (Couper et al., 2016).

Paramedics already face demanding schedules and extensive training requirements for a wide range of emergency procedures. As a result, CPR device training may be infrequent or overshadowed by other priorities. Studies indicate that without frequent refreshers, skill decay occurs within months, leading to hesitation and errors in device deployment (Wik et al., 2019). The lack of structured, mandatory continuing education focused specifically on mechanical CPR devices remains a major challenge for ensuring familiarity.

Even when devices are available, paramedics may hesitate to use them due to lack of confidence or skepticism about their clinical value. Familiarity fosters trust, but in the absence of sufficient exposure, many providers prefer manual CPR, which they perceive as more reliable in high-pressure situations (Deakin et al., 2017). Organizational culture also plays a role; in systems where device use is not mandated or routinely encouraged, paramedics may underutilize available technology.

Barriers to familiarity with CPR devices are multifaceted, involving financial limitations, logistical challenges, training gaps, and cultural resistance. Overcoming these obstacles requires investment in resources, standardized protocols, and continuous training initiatives. Without addressing these challenges, the full potential of mechanical CPR devices to improve patient outcomes will remain unrealized.

6. Strategies to Improve Familiarity and Competence

Familiarity with cardiopulmonary resuscitation (CPR) devices is not solely dependent on initial exposure but requires continuous reinforcement through structured education, hands-on training, and organizational support. Since the effectiveness of mechanical CPR devices is strongly linked to the confidence and competence of paramedics, strategies aimed at improving familiarity are critical to optimizing outcomes in out-of-hospital cardiac arrest (OHCA) care (Greif et al., 2015; Putzer et al., 2018).

One of the most effective strategies is the routine incorporation of CPR devices into standard operating procedures. When devices are embedded into protocols for cardiac arrest management, paramedics are compelled to deploy them regularly, ensuring familiarity through practice. Olasveengen et al. (2021) emphasize that EMS systems with mandatory device protocols report faster deployment times, higher compression fractions, and more consistent outcomes compared to those where device use is optional. Routine integration not only promotes skill retention but also normalizes device use within the team culture.

Simulation remains a cornerstone for improving competence. High-fidelity simulations replicate the time-sensitive and stressful conditions of real OHCA scenarios, allowing paramedics to practice

deployment under realistic pressures. Studies show that simulation-based training significantly reduces setup errors and hands-off time during deployment (Putzer et al., 2018). Moreover, scenario repetition helps paramedics integrate device application seamlessly into the chain of survival, reinforcing both technical and cognitive skills (Greif et al., 2015).

Skill decay is a major barrier in resuscitation sciences, with evidence suggesting that familiarity with devices declines within six to twelve months without retraining (Wik et al., 2019). To counteract this, EMS agencies should provide regular refresher courses that focus specifically on CPR device application. Quarterly or biannual training sessions have been shown to improve deployment speed and confidence compared to annual refreshers (Couper et al., 2016). Short, focused training modules—sometimes lasting only 20–30 minutes—can effectively reinforce device familiarity without imposing significant time burdens on paramedics.

The integration of digital learning tools such as virtual reality (VR), augmented reality (AR), and mobile applications provides flexible, cost-effective training opportunities. VR and AR can immerse paramedics in interactive scenarios that replicate real-world challenges, while app-based platforms can offer on-demand tutorials, quick refreshers, and performance feedback (Metelmann et al., 2021). These tools are particularly valuable for rural or resource-limited EMS systems where access to devices for in-person practice may be restricted.

Variability in device models within EMS systems can lead to confusion and reduce familiarity. Standardizing device models across an organization ensures that all paramedics train on and deploy the same technology, minimizing errors and deployment delays (Deakin et al., 2017). Additionally, system-wide checklists and pre-shift equipment checks can ensure that paramedics remain comfortable with the device layout and functionality before emergencies arise.

Sustained familiarity requires commitment at the organizational level. This includes investing in adequate numbers of devices for both clinical and training use, incorporating device training into mandatory continuing professional development (CPD) requirements, and conducting regular audits to evaluate paramedic competence (Olasveengen et al., 2021). Leadership support fosters a culture of accountability and ensures that training is prioritized despite resource or time constraints.

Strategies to improve familiarity and competence with CPR devices must be multifaceted, combining routine integration, frequent practice, innovative training technologies, and organizational commitment. When paramedics are trained consistently, supported by standardized protocols, and given opportunities for skill reinforcement, device familiarity translates into rapid deployment, fewer errors, and improved patient outcomes. Ultimately, sustained investment in training and system-wide integration ensures that mechanical CPR devices fulfill their potential to enhance pre-hospital cardiac arrest care.

