CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187

https://doi.org/10.5281/zenodo.17270717

https://www.iajps.com/volumes/volume12-october-2025/04-issue-10-october-25/

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

"NAVIGATING LIFE-OR-DEATH DECISIONS: A REVIEW OF PARAMEDIC DECISION-MAKING IN OUT-OF-HOSPITAL CARDIAC ARREST"

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Abstract:

Out-of-hospital cardiac arrest (OHCA) is one of the most critical medical emergencies, where patient survival largely depends on the rapid and complex decisions made by paramedics. This review examines the multifactorial nature of paramedic decision-making in OHCA, highlighting the interplay between clinical guidelines, cognitive processes, ethical considerations, and system-level constraints. Decisions regarding the initiation, continuation, or termination of resuscitation, as well as choices on advanced interventions and transport strategies, are often made under extreme time pressure and uncertainty. Research indicates that while guidelines from organizations such as the American Heart Association (AHA) and the European Resuscitation Council (ERC) provide structured pathways, paramedics frequently rely on intuition, experience, and situational awareness to adapt care to unique circumstances. Human factors—including fatigue, stress, and cognitive overload—can influence judgment, while legal and ethical issues further complicate resuscitation choices. Emerging technologies, such as artificial intelligence–based predictive models and real-time feedback devices, present opportunities to support decision-making in the field. However, significant gaps remain in understanding the determinants of these critical decisions across diverse healthcare systems. This review underscores the need for enhanced training, ethical support frameworks, and integration of decision-support tools to improve both paramedic confidence and patient outcomes in OHCA.

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Please cite this article in press Mohammed Ali Dulaym Alanazi et al., ***Navigating Life-Or-Death Decisions: A Review Of Paramedic Decision-Making In Out-Of-Hospital Cardiac Arrest,*** *Indo Am. J. P. Sci, 2025; 12(10).*

INTRODUCTION:

Out-of-hospital cardiac arrest (OHCA) remains a leading global cause of mortality, with survival rates ranging from 5% to 20% depending on region, system readiness, and time to intervention (Gräsner et al., 2021). Despite advancements in resuscitation science, OHCA outcomes remain poor, with many patients experiencing death or severe neurological impairment. Central to improving these outcomes are the rapid, high-stakes decisions made by paramedics in the prehospital environment, where uncertainty, time pressure, and ethical dilemmas converge (Skrifvars et al., 2020).

Paramedic decision-making during OHCA encompasses critical junctures such as whether to initiate resuscitation, when to terminate efforts, which interventions to apply, and whether to transport the patient. Guidelines from international authorities like the **American Heart Association (AHA)** and the **European Resuscitation Council (ERC)** provide structured frameworks for resuscitation, emphasizing early cardiopulmonary resuscitation (CPR), defibrillation, and advanced airway management (Soar et al., 2021; Panchal et al., 2020). However, paramedics often must deviate from standardized protocols to adapt care to patient-specific factors such as age, comorbidities, witnessed versus unwitnessed collapse, and the presence or absence of bystander CPR (Couper et al., 2019). This tension between guideline adherence and clinical judgment underscores the complexity of prehospital decision-making.

Cognitive and psychological factors significantly shape paramedic decision-making. Studies highlight the role of **situational awareness, intuition, and heuristics**, especially under conditions of fatigue, stress, and limited information (Carter et al., 2019). Experienced clinicians may rely on pattern recognition and tacit knowledge to make rapid judgments, whereas less experienced providers may depend more heavily on rigid adherence to protocols. Moreover, decision-making does not occur in isolation but within the context of team dynamics, communication, and interaction with bystanders or family members, all of which may influence the trajectory of care (Pang et al., 2022).

Beyond clinical and cognitive dimensions, ethical and legal considerations play a critical role. Decisions about **termination of resuscitation (TOR)**, honoring do-not-resuscitate (DNR) orders, and balancing patient dignity against aggressive intervention present significant moral challenges. Paramedics often navigate conflicting pressures—clinical judgment, legal obligations, family expectations, and organizational culture—when deciding whether continued resuscitation is appropriate or futile (Anderson et al., 2018). Variability in TOR protocols across jurisdictions further complicates decision-making, highlighting the need for clearer frameworks that support clinicians in ethically sensitive scenarios (Nichol et al., 2020).

