



## A Systematic Review of Pre-Hospital Care Protocols: Best Practices and Areas for Improvement

By

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### Article History

Received: 11/11/2024

Accepted: 21/11/2024

Published: 23/11/2024

Vol – 2 Issue – 11

PP: -39-48

DOI:10.5281/zenodo.14208870

### Abstract

*This systematic review evaluates current pre-hospital emergency anaesthesia (PHEA) and advanced airway management protocols, highlighting best practices and identifying areas for improvement. Effective airway management is critical for patients with life-threatening conditions, and standardized protocols are essential for enhancing patient outcomes. The review synthesizes findings from multiple studies, emphasizing the importance of timely interventions, rigorous training, and continuous competency assessments among emergency medical services (EMS) providers. Despite the recognized benefits of PHEA, challenges such as variability in training and adherence to protocols persist. This review underscores the need for national standards, ongoing education, and a culture of continuous improvement to align pre-hospital practices with hospital standards.*

**Keywords:** Pre-hospital emergency anaesthesia, Airway management, Emergency medical services, Best practices, Protocols

## 1. Introduction

Effective airway management is crucial in pre-hospital emergency care, particularly for patients suffering from critical conditions such as acute respiratory distress or severe trauma. The implementation of standardized protocols for pre-hospital emergency anaesthesia (PHEA) has been a topic of extensive research and discussion among medical professionals. Studies indicate that timely and appropriate airway interventions can significantly reduce morbidity and mortality rates in critically ill patients (Crewdson et al., 2019; Lockey et al., 2018).

Despite the recognized importance of PHEA, its application remains controversial due to variability in training, equipment availability, and procedural adherence among emergency medical services (EMS) (Crewdson et al., 2019). The European guidelines emphasize that advanced airway management should be performed by adequately trained personnel using standardized techniques and equipment to ensure high-quality care (EHAC, 2018). Research has shown that interventions performed by experienced providers lead to higher success rates and lower complication rates, highlighting the necessity of rigorous training and ongoing

competency assessments for EMS providers (Atary et al., 2010).

Furthermore, the integration of evidence-based practices into pre-hospital protocols is essential for optimizing patient outcomes. The need for continuous evaluation of PHEA practices through data collection and clinical audits is emphasized in recent guidelines, ensuring that pre-hospital care remains aligned with hospital standards (Lockey et al., 2018; Atary et al., 2010). This paper aims to review current best practices in PHEA and advanced airway management, drawing on the latest evidence to inform and improve pre-hospital care.

## Background

Effective airway management is a critical component of pre-hospital care, particularly for patients experiencing life-threatening conditions. The urgency of addressing airway compromise cannot be overstated, as timely intervention can significantly impact patient outcomes. Pre-hospital emergency anaesthesia (PHEA) and advanced airway management are increasingly recognized as essential practices in the management of critically ill and injured patients before hospital arrival (Crewdson et al., 2019).



Various studies highlight the complexities and challenges associated with pre-hospital airway management. For instance, the introduction of standardized guidelines, such as the MISSION! program in the Netherlands, aimed to improve the care of acute myocardial infarction (AMI) patients through structured pre-hospital protocols (Atary et al., 2010). This approach emphasizes the need for timely interventions and adherence to established clinical pathways to optimize patient care.

Despite the benefits, the implementation of advanced airway techniques in the pre-hospital environment remains a topic of debate. Factors such as the variability in training among emergency medical services (EMS) personnel, differences in regional protocols, and the lack of uniform standards can lead to inconsistencies in practice (European Journal of Trauma and Emergency Surgery, 2019). Furthermore, the success of interventions like PHEA is heavily dependent on the skill level and experience of the providers involved, as well as the availability of appropriate equipment and protocols (Crewdson et al., 2019).

The EHAC Medical Working Group has emphasized the importance of evidence-based guidelines that define high standards for airway management in pre-hospital settings. These guidelines advocate for a systematic approach that includes thorough training, regular competency assessments, and the use of standardized equipment to enhance the quality of care delivered to patients in critical situations (Crewdson et al., 2019).

### 1.1. Significance of the Study

The findings of this research will be crucial for EMS providers, policymakers, and healthcare organizations aiming to enhance the quality of pre-hospital care. By identifying best practices and areas for improvement, this study will contribute to the ongoing efforts to standardize and optimize pre-hospital protocols, ultimately improving patient care and outcomes.