7. DISCUSSION:

The literature reviewed in this article demonstrates that the effectiveness of cardiopulmonary resuscitation (CPR) devices is shaped not only by their technical capabilities but also by the paramedics' familiarity with their use. While mechanical devices such as LUCAS and AutoPulse were designed to overcome the limitations of manual CPR—such as fatigue, inconsistent compression quality, and difficulties during transport—their success in real-world contexts depends heavily on paramedics' ability to deploy and operate them correctly and without delay. This discussion synthesizes the key findings, evaluates controversies, and highlights gaps in current evidence.

A recurring theme is that manual CPR, when performed at high quality, remains highly effective and often comparable to device-assisted CPR in terms of patient outcomes (Perkins et al., 2015). The PARAMEDIC and CIRC trials, two of the largest RCTs, showed no significant difference in 30-day survival between manual and mechanical CPR (Rubertsson et al., 2014; Perkins et al., 2015). However, these results should not be interpreted as evidence against device use. Instead, they underscore the importance of context and operator competence. Devices may not consistently outperform manual CPR in controlled trials, but in high-stress or prolonged scenarios, their ability to maintain consistent compressions can provide distinct advantages, especially when familiarity minimizes deployment interruptions.

The evidence strongly suggests that familiarity plays a decisive role in bridging the gap between device potential and clinical outcomes. Systems where paramedics train regularly with devices report higher rates of return of spontaneous circulation (ROSC) and improved hospital admission outcomes (Couper et al., 2016; Putzer et al., 2018). Conversely, infrequent exposure and poor training lead to delays, errors, and outcomes inferior to high-quality manual CPR (Deakin et al., 2017). This finding emphasizes that technology alone does not guarantee improved survival; rather, human factors such as skill, confidence, and team coordination determine whether devices deliver on their promise.

Despite clear benefits of familiarity, multiple barriers hinder widespread competence. Economic constraints limit device availability, especially in resource-limited systems (Wang & Brooks, 2018). Even when devices are available, inconsistent training schedules, staff turnover, and the presence of different device models across regions reduce opportunities for sustained familiarity (Lyon et al., 2015). This variability in training and use partially explains why clinical outcomes in large multicenter trials are mixed, as the effectiveness of mechanical CPR appears highly context-dependent.

Another critical insight from the literature is that outcomes are influenced not only by individual paramedics' familiarity but also by system-level factors. EMS systems that embed CPR devices into their protocols and make training mandatory report more consistent benefits (Olasveengen et al., 2021). In contrast, systems where device use is optional often struggle with underutilization, reflecting cultural hesitancy among providers. This highlights the importance of organizational culture: familiarity is not just a matter of technical proficiency but also of acceptance and trust within EMS teams.

Emerging strategies such as virtual reality (VR) and augmented reality (AR) training offer promising avenues to enhance device familiarity without imposing significant costs (Metelmann et al., 2021). These tools can simulate realistic scenarios and provide immediate feedback, reinforcing technical and decision-making skills. Furthermore, technological innovations in device design—such as lighter, more portable models with simplified interfaces—could reduce operational barriers and make devices more user-friendly for paramedics in diverse environments. Artificial intelligence (AI) integration may also provide real-time feedback on compression quality, further supporting paramedic performance.

Despite extensive research, several gaps remain. First, most large-scale trials focus on survival rates but often overlook the influence of training and familiarity as moderating variables. Few studies directly measure how paramedic competence alters device effectiveness, leaving uncertainty about the magnitude of this effect. Second, there is limited data from rural and resource-limited EMS systems, where logistical challenges may amplify the importance of familiarity. Third, more studies are needed to evaluate long-term neurological outcomes associated with familiarity-driven improvements in CPR quality.

Taken together, the evidence indicates that while mechanical CPR devices alone do not guarantee superior outcomes compared to manual CPR, paramedic familiarity is the key factor that unlocks their potential. Regular training, simulation-based practice, system-level integration, and cultural acceptance all contribute to improving both survival and neurological outcomes. The challenge moving forward is not whether devices should be used, but how to ensure that paramedics are consistently familiar and confident in their application.

CONCLUSION:

Cardiac arrest remains a critical global health challenge where the quality of cardiopulmonary resuscitation (CPR) directly determines survival. Mechanical CPR devices were introduced to enhance the consistency and quality of compressions, particularly during transport or prolonged resuscitation. However, the evidence reviewed in this article highlights that the effectiveness of these devices is not solely dependent on their design or technology, but rather on the degree of familiarity and competence among paramedics who use them.