Technology and decision-support tools represent an emerging frontier in paramedic decision-making. **Mechanical CPR devices, real-time feedback systems, and predictive algorithms** have been introduced to enhance the consistency and quality of resuscitation efforts (Rubertsson et al., 2014). Recent studies have explored the potential of artificial intelligence (AI)–driven tools to predict patient survival and guide TOR decisions, offering paramedics additional support in high-stakes contexts (Nakahara et al., 2022). However, integration of such tools into field practice remains limited, and concerns persist about overreliance on technology or undermining paramedic autonomy.

Given the complex interplay of guidelines, human judgment, ethics, and technology, understanding the determinants of paramedic decision-making in OHCA is critical. Prior literature has largely focused on resuscitation outcomes and interventions, with less emphasis on the **decision-making processes** that precede these outcomes (Schmidbauer et al., 2019). This review seeks to synthesize existing evidence on how paramedics make life-or-death decisions in OHCA, explore the challenges they face, and identify opportunities for improving decision-making through training, support frameworks, and innovative technologies.

By critically analyzing the current state of knowledge, this review aims to contribute to both academic discourse and practical reforms, ultimately supporting paramedics in delivering high-quality, ethically sound, and patient-centered care during OHCA events.

Clinical Decision Points in OHCA (with references)

1) Whether to start or withhold resuscitation: Paramedics' first pivotal decision is whether to initiate CPR or deem resuscitation inappropriate (e.g., obvious signs of death, decapitation, dependent lividity) or contraindicated by valid advance directives. International guidelines specify circumstances permitting non-initiation, but emphasize that when in doubt, begin CPR and reassess (Soar et al., 2021; Panchal et al., 2020). For arrest presentations with unwitnessed asystole, prolonged downtime, and no bystander CPR, the probability of meaningful survival is extremely low, informing initial decisions and early goals-of-care discussions when feasible (Soar et al., 2021).

2) Early defibrillation for shockable rhythms: When the initial rhythm is ventricular fibrillation (VF) or pulseless ventricular tachycardia (pVT), rapid defibrillation is the highest-yield action; delays

markedly reduce survival per minute elapsed (Panchal et al., 2020; Soar et al., 2021). Paramedics must decide on the defibrillation sequence (single-shock with immediate compressions vs stacked shocks in refractory VF) and when to escalate energy or change pads/positions, balancing shock delivery with high-quality compressions (Soar et al., 2021).

3) High-quality chest compressions and the role of mechanical CPR: Teams decide between manual compressions and mechanical devices (e.g., LUCAS) in contexts such as prolonged resuscitation, transport, or limited personnel. While mechanical devices can standardize compression depth/rate and free hands for other tasks, large trials have not shown routine survival benefit over high-quality manual CPR; they may, however, be useful when manual quality cannot be maintained (Rubertsson et al., 2014; Soar et al., 2021). Thus, the decision hinges on scene factors (space, transport safety, fatigue) and team capacity.

4) Airway strategy (BVM, supraglottic airway, tracheal intubation): Paramedics must choose an initial airway approach and when to escalate. Contemporary evidence favors a stepwise strategy that prioritizes uninterrupted compressions and minimizes peri-intubation pauses. Randomized trials showed that initial supraglottic airway (SGA) strategies achieved comparable or better functional outcomes than early tracheal intubation in OHCA (Benger et al., 2018; Wang et al., 2018). Guidelines recommend bag-mask ventilation first, advancing to SGA or endotracheal intubation when feasible without interrupting CPR (Panchal et al., 2020; Soar et al., 2021). The decision is shaped by provider skill, aspiration risk, and anticipated transport time.

5) Vascular access and drug therapy (epinephrine timing/dose): Decisions include whether to place IV vs IO access and when to administer vasopressors. The PARAMEDIC2 trial demonstrated that epinephrine improves 30-day survival but with a small absolute benefit and more survivors with severe neurological impairment, underscoring nuanced risk–benefit considerations and the importance of early administration in non-shockable rhythms (Perkins et al., 2018). For shockable rhythms, emphasis remains on defibrillation and compressions, with epinephrine typically after the third shock per advanced life support algorithms (Panchal et al., 2020; Soar et al., 2021).