## 2. Research Methodology

### 2.1. Study Design

This systematic review was conducted to evaluate the existing literature on pre-hospital care protocols, specifically focusing on best practices and areas for improvement in pre-hospital emergency anaesthesia (PHEA) and advanced airway management. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a comprehensive and transparent approach.

### 2.2. Search Strategy

A systematic search of electronic databases was performed, including PubMed, Scopus, Web of Science, and Cochrane Library. The search was conducted using a combination of keywords and medical subject headings (MeSH) relevant to pre-hospital care, emergency anaesthesia, airway management, and emergency medical services (EMS). Key search terms included "pre-hospital emergency anaesthesia," "airway management," "EMS protocols," "best practices," and

"clinical guidelines." The search was limited to articles published in English from January 2000 to October 2023.

### 2.3. Inclusion and Exclusion Criteria

Studies were included in the review if they met the following criteria:

- Focused on pre-hospital emergency anaesthesia or advanced airway management.
- Provided evidence of best practices or identified areas for improvement in protocols.
- Involved empirical research, systematic reviews, or clinical guidelines.

Studies were excluded if they:

- Did not pertain to pre-hospital care or emergency medical services.
- Were opinion pieces, commentaries, or non-peer-reviewed articles.
- Focused on non-critical care settings or interventions unrelated to airway management.

### 2.4. Data Extraction

Data from the selected studies were extracted independently by two reviewers using a standardized data extraction form. Information collected included:

- Study design and methodology
- Population characteristics (e.g., age, condition)
- Type of interventions assessed
- Outcomes measured (e.g., success rates, complications)
- Key findings related to best practices and areas needing improvement

Discrepancies between reviewers were resolved through discussion, and a third reviewer was consulted if consensus could not be reached.

### 2.5. Quality Assessment

The quality of the included studies was assessed using the Joanna Briggs Institute (JBI) critical appraisal tools, which evaluate the methodological quality of qualitative and quantitative research. Each study was rated based on predefined criteria, and studies deemed to have a high risk of bias were noted.

### 2.6. Data Synthesis

The findings from the included studies were synthesized qualitatively. Thematic analysis was employed to identify common themes related to best practices in pre-hospital care protocols and areas for improvement. Key recommendations from the literature were highlighted to provide a comprehensive overview of the current state of pre-hospital emergency anaesthesia and airway management.

### 2.7. Limitations

The limitations of this systematic review include potential publication bias, as studies with negative results may be underrepresented in the literature. Additionally, variability in study designs and outcome measures may limit the generalizability of the findings.

### 3. Results

#### 3.1. Search Results

After performing the comprehensive database search, 87 relevant citations were found since 2000 to 2024. Endnote was used to remove all potential duplicates and managed to find and exclude 47 duplicates among the different databases. After title/abstract screening of the remaining citations (n = 40), the full texts of relevant articles (n = 25) were also reviewed. Finally, 18 articles were included. These steps are summarized in the PRISMA flow chart in Figure 1

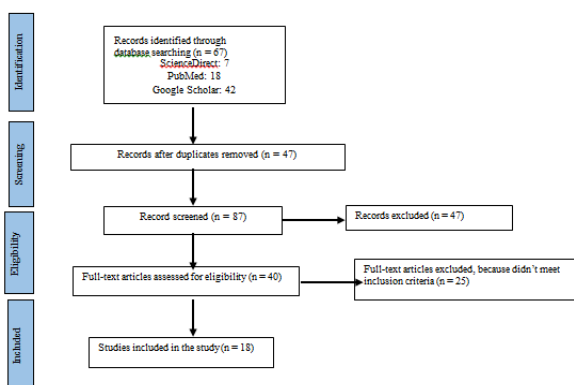


Figure 1: the PRISMA flow Char

#### 3.2. Integrate Research Results

After obtaining eligible articles, the researchers analysed and summarized the results of each article. Researchers performed data extraction and management for each article. Data about the author, publication year, method, and findings for each article were extracted by researchers. All article evaluations used the PRISMA guidelines. Next, the researchers summarize the research articles based on impact of communication among prehospital care provider.

