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REVIEWS

STAKEHOLDER ACCEPTANCE OF DRONES IN PREHOSPITAL EMERGENCY CARE: AN INTEGRATIVE REVIEW

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ABSTRACT

Objectives: Drones are increasingly examined as tools to strengthen prehospital emergency care through rapid supply delivery, improved scene access, and situational support. Successful integration depends not only on technical performance, but on how drones are perceived by clinicians, telecommunicators, bystanders, patients, and communities. This integrative review, informed by the Technology Acceptance Model (TAM), synthesized empirical evidence on stakeholder perspectives regarding drone integration in prehospital emergency care to identify perceived benefits, concerns, and implications for practice and policy.

Methods: Five databases were searched in November 2025: CINAHL, PubMed, Web of Science, Embase, and Google Scholar. English-language peer-reviewed studies from the previous 10 years were included if they examined stakeholder perceptions of drones in prehospital or emergency contexts. Studies without perceptual data or unrelated to prehospital care were excluded. Included studies were appraised using the Mixed Methods Appraisal Tool (MMAT) and synthesized thematically.

Results: Eighteen empirical studies were included, reflecting perspectives of bystanders, health care professionals, telecommunicators, patients, and community members. Five themes emerged: perceived value and acceptance; safety and ethical concerns; usability experiences; operational feasibility and system readiness; and training needs. Perceived usefulness was the strongest driver of acceptance; perceived ease of use was more variable and shaped by communication, preparation, and contextual readiness.

Conclusions: Drone adoption in prehospital emergency care requires human and organizational readiness alongside technical capability. Implementation should prioritize drone-integrated workflows, telecommunicator and community training, and equitable deployment planning.

BACKGROUND

Drones, or unmanned aerial vehicles (UAVs), are increasingly being explored as tools to improve prehospital emergency response. Their advantage lies in their capacity for rapid deployment, relative independence from road traffic, and potential to shorten the delay between the onset of a medical emergency and the arrival of emergency medical services (EMS) (Claesson et al., 2017; Roberts et al., 2023). In this review, prehospital emergency care refers to the assessment and initial treatment of acute med-

ical conditions before or during transport to a hospital, involving EMS personnel, telecommunication coordination, and often lay bystander participation.

The clinical urgency is considerable. Out-of-hospital cardiac arrest (OHCA) affects more than 350,000 people annually in the United States, and survival to hospital discharge for adult EMS-treated nontraumatic OHCA remains approximately 9.1% (Martin et al., 2025). Time to defibrillation is especially consequential: Virani et al. (2020) reported that nearly 60% of patients defibrillated within two minutes survived, compared with 13.2% of those defibrillated within 10 minutes.

Drones have shown promise as one strategy to reduce this delay. Claesson et al. (2017) found that autonomous drones arrived faster than EMS in all tested cases during a simulated AED delivery study. By the mid-2020s, drone-enabled AED delivery had moved from simulation into real-world dispatch studies and pilot implementation, particularly in Sweden, though routine large-scale integration remains limited (Schierbeck et al., 2022; Smith et al., 2025; Zègre-Hemsey et al., 2024).

Successful integration, however, depends on more than technical performance. End-user reactions, trust, usability, and workflow fit shape whether a technology is meaningfully adopted. This concern is especially salient in prehospital contexts, where drone interventions may depend on telecommunicators, clinicians, or lay responders making rapid decisions under acute stress with limited prior training.

Existing reviews have not fully addressed this stakeholder-centered question. Roberts et al. (2023) emphasized operational potential and time-to-intervention more than stakeholder perceptions. Stephan et al. (2022) focused narrowly on user interaction in experimental OHCA studies. Sanz-Martos et al. (2022) summarized applications and feasibility without centering acceptance across stakeholder groups. The present review addresses this gap by synthesizing how health care professionals, telecommunicators, bystanders, patients, and community members perceive the value, usability, risks, and acceptability of drone integration across prehospital emergency settings. Based on the prior review literature identified, this appears to be the first integrative review to synthesize perspectives across all five of these stakeholder groups and one of the first to interpret findings through the Technology Acceptance Model.

THEORETICAL FRAMEWORK

This review was informed by the Technology Acceptance Model (TAM) (Davis, 1989). TAM proposes that technology acceptance is shaped primarily by perceived usefulness, or the extent to which a system is believed to enhance performance, and perceived ease of use, or the extent to which the system is perceived as free of effort. These perceptions influence attitudes toward use, behavioral intention, and eventual adoption.

TAM informed the construction of the review question, search strategy, and data extraction domains. Thematic coding proceeded inductively, and resulting themes were subsequently interpreted in relation to TAM constructs: perceived value and acceptance align most closely with perceived usefulness, while usability experiences correspond to perceived ease of use. Training needs, operational readiness, and safety and ethical concerns reflect contextual influences shaping both.

TAM has recognized limitations in health care contexts. It does not fully account for organizational constraints, clinical complexity, or involuntary adoption. Related frameworks including Normalization Process Theory and Diffusion of Innovations may better capture implementation dynamics. In this review, TAM is useful for understanding judgments of value and usability but insufficient to explain the full regulatory, ethical, and sociopolitical complexity of drone integration.