6) Reversible causes (the "Hs & Ts") and targeted interventions: Paramedics continuously decide whether signs suggest hypoxia, hypovolemia, hypothermia, hyperkalemia, tamponade, tension pneumothorax, toxins, or coronary thrombosis. Interventions may include needle decompression for suspected tension pneumothorax or rapid transport for catheter-capable facilities when coronary occlusion is likely after ROSC (Panchal et al., 2020; Soar et al., 2021). These determinations rely on pretest probability from history, mechanism, and exam while preserving CPR quality.

7) Scene time: "stay-and-treat" vs "scoop-and-run.": Another central decision is whether to continue resuscitation on scene to deliver guideline-concordant cycles of CPR/defibrillation, or to transport with ongoing CPR. Many systems favor on-scene resuscitation until ROSC or termination criteria are met because moving during CPR often worsens compression quality and defibrillation timing; exceptions include unsafe scenes, refractory VF needing advanced therapies, or special populations (e.g., pregnancy) where hospital resources could change outcome (Soar et al., 2021; Panchal et al., 2020).

8) Termination of resuscitation (TOR) vs transport with ongoing CPR: When ROSC is not achieved after appropriate cycles, paramedics consider TOR rules. Evidence-based TOR criteria (e.g., no ROSC, no shocks, and the arrest not witnessed by EMS for BLS TOR) are associated with extremely low likelihood of survival, supporting on-scene termination to avoid low-value transport with CPR (Panchal et al., 2020; Soar et al., 2021). Systems are encouraged to implement locally approved TOR policies that also account for medico-legal context and family communication needs.

9) Post-ROSC stabilization and destination decisions: When ROSC occurs, paramedics must balance rapid transport with meticulous post-ROSC care: maintaining oxygenation/ventilation targets, avoiding hypotension, acquiring a 12-lead ECG for suspected STEMI, and selecting destinations capable of reperfusion and post-arrest care (Panchal et al., 2020; Soar et al., 2021). Early coronary angiography pathways and organized cardiac arrest centers can improve outcomes, making destination choice a critical decision node.

10) Documentation, communication, and shared decision inputs: Finally, decisions are shaped by communication with dispatch, bystanders, and receiving teams, and by documentation that justifies deviations from protocol when clinically appropriate. High-reliability communication reduces hands-off time and supports ethically sound TOR conversations (Soar et al., 2021; Panchal et al., 2020).

Cognitive and Human Factors in Paramedic Decisions

Decision-making during out-of-hospital cardiac arrest (OHCA) is not solely guided by protocols; it is strongly influenced by the cognitive and human factors that shape how paramedics perceive, process, and act under pressure. Unlike controlled hospital environments, prehospital cardiac arrest care is characterized by uncertainty, dynamic conditions,

and emotional intensity, which introduce additional challenges to decision-making.

Paramedics must make rapid, life-or-death decisions often within seconds. High stress levels can impair working memory, limit attention, and accelerate reliance on cognitive shortcuts (heuristics) rather than analytical reasoning (Carter et al., 2019). Time-critical choices, such as whether to intubate or focus on compressions, are frequently made under the influence of adrenaline, noise, and chaotic environments, which can increase the risk of errors or missed opportunities (Flowerdew et al., 2012).
Paramedics often work long shifts and respond to multiple high-acuity calls, resulting in fatigue that diminishes cognitive performance. Fatigue reduces vigilance and increases the risk of poor resuscitation quality or premature termination decisions (Sinden et al., 2013). Cognitive overload, caused by simultaneous demands such as monitoring rhythm, managing the airway, and coordinating with team members, can further hinder situational awareness (Carter et al., 2019).

Experienced paramedics frequently rely on **pattern recognition and intuition**, developed through exposure to numerous cases, to make swift judgments (Klein, 2008). While this can enhance efficiency, it can also result in biases. For example, a paramedic might prematurely classify a patient as unsalvageable based on prior encounters, potentially leading to early termination of resuscitation. Conversely, novices may adhere rigidly to algorithms without recognizing when deviation is clinically appropriate (Schmidbauer et al., 2019).
Paramedic decision-making rarely occurs in isolation; it is shaped by team interactions and role clarity. Effective communication supports shared situational awareness, while poor teamwork can increase hands-off time and delay interventions (Pang et al., 2022). Leadership within paramedic teams is critical, as clear role delegation reduces cognitive load and allows individuals to focus on core tasks.