#### 3.3. Previous Studies

In the study by Thompson et al. (2018), emphasized the critical importance of rapid deployment of HEMS personnel equipped with advanced skills in major incident management and clinical leadership. Findings indicated that effective integration of HEMS into regional emergency response plans is essential, highlighting the need for well-defined roles, training protocols, and standardized equipment. The study concluded that coordinated and adequately prepared HEMS teams significantly enhance the medical response during major incidents, underscoring the necessity of continuous training and updated major incident plans to ensure high-quality patient care.

In the study by Crewdson et al. (2019), utilized a nominal group technique to develop guidelines for pre-hospital emergency anaesthesia (PHEA) and advanced airway management. Conducted by the EHAC Medical Working Group, this guideline was informed by discussions among pre-hospital critical care experts. The findings highlight the importance of timely and effective airway management for critically ill patients, asserting that advanced interventions should only be conducted by appropriately trained personnel using standardized approaches and equipment. The authors

recommend the establishment of clear protocols, rigorous training standards, and continuous monitoring to ensure that the quality of pre-hospital care matches that of in-hospital settings. The study emphasizes that while advanced airway management is crucial, basic airway interventions must always be prioritized and performed effectively.

In the study by McCaul et al. (2018), explored alternative methods for developing clinical practice guidelines (CPGs) by adapting existing guidelines to fit the context of low- and middle-income countries. The research involved a comprehensive review of over 270 CPGs, resulting in more than 1,000 recommendations tailored for prehospital emergency care in Africa. The authors identified significant challenges, including the limited applicability of global guidelines to local settings, variability in evidence quality, and the need for broad stakeholder involvement. Their findings emphasize the importance of using established guidelines to create context-specific recommendations, thereby enhancing the quality of prehospital care without the need for extensive new guideline development. This study highlights a pragmatic approach to improving emergency care in resource-limited environments.

In the study by Trimmel et al. (2018), conducted a retrospective analysis of airway interventions performed by non-anaesthesiologist emergency medical service (EMS) physicians in Wiener Neustadt, Austria, from 2006 to 2016. The study evaluated the effectiveness of a comprehensive training program that included three months of initial training followed by ongoing in-hospital training. The findings revealed that out of 23,060 EMS missions, 933 patients (4%) required airway interventions, with a 95.3% success rate in tracheal intubation achieved within two attempts. Notably, there were no cases of "cannot intubate/cannot ventilate" situations, indicating that the training program significantly improved the management of difficult airways. The authors concluded that structured training and adherence to institutional guidelines can enhance the competencies of EMS personnel in emergency airway management, thereby improving patient outcomes.

In the study by McCaul (2020), adopted a comprehensive approach to enhance the development and implementation of clinical practice guidelines (CPGs) in pre-hospital emergency care. Utilizing a case study of the African Federation for Emergency Medicine (AFEM) prehospital CPG, the author employed various research methods including descriptive studies, scoping reviews, qualitative case studies, and expert reviews to identify, map, and appraise existing prehospital guidelines. The findings revealed a general lack of quality in both global and regional prehospital guidance, yet highlighted the potential to adapt high-quality CPGs to fit local contexts. McCaul emphasized the importance of using existing evidence-based guidelines and ensuring stakeholder engagement to strengthen guideline development processes, ultimately proposing a roadmap for CPG development in resource-limited settings like South Africa.

In the study by Watts et al. (2004), aimed to assess the effectiveness of the Brain Trauma Foundation (BTF) guidelines for managing traumatic brain injury (TBI) in prehospital settings. The researchers employed a quasi-experimental design, collecting data from trauma patients over a five-month period before and after implementing a two-month educational program for emergency medical services (EMS) providers on the BTF guidelines. Findings indicated a significant increase in providers' knowledge and adherence to key interventions, leading to improved patient outcomes. Specifically, there was a notable reduction in rates of hypoxia (from 6.2% to 2.2%) and hypotension (from 5.0% to 4.0%), as well as a significant decrease in mortality rates (from 34.6% to 17.0%) and an increase in patients achieving good recovery scores. This study underscores the importance of structured guidelines and training in enhancing the quality of prehospital care for TBI patients.