PURPOSE STATEMENT

The purpose of this integrative review is to synthesize the existing literature on stakeholder perspectives regarding drone integration in prehospital emergency care. Specifically, this review aims to (1) describe how health care professionals, telecommunicators, bystanders, patients, and community members understand, value, and experience drone use across prehospital emergency applications; (2) identify common and context-specific perceived benefits, concerns, and influences on acceptance; and (3) outline implications for practice, policy, and future research. This review sought to answer: How do stakeholders across prehospital emergency care contexts perceive the value, usability, safety, and acceptability of drone integration?

METHODS

Design

This review used integrative review methodology to synthesize primary empirical evidence across multiple methodological traditions (Whittemore & Knafl, 2005). A predefined review protocol was developed before screening and data extraction to guide search, eligibility, selection, extraction, appraisal, and thematic synthesis procedures. The protocol was not prospectively registered in PROSPERO—a limitation that reduces external transparency—but was applied consistently throughout to improve rigor. Review reporting was informed by PRISMA 2020 guidance (Page et al., 2021).

Search Strategy

A systematic literature search was conducted in November 2025 across CINAHL, PubMed, Web of Science, Embase, and Google Scholar. Search terms were organized into three conceptual domains: drone terminology (e.g., "drone," "UAV," "UAS"), prehospital and emergency terminology (e.g., "prehospital," "EMS," "triage," "search and rescue"), and perception terminology (e.g., "perception," "attitude," "acceptance," "trust"). Domains were combined using Boolean operators, truncation, and database-specific controlled vocabulary including MeSH terms. Full search strings are provided in Appendix A. The search was limited to English-language, peer-reviewed publications from the past 10 years. Grey literature, dissertations, and preprints were excluded. In Google Scholar, the first 200 results were eligible for screening per protocol. The Google Scholar search returned 166 results, all of which were screened. No published, validated search filters were applied; the search strategy was developed de novo for this review, with each database string constructed independently using database-specific controlled vocabulary and syntax. The search strategy was developed in consultation with a health sciences librarian, who reviewed the search terms and database syntax during development. A formal peer-review instrument was not used.

Eligibility Criteria

Eligibility criteria were informed by the SPIDER framework (Cooke et al., 2012), encompassing: Sample (nurses, paramedics, clinicians, telecommunicators, patients, bystanders, and community members); Phenomenon of Interest (drone use in prehospital, disaster, search-and-rescue, and emergency contexts); Design (qualitative, quantitative descriptive, and mixed-methods studies); and Evaluation (stakeholder-reported perceptions or experiences of drone use).

Studies were included if they were published in English within the previous 10 years, examined stakeholder perceptions of drones in prehospital or emergency contexts, used qualitative, quantitative descriptive, or mixed-methods designs, and addressed medical drone applications such as AED delivery, medication delivery, scene assessment, triage, or search-and-rescue. Studies were excluded if they focused on engineering or technical performance without perceptual data, investigated drone applications unrelated to prehospital emergency care, or were not full-text, peer-reviewed English-language articles within the specified date range.

Study Selection

All search results were imported into EndNote for deduplication and uploaded into Covidence for secondary deduplication and screening. Study selection occurred in two stages: title and abstract screening, followed by full-text review. Screening was conducted by one reviewer using the predefined eligibility criteria. Because dual independent screening was not performed, the review carries increased risk of selection bias. Reasons for exclusion at the full-text stage were recorded. The study selection process is reported using a PRISMA flow diagram (Figure 1).

Data Extraction

A standardized extraction form in Covidence was used to collect citation information, study setting, participant groups, sample size, study aim, drone application, study design, theoretical framework, key findings related to stakeholder perceptions, strengths and limitations, and funding source. Extracted data were organized into a study characteristics matrix summarized in Table 1.

Quality Appraisal

Included studies were appraised using the Mixed Methods Appraisal Tool (MMAT) version 2018, which provides design-specific quality criteria applicable to qualitative, quantitative, and mixed-methods studies (Hong et al., 2018). Appraisal was conducted by one reviewer. Results are presented in Appendix B.

Thematic Synthesis

Data synthesis followed thematic synthesis methods informed by Thomas and Harden (2008). Key perception-related findings were extracted verbatim, grouped into descriptive codes, and progressively consolidated into analytic themes. Coding proceeded inductively without predetermined categories. Resulting themes were subsequently interpreted in relation to TAM constructs.