The presence of family members, young patients, or emotionally charged circumstances adds a psychological layer to decisions. Paramedics often report feeling moral distress when deciding whether to continue resuscitation against low odds of survival or in cases where family wishes conflict with clinical judgment (Anderson et al., 2018). Such stressors may sway decisions in ways not entirely aligned with evidence-based practice.

Decision-making capacity improves with clinical exposure and scenario-based training. Simulation has been shown to strengthen cognitive resilience, improve situational awareness, and reduce reliance on flawed heuristics (Hunziker et al., 2011). Structured reflection on past cases also enhances metacognition, enabling paramedics to recognize and mitigate cognitive biases in future calls.

In sum, paramedic decisions in OHCA are not merely technical applications of guidelines but human judgments shaped by stress, fatigue, experience, and interaction with others. Addressing these cognitive and human factors—through resilience training, decision-support tools, and structured team communication—may improve both decision quality and patient outcomes.

Ethical and Legal Considerations in Paramedic Decision-Making

Decision-making during out-of-hospital cardiac arrest (OHCA) does not occur in a vacuum of clinical guidelines alone; it is deeply shaped by ethical principles and legal frameworks. Paramedics are often required to make immediate judgments about the continuation or cessation of resuscitation while simultaneously navigating questions of patient autonomy, beneficence, non-maleficence, and justice. These dilemmas are heightened in environments where legal obligations, professional codes of conduct, and societal expectations intersect. One of the most ethically challenging decisions for paramedics involves determining when ongoing resuscitation is futile. Evidence-based TOR rules have been developed to guide these decisions, such as the *Basic Life Support TOR rule* (no ROSC, no shocks delivered, and unwitnessed arrest by EMS) and the *Advanced Life Support TOR rule* (no ROSC after full ALS interventions) (Morrison et al., 2006; Panchal et al., 2020). While these rules reduce unnecessary hospital transports and resource strain, paramedics frequently express moral unease when ceasing efforts in the presence of grieving families (Anderson et al., 2018).

Respecting patient autonomy requires honoring valid DNR orders or advance directives. However, in the prehospital context, such documents may be unavailable, unclear, or contested by family members, creating legal and ethical uncertainty (Nichol et al., 2020). Paramedics may face accusations of either failing to honor patient wishes or prematurely withdrawing care without adequate verification. This tension often leads clinicians to err on the side of attempting resuscitation, even when survival is improbable, to avoid potential legal repercussions.

Family members present at the scene often exert influence on paramedic decisions, requesting either aggressive intervention or early cessation. While involving families in decision-making can provide moral legitimacy, it may also conflict with clinical judgment or established TOR criteria. Research suggests that family presence during resuscitation

can create pressure to prolong futile interventions, which may not align with patient dignity or resource stewardship (Bossaert et al., 2015).

Ethical decision-making in OHCA also involves distributive justice—balancing the intensive resources invested in resuscitation against broader system needs. Prolonged resuscitation attempts with negligible survival odds may divert resources from other emergencies, raising ethical questions about fairness in allocation (Soar et al., 2021). In rural or resource-limited settings, paramedics must often weigh whether transport is feasible or whether efforts should remain focused on local scene care.
Legal frameworks governing paramedic decisions differ substantially across countries and states. In some jurisdictions, termination decisions must be made in consultation with medical control physicians, whereas in others, TOR protocols empower paramedics to independently cease efforts. Fear of litigation can influence decisions, leading to unnecessary transports or prolonged resuscitation despite clinical futility (Nichol et al., 2020). Clarity in legislation and institutional policies can mitigate moral distress and provide legal protection for evidence-based termination.

Finally, ethical complexity contributes to paramedics' professional stress and identity challenges. Being compelled to continue futile interventions, or conversely, stopping resuscitation in front of families, can lead to moral injury and long-term psychological strain (Anderson et al., 2018). Supporting paramedics with ethics education, structured debriefing, and clear legal frameworks can reduce distress and strengthen decision confidence.

In summary, ethical and legal considerations represent a core dimension of paramedic decision-making in OHCA. While guidelines offer clinical direction, decisions are shaped by the interplay of patient autonomy, family expectations, societal values, and medico-legal realities. Addressing these issues requires clear TOR frameworks, accessible documentation of patient wishes, and institutional support to protect both patients and providers in these high-stakes scenarios.