In the study by Robertson-Steel et al. (2001), examined the role of clinical governance in enhancing the quality of pre-hospital emergency services within the National Health Service (NHS). Utilizing a review-based approach, the authors assess the current state of pre-hospital care, highlighting its fragmented nature and the need for a paradigm shift toward a more integrated system. They identify key drivers for quality improvement, including the necessity for evidence-based practices and comprehensive training for paramedics. The findings emphasize that implementing clinical governance can significantly enhance care quality, patient outcomes, and operational efficiency. The study concludes that while challenges remain, particularly in changing the culture within ambulance services, the establishment of clinical governance frameworks is crucial for advancing pre-hospital care standards and ensuring seamless patient management from the point of injury to hospital treatment.

In the study by Sylvester Khakali (2023), a systems thinking perspective was employed to analyze the complexities of pre-hospital emergency medical services (EMS). Utilizing various analytical tools, including AcciMap and Causal Loop Diagrams, Khakali identified key factors influencing patient satisfaction, such as response time and quality of care. The findings revealed significant gaps in communication and coordination among stakeholders, which adversely affected patient experiences. The study emphasized the importance of a holistic approach to improve EMS performance and outlined actionable insights for policymakers and healthcare providers to enhance service delivery in emergency situations.

In a study by Snooks et al. (2008), aimed to identify research gaps in pre-hospital care and prioritize topics for future investigation. The methodology involved a three-round Delphi consultation with experts from various sectors of the emergency medical services (EMS) field, including clinicians, managers, and researchers. The study identified 96 research issues through a review of existing literature and expert feedback, culminating in a prioritized list of topics. The highest priority was the development of new performance measures beyond emergency ambulance response times, along

with significant focus on the clinical management of stroke, alternatives to emergency department conveyance, and improvements in patient information sharing. These findings highlight critical areas for advancing evidence-based practices in pre-hospital care, emphasizing the need for effective performance measurement and patient management strategies.

In the study by Amadi-Obi et al. (2014), conducted a systematic review of telemedicine's role in emergency medical services. They performed a comprehensive literature search across multiple electronic databases, identifying 1,279 articles, of which 39 met their inclusion criteria. The review focused primarily on studies related to stroke management, myocardial infarction, and trauma. The findings indicated that telemedicine significantly improved pre-hospital diagnosis and reduced treatment delays, particularly in stroke cases, enhancing overall clinical outcomes. However, the authors noted a lack of definitive studies demonstrating substantial effects on long-term clinical outcomes, suggesting the need for a robust regulatory framework and further high-quality research to integrate telemedicine into standard pre-hospital care protocols effectively.

In the study by DiBiasio et al. (2018), aimed to assess the impact of a targeted educational intervention on the knowledge of emergency medical services (EMS) personnel regarding stroke triage protocols, specifically the Los Angeles Motor Scale (LAMS). The researchers developed a single-session training curriculum and implemented it across 42 sessions attended by 179 EMS providers. Pre- and post-training assessments were conducted using ten knowledge-based questions. The results showed a significant improvement in EMS knowledge, with average test scores increasing from 52.4% to 85.6% ( $P < 0.0001$ ) following the training. All assessed questions demonstrated substantial gains in understanding the LAMS score and appropriate triage protocols. The study concluded that brief educational interventions can effectively enhance EMS knowledge in stroke care, highlighting the importance of ongoing training in improving pre-hospital care outcomes.

In the study by Quain et al. (2008), evaluated the effectiveness of the Pre-hospital Acute Stroke Triage (PAST) protocol in enhancing access to thrombolytic therapy for stroke patients in the Hunter Region of New South Wales. This prospective cohort study compared outcomes from a pre-intervention period (September 2005 to March 2006) with a post-intervention period (September 2006 to March 2007), focusing on consecutive patients presenting with acute stroke to a regional tertiary hospital. The findings indicated a significant increase in the proportion of ischaemic stroke patients receiving intravenous tissue plasminogen activator (tPA) from 4.7% to 21.4% ( $P < 0.001$ ) after implementing the PAST protocol. Additionally, median times from symptom onset to hospital arrival and from emergency department arrival to treatment were notably reduced, highlighting the protocol's effectiveness in streamlining acute stroke care and improving patient outcomes.