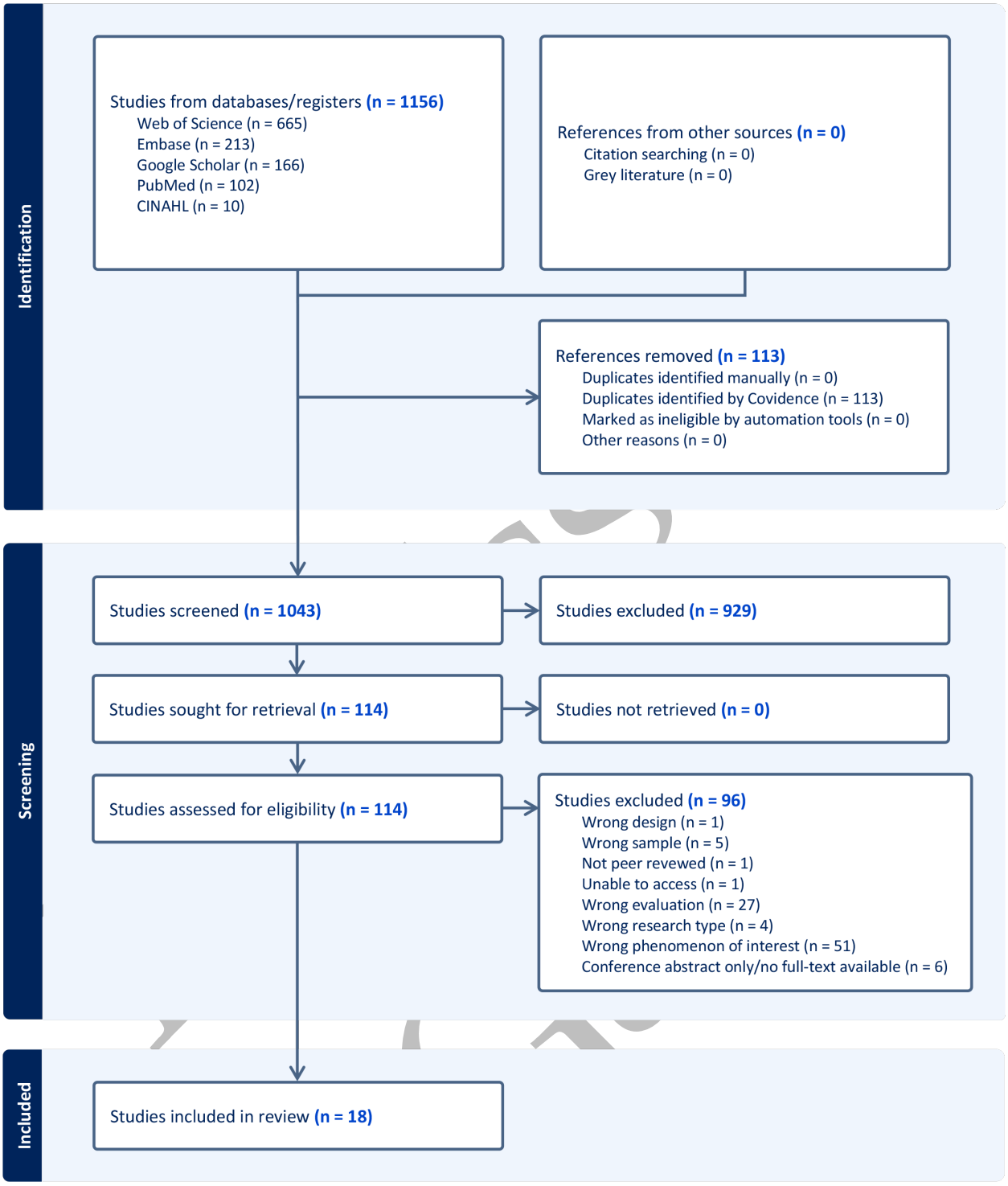

Figure 1. PRISMA flow diagram.

Author/ Year	Country	Design	Population/ Sample	Sample Size	Drone Application	Key Perception-Related Findings
Bernstein et al., 2025	UK	Qualitative interview study	Real-life OHCA bystanders	14	Drone-delivered AED for OHCA	Bystanders generally accepted drone-delivered AEDs in principle but were uncertain about effectiveness, retrieval, and use under stress. Low AED literacy was prominent. Participants suggested training, regulation, visibility/access improvements, call-handler scripts, and co-responder support.
Fink et al., 2023	Germany	Qualitative focus-group study	Patients, pharmacists, physicians, and nurses	36	Medical drone delivery of medicines	Participants viewed drones as useful for limited mobility, time-critical medication, emergencies, disasters, and rural delivery. Knowledge deficits and the need for education were recurring concerns.
Finney et al., 2025	UK	Qualitative study	Older adults interviewed	12	Drone-delivered AED for OHCA	Participants identified themes of human-drone interaction, societal benefit, and safety. Concerns focused more on AED use and leaving the patient than on the drone itself.
Dalby-Pedersen et al., 2024	Sweden	Qualitative phenomenological interview study	Registered nurses / dispatcher nurses	10	Drone-delivered AED for OHCA	Dispatcher nurses described variable protocol compliance, uncertainty about acceptable CPR interruption, and the importance of technical support, routines, and training.
Hartman et al., 2020	USA	Prospective simulation survey study	Conference attendees	44	Drone-assisted delivery of life-saving supplies during mass-casualty triage	Participants under-triaged overall, but confidence improved after the exercise. Most were initially unaware of drone use in mass-casualty incidents and rated drones as useful after the simulation.
Holzmann et al., 2021	Austria	Quantitative survey study	Mountain rescuers	146	Drones in mountain rescue missions	Behavioral intention to adopt drones was driven by performance expectancy and facilitating conditions. Previous drone experience strengthened adoption; effort expectancy and social influence were not significant.
Kim et al., 2021	South Korea	Mixed methods randomized simulation study	College students randomized to audio-only vs. video plus audio groups	24	Drone-delivered AED for OHCA	Video-assisted instruction improved CPR performance measures. Qualitative findings suggested that drone use felt unfamiliar but helpful, provided emotional support, and generated mixed views about the technology.
Mahmoud & Mahroof, 2025	Multi-country social media dataset	Mixed-methods big-data content analysis	Reddit and YouTube comments	2,337 cleaned comments from 6,403 scraped comments	Drone delivery in extreme contexts	Five themes emerged: safety/security, skepticism/distrust, ethical concerns, support for innovation/efficiency, and practicality/feasibility. Overall sentiment was slightly more negative than positive.
Ornato et al., 2020	USA	Quantitative simulation study	Waiting-room patients and visitors	30	Drone-delivered naloxone for opioid overdose	All participants successfully administered naloxone. Prior medical training and familiarity with nasal spray devices shortened delivery time.