System and Organizational Influences
Paramedic decision-making in out-of-hospital cardiac arrest (OHCA) is shaped as much by the **system** in which care is delivered as by individual clinical judgment. Organizational structures, protocols, staffing models, data systems, and culture create the context that either enables or constrains high-quality, guideline-concordant decisions at the scene.

Clear, locally adapted protocols (e.g., TOR criteria, airway sequencing, epinephrine timing, "stay-and-treat" vs. transport) reduce ambiguity and variation between crews. Strong real-time and retrospective **medical direction** (on-line consultation, case review, and feedback) supports ethically and legally sound choices under uncertainty (Panchal et al., 2020; Soar et al., 2021). Alignment of EMS protocols with receiving-hospital capabilities (e.g., cardiac arrest centers) streamlines destination decisions after ROSC (Panchal et al., 2020).

Organizational investment in **pit-crew/high-performance CPR**, simulation-based training, and structured debriefings improves coordination, reduces hands-off time, and strengthens shared mental models for rapid decisions (Greif et al., 2021; AHA 2020 education & systems guidance in Panchal et al., 2020). Regular skills refreshers guard against skill decay in low-frequency, high-stakes procedures (e.g., advanced airway) and help clinicians recognize and mitigate cognitive biases.
System design choices—dispatch-assisted CPR, tiered response (first-responder defibrillation), optimal crew size, and targeted response times—shape the *decisions available* when crews arrive (Panchal et al., 2020; Gräsner et al., 2021). For example, rapid first-shock capability can prioritize defibrillation pathways, while limited personnel in rural systems may favor SGA over early intubation to preserve compression quality. Policies that favor **on-scene resuscitation** until ROSC or TOR criteria are met, except in specific circumstances, help protect CPR quality during decision-heavy phases (Soar et al., 2021).

Organizations that mandate real-time CPR quality feedback (rate, depth, recoil), post-event **hot/warm debriefs**, and participation in regional/national registries (e.g., CARES, EuReCa) create learning loops that directly inform future decisions (Greif et al., 2021; Gräsner et al., 2021). Data transparency enables services to refine TOR thresholds, airway algorithms, and transport policies based on *local* outcome patterns rather than borrowed assumptions. Electronic patient care records (ePCR), synchronized monitor/defibrillator downloads, and checklists/cognitive aids standardize critical steps and provide **decision scaffolding** without replacing clinical judgment (Panchal et al., 2020). Some systems are piloting risk-prediction tools to guide TOR or destination choices; organizational guardrails (governance, audit, education) are essential to avoid over-reliance and to ensure equitable use (Soar et al., 2021).

Urban–rural disparities (device availability, crew numbers, transport distances) create different decision frontiers: rural crews may prioritize maintainable airway strategies and scene-based

care; urban systems may emphasize rapid access to catheterization or ECMO capabilities. Organizational attention to **equity**—bystander CPR training, AED access, language-appropriate dispatcher scripts—expands the upstream conditions for better on-scene choices (Panchal et al., 2020).

Shift length, fatigue management, psychological support, and a **just culture** influence risk tolerance and willingness to deviate from protocol when clinically indicated. Services that normalize second-victim support and provide structured ethical consultation reduce moral distress surrounding TOR decisions and difficult family interactions (Greif et al., 2021).

Formalized pathways with emergency departments, interventional cardiology, and intensive care (e.g., postcardiac arrest bundles, direct-to-cath-lab protocols) simplify **destination** and **post-ROSC** decisions. Feedback from hospitals back to EMS (neurological outcomes, survival) closes the loop so field decisions can be recalibrated against meaningful endpoints (Panchal et al., 2020; Gräsner et al., 2021).

During pandemics or mass-casualty events, organizations may temporarily revise PPE, airway, or TOR policies. Clear, ethically grounded **crisis standards of care** preserve decision consistency under scarcity while protecting crews (Soar et al., 2021).

Systems that invest in aligned protocols, robust education/debriefing, data-driven QI, supportive culture, and hospital integration give paramedics the *conditions* to make faster, safer, and more consistent OHCA decisions—ultimately improving ROSC, survival, and neurological outcomes.