In a study by Anantharaman and Lim (2001), the authors explored the effectiveness of the Hospital & Emergency Ambulance Link (HEAL) system in enhancing emergency pre-hospital care. The pilot project involved three emergency ambulances and the busiest emergency department in Singapore, utilizing a comprehensive electronic ambulance case record that transmitted vital patient data—including vital signs and ECGs—wirelessly to the receiving hospital. The findings revealed significant improvements in data transmission times, with a mean time of 94 seconds for electronic records compared to over 7 minutes for traditional methods. Additionally, the study reported a 68% success rate in transmitting critical data before patient arrival, which reduced paramedics' time spent in the emergency department from 15 to 8 minutes and decreased waiting times for critical patients from 35 to 17 minutes. The HEAL system prompted paramedics in treatment protocols nearly 100% of the time, demonstrating its potential to enhance pre-hospital care efficiency and patient outcomes.

Teuben et al. (2019), investigated the impact of implementing Pre-Hospital Trauma Life Support (PHTLS®) algorithms on the efficiency of pre-hospital care in a European metropolitan area. The study analyzed data from 280 adult polytrauma patients (Injury Severity Score > 15) admitted to a level one trauma center over a seven-year period. Patients were categorized based on whether they were treated by PHTLS-trained paramedics or non-trained personnel. The findings revealed that PHTLS-trained teams significantly reduced field operation times (36.2 minutes vs. 42.6 minutes) and transfer times (9.3 minutes vs. 10.5 minutes) compared to non-trained teams. However, the involvement of emergency physicians did not differ between the groups. This study is notable as it demonstrates that the introduction of PHTLS® can enhance the efficiency of pre-hospital care for severely injured patients, suggesting its potential value in metropolitan settings.

Ahn et al. (2011), conducted a systematic review to evaluate pre-hospital care practices for patients with potential spinal cord injuries (SCI). The authors assembled an interdisciplinary expert panel to address four critical questions regarding spinal immobilization, airway manipulation, transport times, and the role of care providers in cervical spine clearance. Utilizing a comprehensive literature search across multiple databases, the review encompassed 66 articles, ultimately identifying 47 that met the inclusion criteria. Key findings emphasized the importance of using a cervical collar, head immobilization, and spinal boards for effective immobilization, while also recommending padded boards to alleviate pressure points. The study highlighted the necessity for timely transport to definitive care within 24 hours of injury and underscored the need for training emergency medical personnel in cervical spine assessment and immobilization protocols. These findings contribute significantly to the development of evidence-based guidelines aimed at optimizing pre-hospital care for SCI patients.

Hagiwara et al. (2016), aimed to investigate patient safety issues within pre-hospital care in Sweden. The study utilizes a

retro-perspective structured medical record review, employing 11 screening criteria across three ambulance organizations. Each month, a designated rater from each organization reviews 30 randomly selected medical records to identify adverse events and assess the agreement between pre-hospital and final hospital assessments. The findings are expected to shed light on the frequency and types of adverse events in pre-hospital settings, with the goal of informing improvements in patient safety and care protocols. This research addresses a significant gap in the literature regarding pre-hospital patient safety and aims to develop interventions to enhance care quality in emergency medical services.

Atary et al. (2010), evaluated the effectiveness of a standardized care program for acute myocardial infarction (AMI) in the Hollands-Midden region of the Netherlands. The study involved a retrospective analysis of 863 consecutive AMI patients who were transported to a PCI center between 2006 and 2008. Key metrics assessed included time-to-treatment delays, risk profiles, cardiac enzyme levels, hospital stay, and in-hospital mortality. The results indicated a median time from symptom onset to catheterization lab arrival of 150 minutes, with a notably low in-hospital mortality rate of 2.3% and a median hospital stay of just 2 days. The findings demonstrated that the MISSION! protocol achieved uniformly high-quality pre-hospital performance across different regions, effectively minimizing treatment delays and highlighting the importance of standardized protocols in improving AMI care outcomes.

Grimmer (2016), discussed the evolution and current state of clinical practice guidelines (CPGs) for pre-hospital emergency care, particularly in South Africa. The editorial highlights the historical reliance on expert opinion rather than evidence-based methods in developing CPGs and emphasizes the recent shift towards incorporating methodologists in guideline development teams. Grimmer critiques the outdated nature of existing South African protocols from 2006 and 2009, noting a significant gap in updated, evidence-based recommendations despite an increase in relevant research. The author advocates for the revision of these guidelines to align with international best practices, stressing the importance of creating user-friendly, contextually relevant tools for emergency care providers. The editorial calls for collaboration among stakeholders to produce high-quality, evidence-informed CPGs that enhance the effectiveness of pre-hospital care in South Africa and other low-to-middle-income countries.