Table 1. Characteristics of the 18 included studies.

Author/ Year	Country	Design	Population/ Sample	Sample Size	Drone Application	Key Perception-Related Findings
Rosamond et al., 2020	USA	Quantitative randomized simulation study	Bystanders at a public access site	50	Drone-delivered AED for OHCA	Participants who received drone delivery retrieved the AED and applied it more quickly than controls. Participants expressed high overall satisfaction and willingness to use the drone again.
Sanfridsson et al., 2019	Sweden	Mixed methods simulation study	Lay bystanders	23	Drone-delivered AED for OHCA	Participants generally had positive experiences. Key challenges included drone noise, uncertainty about approach, and time taken to retrieve the AED. Most preferred the drone over waiting for EMS.
Sedig et al., 2020	Canada	Qualitative interview study	Public community members	25	Drone-delivered AED for OHCA	Participants supported drone AED delivery but many had no AED literacy. Themes included public trust, the importance of guidance, and the value of community education campaigns.
Showalter et al., 2025	USA	Mixed methods simulation study	Nursing students	NR	Drone technology in obstetrical simulation	Simulation improved students' understanding of and readiness for technology-based care delivery. Students reported increased confidence and interest in drone-enabled care.
Smith et al., 2025	UK	Mixed methods simulation study	Bystander lay responders	53	Drone-delivered AED for OHCA	Participants successfully retrieved and applied AEDs. Common challenges included approach uncertainty and payload retrieval. Most supported ongoing drone AED programs.
Truog et al., 2020	Multi-country (Malawi, Mozambique, Democratic Republic of the Congo, Dominican Republic)	Qualitative community perception study	Rural community members and leaders	450	Medical drone delivery	Community acceptance was contingent on trust in the operating organization, understanding of drone purpose, and perception of community benefit. Distrust of external actors was a key barrier.
Wankmüller et al., 2021	Multi-country dataset (Austria, Italy)	Qualitative usability test study	Multi-disciplinary emergency responders	146	Drones in cross-border emergency response	Participants valued drone speed but identified key usability challenges in handoff coordination, airspace management, and role clarity across agencies.
Zègre-Hemsey et al., 2020	USA	Qualitative embedded simulation study	Lay bystanders	50	Drone-delivered AED for OHCA	Positive interaction with drone delivery; usability challenges included noise, approach uncertainty, and interruption to CPR. Communication from dispatchers was identified as a critical success factor.
Zhang et al., 2025	China	Quantitative descriptive survey study	Medical professionals	239	Drone delivery of medical supplies	High overall acceptance. Perceived usefulness, ease of use, and system reliability were significant predictors of acceptance. Older professionals and those in rural areas expressed stronger support.

Note. OHCA = out-of-hospital cardiac arrest; AED = automated external defibrillator; NR = not reported; UAV = unmanned aerial vehicle.

Table 1 (continued). Characteristics of the 18 included studies.

RESULTS

Study Characteristics

The database search yielded 1,156 records before deduplication: Web of Science (n = 665), Embase (n = 213), Google Scholar (n = 166), PubMed (n = 102), and CINAHL (n = 10). After the removal of 113 duplicate records, 1,043 records remained for screening. Following title and abstract screening and full-text review, 18 studies were included. Across the included studies, participants were drawn from 13 countries. Eight countries were represented by single-country studies (United States, United Kingdom, Sweden, Germany, South Korea, Canada, Austria, and China), and three used multi-country designs: one spanning Malawi, Mozambique, the Democratic Republic of the Congo, and the Dominican Republic; one spanning Austria and Italy; and one drawing on an international social media dataset. Designs included qualitative studies (n = 8), quantitative descriptive or simulation studies (n = 5), and mixed-methods studies (n = 5). Participants included health care professionals, telecommunicators, patients, community members, and bystanders. Study characteristics are presented in Table 1.