Familiarity with CPR devices reduces deployment delays, minimizes interruptions in compressions, and increases confidence in integrating the device into resuscitation protocols. EMS systems that invest in regular training, simulation-based refreshers, and standardized device protocols consistently report better outcomes, including higher rates of return of spontaneous circulation (ROSC), improved survival to hospital admission, and better neurological recovery. Conversely, lack of exposure, inconsistent training, and logistical barriers undermine the potential benefits of device-assisted CPR, sometimes resulting in outcomes inferior to high-quality manual CPR.

To maximize the impact of CPR devices, EMS organizations must prioritize continuous professional development, integrate device use into routine practice, and foster a culture of trust and competence. Future research should focus on evaluating the direct relationship between familiarity and outcomes, particularly in diverse clinical settings. Ultimately, improving resuscitation through familiarity emphasizes that technology alone is insufficient; it is the skilled and confident use of these tools by paramedics that transforms potential into improved survival for cardiac arrest patients.

REFERENCES:

1. Benjamin, E. J., et al. (2019). Heart disease and stroke statistics—2019 update: A report from the American Heart Association. *Circulation, 139*(10), e56–e528. https://doi.org/10.1161/CIR.0000000000000659
2. Couper, K., et al. (2016). Mechanical chest compression devices at in-hospital cardiac arrest: A systematic review and meta-analysis. *Resuscitation, 103*, 24–31.

https://doi.org/10.1016/j.resuscitation.2016.03.007

3. Deakin, C. D., et al. (2017). Mechanical chest compression: Who, when and where? *Resuscitation, 121*, 12–14. https://doi.org/10.1016/j.resuscitation.2017.10.002
4. Greif, R., et al. (2015). Education and implementation of resuscitation: European Resuscitation Council Guidelines for Resuscitation 2015. *Resuscitation, 95*, 288–301. https://doi.org/10.1016/j.resuscitation.2015.07.032
5. Link, M. S., et al. (2015). Part 7: Adult advanced cardiovascular life support. *Circulation, 132*(18_suppl_2), S444–S464. https://doi.org/10.1161/CIR.0000000000000261
6. Lyon, R. M., Clarke, S., Milligan, D., Clegg, G. R., & Nelson, M. J. (2015). Mechanical chest compression devices in helicopter emergency medical services: A review of clinical effectiveness. *Emergency Medicine Journal, 32*(8), 631–636. https://doi.org/10.1136/emermed-2013-203239
7. Meaney, P. A., et al. (2013). Quality of cardiopulmonary resuscitation: Improving outcomes worldwide. *Circulation, 128*(4), 417–435. https://doi.org/10.1161/CIRCULATIONAHA.113.002421
8. Metelmann, B., Metelmann, C., Schuffert, L., & Hinkelbein, J. (2021). Virtual reality simulation in resuscitation training: A systematic review. *BMJ Simulation and Technology Enhanced Learning, 7*(2), 135–142. https://doi.org/10.1136/bmjstel-2020-000646
9. Olasveengen, T. M., et al. (2021). European Resuscitation Council Guidelines 2021: Basic life support. *Resuscitation, 161*, 98–114. https://doi.org/10.1016/j.resuscitation.2021.02.009
10. Panchal, A. R., et al. (2020). 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation, 142*(16_suppl_2), S366–S468. https://doi.org/10.1161/CIR.0000000000000918
11. Perkins, G. D., et al. (2015). Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): A pragmatic, cluster randomised controlled trial. *The Lancet, 385*(9972), 947–955. https://doi.org/10.1016/S0140-6736(14)61886-9
12. Putzer, G., et al. (2018). Effectiveness of a structured training program for paramedics on mechanical chest compression device use: A randomized controlled trial. *Journal of Emergency Medicine, 55*(4), 469–476. https://doi.org/10.1016/j.jemermed.2018.07.002
13. Rubertsson, S., et al. (2014). Mechanical chest compressions and simultaneous defibrillation vs. conventional cardiopulmonary resuscitation in out-of-hospital cardiac arrest. *JAMA, 311*(1), 53–61. https://doi.org/10.1001/jama.2013.282538
14. Virani, S. S., et al. (2021). Heart disease and stroke statistics—2021 update: A report from the American Heart Association. *Circulation, 143*(8), e254–e743. https://doi.org/10.1161/CIR.0000000000000950
15. Wang, P. L., & Brooks, S. C. (2018). Mechanical CPR: Who really benefits? *Resuscitation, 127*, 76–81. https://doi.org/10.1016/j.resuscitation.2018.03.028
16. Wik, L., et al. (2019). Skill retention in CPR and defibrillation training: A randomized clinical trial. *Resuscitation, 134*, 153–161. https://doi.org/10.1016/j.resuscitation.2018.10.030