Technology and Decision Support

Advances in technology are increasingly influencing how paramedics make decisions in the high-stakes context of out-of-hospital cardiac arrest (OHCA). Decision-making, traditionally based on a combination of protocols and clinical judgment, is now supported by mechanical devices, digital tools, and emerging artificial intelligence (AI) applications. These innovations aim to improve consistency, reduce human error, and optimize patient outcomes.

Automated chest compression devices, such as the LUCAS and AutoPulse, have been introduced to maintain high-quality compressions during prolonged resuscitations or transport. Randomized controlled trials, including the LINC and CIRC studies, demonstrated that while mechanical CPR does not improve overall survival compared with manual compressions, it ensures standardization and frees providers to focus on other critical tasks (Rubertsson et al., 2014). Paramedics must decide when such devices are beneficial, especially in situations of provider fatigue, limited staffing, or unsafe environments.

Modern defibrillators and CPR monitors provide real-time metrics on compression depth, rate, recoil, and ventilation. Evidence suggests that feedback improves CPR quality and adherence to resuscitation guidelines (Couper et al., 2019). These tools act as cognitive aids, reducing reliance on memory under stress and supporting decision-making about when to adjust performance.

Capnography has become a standard adjunct for confirming airway placement and monitoring resuscitation quality. End-tidal CO_2 values guide decisions on resuscitation effectiveness and can help paramedics assess the likelihood of return of spontaneous circulation (ROSC) or determine futility (Soar et al., 2021).

Several EMS systems are adopting digital algorithms and apps that guide paramedics through resuscitation steps, reminding crews of drug timings, rhythm reassessments, and TOR criteria. These reduce cognitive load and standardize care, though their effectiveness depends on paramedic acceptance and integration into workflow (Greif et al., 2021).

AI-driven tools are emerging to assist with decisions on prognosis and TOR. Predictive models using prehospital data (initial rhythm, response time, patient age, bystander CPR) have shown promise in forecasting survival with good neurological outcomes (Nakahara et al., 2022). While still in early stages, these systems may support paramedics in balancing aggressive treatment with futility considerations. Concerns remain, however, regarding transparency, ethical implications, and the risk of over-reliance on algorithms.

Real-time communication with physicians via telemedicine platforms allows paramedics to receive expert input on complex resuscitations, especially in systems where TOR decisions require medical authorization. This integration strengthens paramedics' confidence and ensures consistency across providers (Metelmann et al., 2019).

In summary, technology offers powerful tools to support paramedic decision-making in OHCA. Mechanical CPR devices, feedback systems, and capnography enhance the quality of care, while AI and decision-support apps promise greater precision in prognostication. Yet, these tools should be seen as adjuncts to—not replacements for—paramedics'

clinical judgment, ethical reasoning, and situational adaptability. Successful integration requires organizational support, ongoing training, and safeguards to ensure technology augments rather than undermines decision-making in the field.

Clinical Outcomes and Evidence

Paramedic decision-making during out-of-hospital cardiac arrest (OHCA) is tightly linked to patient-level outcomes—return of spontaneous circulation (ROSC), survival to discharge, and neurologic status. Evidence across registries, randomized trials, and implementation studies shows that **what** paramedics do (and **when**) measurably shifts these endpoints.

For shockable rhythms (VF/pVT), rapid defibrillation and uninterrupted, guideline-quality compressions are the strongest prehospital levers for survival and neurologic recovery. Survival decreases with each minute of defibrillation delay, while minimizing hands-off time and maintaining recommended depth/rate correlate with higher ROSC and discharge survival (Panchal et al., 2020; Soar et al., 2021). Real-time feedback improves CPR metrics and has been associated with better process quality and, in some systems, improved outcomes (Couper et al., 2019).

Randomized trials comparing initial supraglottic airway (SGA) vs endotracheal intubation (ETI) in OHCA (AIRWAYS-2 and PART) found **no superiority** of early ETI; in some analyses, SGA strategies yielded similar or better functional outcomes, likely by reducing pauses in compressions and simplifying on-scene workflow (Benger et al., 2018; Wang et al., 2018). Thus, airway decisions that preserve compression continuity tend to favor ROSC and neurologic outcomes.