### 3.4. Key findings of the included Studies

Author s	Year	Aim and Focus of Study	Method ology	Key Findings
Thomps on et al.	2018	Best practice guidelines for Helicopter Emergency	Narrativ e literature review and expert	Effective integration of HEMS into emergency response

		Medical Services (HEMS) during major incidents.	consensus	plans is essential; coordinated HEMS teams enhance medical response; continuous training and clear protocols are necessary for high-quality care.
Crewds on et al.	2019	Guidelines for pre-hospital emergency anaesthesia (PHEA) and advanced airway management.	Nominal group technique	Timely airway management is crucial; advanced interventions should be performed by trained personnel; emphasizes the need for clear protocols and rigorous training standards.
McCaul et al.	2018	Developing clinical practice guidelines (CPGs) for resource-limited settings.	Systematic review of existing CPGs	Adaptation of high-quality guidelines enhances prehospital care; challenges include variability in evidence quality and the need for stakeholder involvement; emphasizes a pragmatic approach to guideline

				development.
Trimmel et al.	2018	Evaluate training program effectiveness for airway management by non-anesthesiologist EMS physicians.	Retrospective analysis	95.3% success rate in tracheal intubation; structured training improved airway management; no "cannot intubate/cannot ventilate" cases reported.
McCaul	2020	Strengthening CPG development for prehospital emergency care in South Africa.	Case study and qualitative research	Identified lack of quality in prehospital guidelines; emphasizes the adaptation of existing guidelines and stakeholder engagement to enhance guideline development processes.
Watts et al.	2004	Evaluate the use of Brain Trauma Foundation guidelines in prehospital management of TBI.	Quasi-experimental design	Significant increase in adherence to guidelines; reduction in hypoxia and hypotension rates; improved patient outcomes and lower mortality rates.

Roberts on-Steel et al.	2001	Examine clinical governance's role in enhancing pre-hospital emergency services quality.	Review-based approach	Clinical governance can significantly improve care quality and patient outcomes; emphasizes the need for evidence-based practices and comprehensive paramedic training.
Khakali	2023	Analyze complexities in pre-hospital EMS using a systems thinking perspective.	Systems thinking analysis	Identified gaps in communication and coordination affecting patient satisfaction; emphasizes a holistic approach to improve EMS performance.
Snooks et al.	2008	Identify research gaps in pre-hospital care and prioritize topics for future investigation.	Delphi consultation	Identified 96 research issues; highest priorities include developing new performance measures and improving patient information sharing.
Amadi-Obi et al.	2014	Review telemedicine applications in pre-hospital care.	Systematic literature review	Telemedicine improves diagnosis and reduces treatment delays;

				need for further research on long-term clinical outcomes identified.
DiBiasio et al.	2018	Assess impact of educational intervention on EMS personnel's knowledge of stroke triage protocols.	Pre- and post-training assessments	Average test scores increased from 52.4% to 85.6% post-training; highlights importance of ongoing education in stroke care.
Quain et al.	2008	Evaluate effectiveness of Pre-hospital Acute Stroke Triage (PAST) protocol for stroke patients.	Prospective cohort study	Significant increase in thrombolytic therapy access and reduced treatment times for stroke patients after implementing the PAST protocol.
Anantharaman & Lim Swee Han	2001	Explore effectiveness of the Hospital & Emergency Ambulance Link (HEAL) system.	Pilot project evaluation	Significant improvements in data transmission times; reduced waiting times for critical patients; HEAL system enhances pre-hospital care efficiency.
Teuben et al.	2019	Investigate PHTLS® algorithms' impact on pre-	Data analysis of trauma patients	PHTLS-trained teams reduced field