Quality Appraisal

MMAT appraisal indicated that most studies met quality criteria for their respective design categories. Four studies were rated as having moderate quality concern, primarily related to representativeness of sampling and non-random recruitment in quantitative descriptive designs. Fourteen studies were rated as lower or lower-to-moderate concern. Full appraisal results are provided in Appendix B.

Thematic Synthesis

Five themes emerged from the thematic synthesis: (1) perceived value and acceptance, (2) safety and ethical concerns, (3) usability experiences, (4) operational feasibility and system readiness, and (5) training needs.

Theme 1: Perceived Value and Acceptance. Across the evidence base, stakeholders generally viewed drones favorably when they were perceived as meaningfully improving access to time-sensitive care. Bystanders and community participants responded positively to drone delivery of AEDs for OHCA, particularly in settings where EMS response intervals were perceived as long (Bernstein et al., 2025; Finney et al., 2025; Rosamond et al., 2020; Sanfridsson et al., 2019; Smith et al., 2025; Zègre-Hemsey et al., 2020). Clinicians and telecommunicators expressed similar endorsement of drones for AED delivery, drug delivery, and situational support, particularly in rural or geographically challenging terrain (Fink et al., 2023; Hartman et al., 2020; Holzmann et al., 2021; Wankmüller et al., 2021). Health care professionals in a multicenter survey reported high intention to adopt drones for medical supply delivery, especially for urgent medications (Zhang et al., 2025). Participants who expressed initial skepticism frequently shifted toward positive appraisal following hands-on simulation or exposure to operational demonstrations (Hartman et al., 2020; Holzmann et al., 2021; Ornato et al., 2020).

Acceptance was not unconditional. A multi-country social media analysis found slightly more negative than positive public sentiment regarding drones in extreme delivery contexts, organized around themes of safety concern, ethical ambivalence, and skepticism

toward institutional accountability (Mahmoud & Mahroof, 2025). These findings suggest that general acceptance of drones as a concept does not translate automatically into willingness to use them in emergency care.

Theme 2: Safety and Ethical Concerns. Safety and ethical concerns were prominent across clinician, bystander, and community-facing studies. Recurring safety concerns included the risk of drone malfunction or collision during payload delivery, noise and disruption at the scene, uncertainty about drone approach trajectories, and the potential for interaction with bystanders or other responders (Fink et al., 2023; Finney et al., 2025; Kim et al., 2021; Mahmoud & Mahroof, 2025; Sanfridsson et al., 2019). In several qualitative studies, participants raised concerns about drone collision with structures or people and expressed uncertainty about what to do if the drone behaved unexpectedly (Bernstein et al., 2025; Sedig et al., 2020; Zègre-Hemsey et al., 2020).

Ethical concerns included privacy, surveillance, and symbolic associations of drones with military or policing functions. Community-facing studies reported that associations with surveillance technology created mistrust, particularly in settings with histories of community-police tension (Mahmoud & Mahroof, 2025; Truog et al., 2020). Participants also raised questions about accountability and data governance. These concerns were more salient in community and public-perception studies than in professional or clinical contexts.

Theme 3: Usability Experiences. Usability emerged as a critical and variable dimension of drone acceptance. Participants in simulation and field studies described specific challenges including difficulty locating and approaching a hovering drone, confusion about payload retrieval mechanisms, noise interference with telecommunicator communication, and cognitive overload when processing drone-related tasks alongside CPR (Bernstein et al., 2025; Sanfridsson et al., 2019; Kim et al., 2021; Zègre-Hemsey et al., 2020). Telecommunicator nurses described uncertainty about acceptable CPR interruption intervals and variable comfort with protocol-guided decision-making under time pressure (Dalby-Pedersen et al., 2024).

Importantly, usability was shaped not only by device design but by the communicative and situational context in which the drone was used. Participants who received clear, structured guidance from telecommunicators reported markedly better usability experiences than those who received limited or ambiguous direction (Bernstein et al., 2025; Kim et al., 2021; Zègre-Hemsey et al., 2020). These findings suggest that perceived ease of use is a property of the interaction system rather than the device alone.

Theme 4: Operational Feasibility and System Readiness. Several studies examined system-level factors influencing drone integration. Mountain rescue personnel endorsed drones for operational use but highlighted facilitating conditions such as adequate infrastructure, clear coordination protocols, and organizational support as prerequisites for adoption (Holzmann et al., 2021). Telecommunicator nurses described challenges related to protocol compliance, interagency coordination, and the need for clearly defined handoff procedures (Dalby-Pedersen et al., 2024). Community-level studies raised concerns about equitable deployment, noting that drones should be prioritized for rural, underserved, or infrastructure-limited communities where conventional response is most delayed (Truog et al., 2020; Zhang et al., 2025).

Studies also identified infrastructure and regulatory readiness as barriers. Participants raised concerns about airspace coordination, weather-dependent performance, liability in cases of drone failure, and the absence of standardized operational frameworks (Fink et al., 2023; Mahmoud & Mahroof, 2025; Wankmüller et al., 2021).