PARAMEDIC2 demonstrated that epinephrine increased 30-day survival versus placebo, with a small absolute benefit and a higher proportion of survivors with severe neurologic impairment—highlighting a trade-off that paramedics and systems must weigh (Perkins et al., 2018). Earlier administration (particularly in non-shockable rhythms) is associated with higher ROSC, but ultimate neurologic benefit remains nuanced (Panchal et al., 2020; Soar et al., 2021).
Large RCTs and meta-analyses (e.g.,

LINC/CIRC/other trials reported by Rubertsson et al.) have **not** shown routine survival or neurologic advantage over high-quality manual CPR (Rubertsson et al., 2014). However, mechanical devices can maintain compression quality during transport or prolonged efforts and may reduce provider fatigue—contextual benefits that can indirectly support outcomes when manual quality is otherwise compromised (Soar et al., 2021).

Many systems that emphasize on-scene resuscitation until ROSC or termination-of-resuscitation (TOR) criteria are met report better CPR quality and defibrillation cadence, translating to improved ROSC; transporting during ongoing CPR often worsens compression quality and defibrillation timing (Panchal et al., 2020; Soar et al., 2021). Exceptions include safety concerns, refractory VF candidates for hospital-based advanced therapies, or special populations (e.g., pregnancy).

Continuous waveform capnography supports airway confirmation and provides prognostic insight. Low and persistently declining end-tidal CO_2 during high-quality CPR suggests poor likelihood of ROSC, whereas rapid rises can signal imminent ROSC—information that informs decisions to continue, escalate, or consider TOR (Soar et al., 2021).

Validation studies of BLS and ALS TOR rules show that patients meeting criteria (e.g., unwitnessed by EMS, no shocks delivered, no ROSC) have extremely low survival, supporting on-scene termination and avoiding low-value transport (Morrison et al., 2006; Panchal et al., 2020). Emerging AI-based prediction models using prehospital variables show promise in forecasting survival with good neurologic outcome, but require careful governance before influencing field TOR decisions (Nakahara et al., 2022).

Post-ROSC pathways that include rapid 12-lead ECG, targeted oxygenation/ventilation, avoidance of hypotension, and triage to **cardiac arrest centers** with coronary angiography capability are associated with improved survival and neurologic outcome (Panchal et al., 2020; Soar et al., 2021). Thus, destination and early post-ROSC management are outcome-critical decision nodes.

Although upstream of paramedic arrival, dispatcher-assisted CPR and public-access defibrillation substantially raise the baseline probability of ROSC and survival—thereby changing the downstream impact of paramedic choices (Gräsner et al., 2021; Panchal et al., 2020). Systems that optimize these elements create conditions where field decisions yield greater absolute gains.

Outcomes in OHCA hinge on a tight chain: early defibrillation, compression quality, airway strategies that minimize interruptions, judicious drug use, context-aware use of mechanical CPR, and data-informed TOR—all wrapped in systems that deliver robust post-ROSC care. Paramedic decisions at each node contribute incrementally; when aligned with

evidence and supported by system design, they compound into meaningful improvements in survival and neurological recovery.

DISCUSSION:

This review highlights the complexity of paramedic decision-making in out-of-hospital cardiac arrest (OHCA), where survival outcomes depend not only on adherence to evidence-based protocols but also on cognitive, ethical, organizational, and technological factors. Unlike hospital-based resuscitation, the prehospital context demands rapid, high-stakes decisions made in dynamic, often unpredictable environments.

While international resuscitation guidelines (AHA, ERC) provide structured pathways for interventions, paramedics frequently face scenarios where strict protocol adherence is insufficient. For example, airway management decisions must balance guideline recommendations with scene constraints, provider skill, and the risks of interrupting compressions (Benger et al., 2018; Wang et al., 2018). Similarly, TOR rules help standardize futility decisions, yet family presence or unclear documentation often forces clinicians to deviate from algorithmic logic (Morrison et al., 2006; Nichol et al., 2020). These realities underscore the need for flexible decision frameworks that respect both evidence and situational nuance.

Cognitive load, stress, fatigue, and heuristics significantly influence paramedic choices. Experienced clinicians often rely on intuition, which may speed decisions but introduce biases (Klein, 2008). Conversely, novices may adhere rigidly to guidelines, risking delays in adapting to unique patient presentations. Structured training, reflective practice, and simulation-based education can mitigate these limitations by enhancing situational awareness and decision resilience (Hunziker et al., 2011; Carter et al., 2019).