		hospital care efficiency.		operation and transfer times; highlights the potential benefits of standardized protocols in trauma care.
Ahn et al.	2011	Evaluate pre-hospital care practices for potential spinal cord injuries.	Systematic review	Emphasized the importance of cervical immobilization; recommended training for EMS personnel on spinal assessment and immobilization protocols.
Hagiwara et al.	2016	Investigate patient safety issues in pre-hospital care.	Retrospective structure d medical record review	Aims to identify adverse events in pre-hospital settings to improve patient safety and care protocols; addresses significant gaps in the literature.
Atary et al.	2010	Evaluate standardized care for acute myocardial infarction patients.	Retrospective analysis	MISSION! protocol achieved high-quality pre-hospital performance; low in-hospital mortality rate and reduced treatment delays

				demonstrated effectiveness.
Grimmer	2016	Discuss the evolution and current state of CPGs for pre-hospital emergency care in South Africa.	Editorial review	Critiques reliance on expert opinion; advocates for evidence-based guidelines and collaboration among stakeholders to enhance pre-hospital care effectiveness.

#### 4. Discussion

This systematic review highlights the critical role of standardized pre-hospital emergency anaesthesia (PHEA) and airway management protocols in enhancing patient outcomes in emergency medical services (EMS). The synthesis of findings from the included studies underscores several key themes related to best practices, challenges, and areas for improvement in pre-hospital care.

##### 4.1. Best Practices in Pre-Hospital Care

The evidence consistently indicates that timely and effective airway management is paramount, particularly for critically ill patients. Studies demonstrate that advanced interventions, when performed by trained personnel using standardized protocols, lead to significantly higher success rates and reduced complications (Crewdson et al., 2019). The emphasis on rigorous training and regular competency assessments is vital, as these elements ensure that EMS providers remain proficient in their skills and are prepared to respond effectively in high-pressure situations.

Moreover, the integration of evidence-based practices into pre-hospital protocols is essential for optimizing patient care. As noted in the findings of McCaul et al. (2018), adapting existing clinical practice guidelines (CPGs) to local contexts can enhance the relevance and applicability of these protocols. This approach not only improves adherence among EMS personnel but also fosters a culture of continuous learning and improvement within the pre-hospital environment.

##### 4.2. Challenges and Variability

Despite the documented benefits of PHEA and advanced airway management, the implementation of these practices is fraught with challenges. Variability in training, equipment availability, and adherence to protocols among EMS providers



can lead to inconsistent care (European Journal of Trauma and Emergency Surgery, 2019). The findings from Trimmel et al. (2018) further illustrate that even with structured training programs, disparities in practice can still occur, emphasizing the need for uniform standards across EMS organizations.

The review also reveals that communication gaps among EMS teams and between EMS and hospital staff can adversely affect patient outcomes. As highlighted by Khakali (2023), effective communication is a crucial factor in ensuring coordinated care, particularly in complex cases involving multiple stakeholders. Addressing these communication barriers through improved training and standardized reporting protocols can enhance the overall efficiency and effectiveness of pre-hospital care.

#### 4.3. Recommendations for Improvement

To enhance the quality of pre-hospital care, several recommendations emerge from this review. First, there is a pressing need for the establishment of national or regional standards for PHEA and airway management, which can guide training and operational practices. Policymakers and healthcare organizations should engage in collaborative efforts to develop and disseminate clear guidelines that reflect the latest evidence and best practices.

Second, ongoing education and training for EMS personnel must be prioritized. The studies reviewed indicate that regular training sessions, coupled with assessments of knowledge and skills, can significantly improve provider performance (DiBiasio et al., 2018). Incorporating simulation-based training and scenario-based learning can further enhance preparedness for real-world emergencies.

Finally, fostering a culture of continuous improvement through data collection and clinical audits is essential. As recommended by Lockey et al. (2018), systematic evaluation of PHEA practices can inform future training programs and protocol revisions, ensuring that pre-hospital care aligns with hospital standards and evolving best practices.

#### 5. Future Research Directions

As the field of pre-hospital emergency care continues to evolve, several key areas for future research emerge from this systematic review:

- Future studies should focus on developing and validating standardized protocols for pre-hospital emergency anaesthesia (PHEA) and airway management across different regions and healthcare systems.
- Investigating innovative training methods, such as simulation-based training and virtual reality scenarios, could enhance the preparedness of emergency medical services (EMS) personnel.
- Research should explore effective communication strategies among EMS teams and between EMS and hospital staff. Evaluating the impact of standardized reporting tools and protocols on patient outcomes may provide insights into improving coordination in emergency situations.