Theme 5: Training Needs. Training emerged consistently as a necessary condition for safe, acceptable, and effective drone use. Participants across clinical, telecommunicator, and bystander groups identified knowledge deficits regarding what the drone would look and sound like, when to approach, how to retrieve the payload, and how drone-related tasks should be prioritized alongside CPR (Bernstein et al., 2025; Dalby-Pedersen et al., 2024; Fink et al., 2023; Kim et al., 2021; Sanfridsson et al., 2019; Smith et al., 2025; Zègre-Hemsey et al., 2020). In several community-facing studies, participants demonstrated limited baseline CPR and AED confidence independent of the drone, suggesting that drone delivery may expose preexisting first-aid knowledge gaps (Finney et al., 2025; Sedig et al., 2020).

Educational and professional studies showed that hands-on exposure, simulation, and scenario-based preparation could improve confidence and readiness for drone-enabled care (Hartman et al., 2020; Holzmann et al., 2021; Wankmüller et al., 2021). Ornato et al. (2020) found that prior medical training shortened time to naloxone administration. Showalter et al. (2025) found that an obstetrical drone simulation improved students' understanding of and readiness for technology-based care delivery. Cross-context studies highlighted the value of public education and community demonstrations to reduce fear, build trust, and normalize the technology before real-world implementation (Mahmoud & Mahroof, 2025; Truog et al., 2020).

DISCUSSION

This integrative review synthesized 18 studies examining health care professional, telecommunicator, bystander, patient, and community member perspectives on drone use in prehospital emergency care. Drones were generally perceived as promising when understood as addressing a meaningful time-sensitive or logistical problem, particularly for AED access, naloxone delivery, and search-and-rescue. Acceptance, however, depended on whether drones were perceived as safe, usable, ethically legitimate, and compatible with existing emergency response systems.

These findings extend prior work in important ways. Roberts et al. (2023) focused on operational feasibility and time-to-intervention rather than stakeholder perceptions, and Sanz-Martos et al. (2022) summarized applications without centering acceptance across all five stakeholder groups. The present review integrates evidence from clinicians, telecommunicators, bystanders, and community members into a broader account of how drones are interpreted and operationalized across prehospital emergency contexts.

Interpretation Through the Technology Acceptance Model

The findings broadly support TAM, particularly the central role of perceived usefulness. Clinicians, telecommunicators, bystanders, and community participants described drones positively when they offered a clear functional advantage: more rapid AED access, faster medication delivery, or improved situational awareness in difficult terrain (Dalby-Pedersen et al., 2024; Hartman et al., 2020; Sanfridsson et al., 2019; Wankmüller et

al., 2021). This supports TAM's core proposition that technologies are more likely accepted when users believe they will improve task performance.

Perceived ease of use was less stable and more context dependent. Participants described uncertainty about drone approach and landing, difficulty retrieving the payload, interruption of CPR, and cognitive overload when processing telecommunicator instructions during high-acuity events (Bernstein et al., 2025; Holzmann et al., 2021; Sanfridsson et al., 2019). In OHCA studies, participants often expressed support for drone delivery while questioning whether they could retrieve and use the AED under pressure, suggesting a more dynamic conceptualization of perceived ease of use than TAM's original formulation allows.

The findings also illustrate TAM's limits. Concerns about privacy, surveillance, equity, and the symbolic association of drones with military or policing functions are not easily explained by perceived usefulness and ease of use alone. Community perceptions were shaped by who operated drones, trust in regulations, and perceived fairness (Mahmoud & Mahroof, 2025; Truog et al., 2020; Zhang et al., 2025). TAM illuminates judgments of value and usability but is insufficient to account for questions of justice, legitimacy, and public trust.

Patterns of Consensus and Divergence

Participants broadly agreed that drones can improve access to time-sensitive interventions, particularly where geography or limited infrastructure impedes conventional response. Hands-on interaction frequently transformed drones from abstract or intimidating technologies into more understandable clinical tools. The evidence also consistently showed that implementation success depends on telecommunicator communication, workflow fit, role clarity, and training.

The most consequential divergence was between health-system actors and community-facing participants. Clinicians, telecommunicators, and operational personnel evaluated drones primarily in terms of performance, speed, and protocol integration. Community members more often foregrounded privacy, fairness, trust, and broader social meaning. This divergence carries important implementation implications. Formal adoption decisions are typically driven by health care leaders and EMS systems, yet programs depend on bystanders and communities for practical success and social legitimacy.

This distinction is especially important for OHCA applications, where the bystander is an active and indispensable user. A drone-delivered AED is clinically meaningful only if the bystander can notice it, retrieve it, and use it under stress (Bernstein et al., 2025; Smith et al., 2025). Implementation strategies that prioritize operational efficiency while neglecting public trust and readiness may succeed administratively but fail practically.

Implications for Practice and Policy

Successful drone integration requires approaches addressing both operational and social barriers. Clinicians, telecommunicators, and emergency care professionals should serve not only as end users but as co-designers of drone-integrated systems. Evidence from telecommunicator studies shows that end-user involvement in workflow design, commu-

nication script development, and simulation testing can directly improve system readiness and safety (Dalby-Pedersen et al., 2024; Fink et al., 2023).