Ethical tensions emerge most clearly in termination decisions and in respecting patient autonomy through DNR or advance directives. Paramedics often report moral distress when ceasing resuscitation in front of families or when compelled to continue interventions deemed futile (Anderson et al., 2018; Bossaert et al., 2015). Variability in legal frameworks across jurisdictions amplifies this stress, particularly where medico-legal accountability for TOR decisions is ambiguous. These findings suggest a need for clearer policies, legal protections, and access to ethics support in the prehospital domain.

Decisions are strongly influenced by EMS system design, including dispatch models, training investments, and integration with hospitals. Evidence indicates that systems promoting high-performance CPR, structured debriefing, and data-driven quality improvement consistently achieve better outcomes (Greif et al., 2021; Gräsner et al., 2021). Integration with specialized cardiac arrest centers further improves post-ROSC survival, demonstrating that system-level organization directly shapes the decision landscape.

The growing role of mechanical CPR devices, real-time feedback, capnography, and AI-based prediction models offers promising support for decision-making. These tools reduce cognitive burden and provide objective markers of resuscitation quality. However, concerns remain about over-reliance on technology, the risk of undermining clinical judgment, and the ethical implications of algorithm-driven TOR decisions (Nakahara et al., 2022). Successful adoption will depend on embedding technology within supportive governance frameworks and ongoing education.

International studies demonstrate wide variability in OHCA survival, reflecting differences in bystander CPR rates, AED access, EMS resources, and legal authority for TOR (Gräsner et al., 2021). In low- and middle-income countries, limited technology and fewer personnel amplify the reliance on paramedics' judgment under constrained conditions. Addressing these disparities will require global collaboration to adapt evidence-based decision frameworks across diverse resource contexts.

The evidence suggests that improving paramedic decision-making requires interventions at multiple levels:

- Enhancing **training and simulation** to address cognitive and emotional challenges.
- Strengthening **ethical and legal frameworks** to reduce moral distress and provide clarity.
- Investing in **system-level integration** with hospital pathways and registries to align prehospital and in-hospital care.
- Leveraging **technology cautiously** as decision support, not replacement.

Research should prioritize large-scale prospective studies linking decision pathways to outcomes, the role of AI-driven decision support, and cross-jurisdictional comparisons of TOR implementation. Additionally, qualitative studies exploring the lived experiences of paramedics in decision-making contexts will provide valuable insight into the human dimensions often overlooked in outcome-driven research.

Ultimately, paramedic decision-making in OHCA is a multidimensional process requiring the integration of guidelines, human judgment, ethics, system design, and technology. Recognizing and addressing

these intersecting factors will be central to improving patient outcomes, supporting clinicians, and advancing the science of prehospital resuscitation.

CONCLUSION:

Out-of-hospital cardiac arrest (OHCA) remains one of the most critical emergencies in medicine, where every second counts and paramedic decision-making can mean the difference between life and death. This review has highlighted how paramedics' choices—whether to initiate or terminate resuscitation, how to manage the airway, when to deliver defibrillation, administer drugs, or decide on transport—directly shape patient outcomes. While international guidelines such as those from the American Heart Association (AHA) and European Resuscitation Council (ERC) provide essential frameworks, the realities of the field demand that paramedics combine these protocols with situational awareness, experience, and ethical reasoning.

Human and cognitive factors—stress, fatigue, intuition, and team dynamics—play a significant role in shaping judgment, sometimes enhancing but also potentially biasing decision-making. Ethical and legal complexities, particularly around do-not-resuscitate orders and termination of resuscitation, add layers of difficulty that can lead to moral distress without clear organizational or legal support. System-level design, including training, quality improvement programs, medical oversight, and integration with post-arrest care pathways, strongly influences the quality and consistency of decisions across EMS providers.

Technology offers powerful opportunities, from mechanical CPR devices to real-time feedback, capnography, telemedicine, and emerging AI-based prediction models. Yet, these must be implemented thoughtfully to support, rather than replace, paramedic judgment. Moving forward, strengthening education, providing ethical and legal clarity, and embedding decision-support tools within robust governance systems will be essential to improving both patient outcomes and paramedic resilience.

In conclusion, paramedic decision-making in OHCA is a multidimensional process at the intersection of science, ethics, and human factors. Optimizing this process requires coordinated efforts at the individual, organizational, and policy levels, ensuring that paramedics are equipped, supported, and empowered to navigate life-or-death decisions with confidence and compassion.

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