At the policy level, clearer regulatory and governance structures are needed. Participants raised concerns about safety oversight, privacy, accountability, and cross-agency coordination (Finney et al., 2025; Mahmoud & Mahroof, 2025; Truog et al., 2020). Drone programs should also be designed for interoperability, as response can be undermined by unclear communication pathways or poorly coordinated handoffs between telecommunicators, operators, and on-scene responders (Bernstein et al., 2025; Dalby-Pedersen et al., 2024; Smith et al., 2025).

Finally, the findings support a strong equity rationale for targeted implementation. Perceived value was greatest in settings where conventional EMS response is delayed by geography or resource constraints. Policymakers should prioritize rural, remote, and underserved communities for pilot investment, preceded by meaningful local engagement. Trust depends on communities understanding the purpose of drone use, approving of the actors involved, and perceiving the system as serving public benefit rather than being imposed without consultation (Truog et al., 2020).

Future Directions

Three priorities appear especially important. First, the field most urgently needs real-world, longitudinal, and implementation-focused research. Much current evidence derives from simulation, hypothetical scenarios, or early field testing. Future studies should examine how perceptions, trust, usability, and safety evolve as drone-enabled interventions move from pilot testing into routine practice.

Second, future research should focus on implementation design at the human-system interface. Participants rarely rejected drones outright; they identified uncertainty around handoff procedures, telecommunicator communication, payload retrieval, and role clarity. This suggests the need for intervention studies testing specific strategies such as revised telecommunicator scripts, user-centered payload design, and scenario-based training. Standardized measures of perceived usefulness, ease of use, trust, and readiness would also strengthen comparison across studies.

Third, future work should emphasize equity, context, and participatory design. Research is needed across rural and urban communities, varied sociocultural contexts, and populations with differing levels of emergency preparedness and institutional trust. Community-engaged approaches are especially valuable for ensuring that drone-enabled emergency care is designed with, not merely for, the populations it aims to serve.

STRENGTHS AND LIMITATIONS

This review appears to be the first to synthesize clinical, telecommunicator, bystander, and community perspectives on drone integration in prehospital emergency care, and one of the first to interpret findings through TAM. Strengths include an explicit theoretical lens, formal MMAT appraisal, and a diverse evidence base spanning qualitative, survey, simulation, and field evaluation designs.

These strengths must be weighed against important limitations. Screening, extraction, appraisal, and thematic coding were conducted by a single reviewer, increasing the risk

of selection and interpretive bias; the protocol was not prospectively registered. The evidence base was relatively small (18 studies) and weighted toward Western contexts, constraining transferability to settings with different health systems or sociopolitical relationships to drone technology. The search was restricted to English-language publications, and exclusion of grey literature may have introduced publication bias. Many included studies relied on small or convenience samples, and a substantial proportion used simulation-based designs that cannot fully reproduce real emergency conditions. Few studies examined long-term adoption or changes in community acceptance over time, and the literature offered limited attention to intersectional influences such as age, rurality, race and ethnicity, or health literacy.

CONCLUSIONS

This integrative review demonstrates that the central challenge in drone-enabled prehospital emergency care is not whether drones can outpace conventional response, but whether the systems surrounding them are trusted, usable, and ethically acceptable to the people expected to rely on them.

Across the evidence base, participants generally perceived drones as promising tools for improving access to time-sensitive emergency interventions. That promise was consistently moderated by concerns about usability, safety, privacy, fairness, workflow integration, and real-world readiness. The most important implication is that successful drone integration will depend on implementation centered on clinician, telecommunicator, bystander, and community needs rather than technical capability alone. The field's most urgent next step is not broader deployment, but deliberate, equitable co-design with the clinicians, bystanders, and communities whose trust will determine whether these systems save more lives.

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APPENDIX A

Database Search Strings

PubMed

("Drones"[MeSH] OR "Unmanned Aerial Vehicles"[MeSH] OR drone* OR "unmanned aerial vehicle*" OR UAV* OR UAS* OR "unmanned aircraft system*")

AND

("Emergency Medical Services"[MeSH] OR "Emergency Medicine"[MeSH] OR "Triage"[MeSH] OR "Disaster Planning"[MeSH] OR "Disaster Medicine"[MeSH] OR prehospital OR "pre-hospital" OR "prehospital care" OR "out-of-hospital" OR "field triage" OR "mass casualty incident*" OR MCI OR disaster* OR triage OR "search and rescue" OR "search-and-rescue" OR SAR OR EMS OR paramedic* OR clinician* OR nurse*)

AND

(perception* OR perspective* OR attitude* OR opinion* OR sentiment* OR experience* OR trust* OR concern* OR accepta*)

CINAHL (EBSCO)

((MH "Drones") OR (MH "Unmanned Aerial Vehicles") OR drone* OR "unmanned aerial vehicle*" OR UAV* OR UAS* OR "unmanned aircraft system*")

AND

((MH "Emergency Medical Services+") OR (MH "Emergency Medicine+") OR (MH "Emergency Nursing+") OR (MH "Prehospital Care") OR (MH "Triage") OR prehospital OR "pre-hospital" OR "prehospital care" OR "out-of-hospital" OR "mass casualty incident*" OR MCI OR disaster* OR triage OR "field triage" OR "search and rescue" OR "search-and-rescue" OR SAR OR EMS OR paramedic* OR nurse* OR clinician*)

AND

(perception* OR perspective* OR attitude* OR opinion* OR sentiment* OR experience* OR trust* OR concern* OR accepta*)

Web of Science

TS=((drone* OR "unmanned aerial vehicle*" OR UAV* OR UAS* OR "unmanned aircraft system*") AND (prehospital OR "pre-hospital" OR "prehospital care" OR "out-of-hospital" OR "emergency medical service*" OR EMS OR "mass casualty incident*" OR disaster* OR triage OR "field triage" OR "search and rescue" OR "search-and-rescue" OR SAR OR paramedic* OR clinician* OR nurse*) AND (perception* OR perspective* OR attitude* OR opinion* OR sentiment* OR experience* OR trust* OR concern* OR accepta*))

Embase

('drone'/exp OR 'unmanned aerial vehicle'/exp OR drone*:ti,ab,kw OR 'unmanned aerial vehicle*':ti,ab,kw OR uav*:ti,ab,kw OR uas*:ti,ab,kw OR 'unmanned aircraft system*':ti,ab,kw) AND ('emergency medical service'/exp OR 'emergency medicine'/exp OR

'prehospital care'/exp OR 'triage'/exp OR 'disaster medicine'/exp OR 'mass casualty incident'/exp OR prehospital:ti,ab,kw OR 'pre-hospital':ti,ab,kw OR 'out-of-hospital':ti,ab,kw OR 'field triage':ti,ab,kw OR 'mass casualty incident*':ti,ab,kw OR mci:ti,ab,kw OR disaster*:ti,ab,kw OR 'search and rescue':ti,ab,kw OR 'search-and-rescue':ti,ab,kw OR sar:ti,ab,kw OR ems:ti,ab,kw OR paramedic*:ti,ab,kw OR clinician*:ti,ab,kw OR nurse*:ti,ab,kw) AND (perception*:ti,ab,kw OR perspective*:ti,ab,kw OR attitude*:ti,ab,kw OR opinion*:ti,ab,kw OR sentiment*:ti,ab,kw OR experience*:ti,ab,kw OR trust*:ti,ab,kw OR concern*:ti,ab,kw OR accepta*:ti,ab,kw)

Google Scholar

With all of the words: prehospital "emergency medical services" EMS triage disaster "mass casualty" "search and rescue"

With at least one of the words: drone OR "unmanned aerial vehicle" OR UAV OR UAS OR "unmanned aircraft system" OR perception OR perceptions OR perspective OR perspectives OR attitude OR attitudes OR opinion OR opinions OR trust OR acceptability OR concern OR experience OR experiences

APPENDIX B

Mixed Methods Appraisal Tool (MMAT) Appraisal of Included Studies

Author/year	Study Design Category	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Overall Quality
Bernstein et al., 2025	Qualitative	Yes	Yes	Yes	Yes	Yes	Lower concern
Fink et al., 2023	Qualitative	Yes	Yes	Yes	Yes	Yes	Lower concern
Finney et al., 2025	Qualitative	Yes	Yes	Yes	Yes	Yes	Lower concern
Dalby-Pedersen et al., 2024	Qualitative	Yes	Yes	Yes	Yes	Yes	Lower concern
Hartman et al., 2020	Quantitative descriptive	Yes	No	Cannot tell	Yes	Yes	Moderate concern
Holzmann et al., 2021	Quantitative descriptive	Yes	Cannot tell	Yes	Yes	Yes	Lower-to-moderate concern
Kim et al., 2021	Mixed methods	Yes	Yes	Yes	Yes	Yes	Lower concern
Mahmoud & Mahroof, 2025	Mixed methods	Yes	Yes	Yes	Yes	Yes	Lower-to-moderate concern
Ornato et al., 2020	Quantitative descriptive	Yes	No	Yes	Yes	Yes	Moderate concern
Rosamond et al., 2020	Quantitative randomized	Yes	Cannot tell	Cannot tell	Yes	Yes	Moderate concern
Sanfridsson et al., 2019	Mixed methods	Yes	Yes	Yes	Yes	Yes	Lower concern
Sedig et al., 2020	Qualitative	Yes	Yes	Yes	Yes	Yes	Lower concern
Showalter et al., 2025	Mixed methods	Yes	Yes	Cannot tell	Yes	Yes	Lower-to-moderate concern
Smith et al., 2025	Mixed methods	Yes	Yes	Cannot tell	Yes	Yes	Lower-to-moderate concern
Truog et al., 2020	Qualitative	Yes	Yes	Yes	Yes	Yes	Lower concern
Wankmüller et al., 2021	Qualitative	Yes	Yes	Yes	Yes	Yes	Lower concern
Zègre-Hemsey et al., 2020	Qualitative	Yes	Yes	Yes	Yes	Yes	Lower concern
Zhang et al., 2025	Quantitative descriptive	Yes	No	Yes	Yes	Yes	Moderate concern

Note. Criteria 1-5 correspond to the design-specific MMAT items for each study category.