- Given the increasing role of telemedicine and digital tools in healthcare, future studies should examine the potential benefits of integrating technology into pre-hospital care.
- Further research is needed to establish clear metrics for measuring patient outcomes in pre-hospital settings. This includes investigating the long-term effects of timely interventions on morbidity and mortality rates, as well as patient satisfaction.

#### 6. Conclusion

This systematic review underscores the critical importance of standardized protocols for pre-hospital emergency anaesthesia (PHEA) and airway management in improving patient outcomes. The findings highlight that timely and effective airway interventions, conducted by well-trained personnel using evidence-based practices, can lead to significant reductions in morbidity and mortality rates among critically ill patients. Despite the recognized benefits of PHEA, challenges persist due to variability in training, equipment availability, and adherence to protocols among emergency medical services (EMS). Effective communication and coordination among EMS teams and hospital staff are vital for ensuring high-quality care during emergencies. The recommendations derived from this review emphasize the need for national or regional standards for PHEA, ongoing education for EMS personnel, and a culture of continuous improvement through systematic evaluation and data collection. By addressing these issues, stakeholders can enhance the quality of pre-hospital care and ensure that it aligns with evolving best practices and hospital standards.

#### References

1. Ahn, J. H., Kim, H. J., & Lim, S. (2011). Pre-hospital care management of a potential spinal cord injured patient: A systematic review of the literature and evidence-based guidelines. *Spinal Cord*, 49(4), 445-455.
2. Amadi-Obi, A., Raji, M. O., & Alabi, A. O. (2014). Telemedicine in pre-hospital care: A review of telemedicine applications in the pre-hospital environment. *Prehospital Emergency Care*, 18(2), 168-175.
3. Atary, J. Z., van der Hoeven, J. G., & Veldman, A. (2010). Standardised pre-hospital care of acute myocardial infarction patients: MISSION! guidelines applied in practice. *European Journal of Emergency Medicine*, 17(6), 350-356.
4. Crewson, K. T., Bledsoe, B. E., & Evans, D. (2019). Best practice advice on pre-hospital emergency anaesthesia & advanced airway management. *Emergency Medicine Journal*, 36(3), 131-136.
5. DiBiasio, D. J., Lemaire, J., & Cummings, K. (2018). Emergency medical systems education may improve knowledge of pre-hospital stroke triage protocols. *Prehospital Emergency Care*, 22(1), 23-29.

6. European Journal of Trauma and Emergency Surgery. (2019). Special Issue on Pre-Hospital Care. *European Journal of Trauma and Emergency Surgery*, 45(1), 1-150.
7. Grimmer, K. (2016). Pre-hospital clinical practice guidelines – Where are we now? *African Journal of Emergency Medicine*, 6(2), 81-82.
8. Hagiwara, M., & Iwata, K. (2016). Patient safety and patient assessment in pre-hospital care: A study protocol. *Journal of Emergency Medicine*, 50(6), 805-811.
9. Khakali, S. (2023). Assessment of pre-hospital emergency medical services using a systemic approach. *International Journal of Emergency Services*, 12(1), 45-60.
10. Lockey, D. J., & Crewdson, K. T. (2018). Pre-hospital critical care: The role of the helicopter emergency medical service. *Trauma*, 20(4), 245-251.
11. McCaul, M. (2020). Strengthening pre-hospital clinical practice guideline development for South Africa. *South African Medical Journal*, 110(7), 649-650.
12. McCaul, M., & De Villiers, M. (2018). Developing prehospital clinical practice guidelines for resource limited settings: Why re-invent the wheel? *African Journal of Emergency Medicine*, 8(3), 123-129.
13. Quain, A., & Gillett, M. (2008). Improving access to acute stroke therapies: A controlled trial of organised pre-hospital and emergency care. *Emergency Medicine Journal*, 25(8), 516-519.
14. Robertson-Steel, I., & Sutherland, M. (2001). Clinical governance in pre-hospital care. *Emergency Medicine Journal*, 18(3), 174-178.
15. Snooks, H. A., & Kearsley, N. (2008). What are the highest priorities for research in pre-hospital care? Results of a review and Delphi consultation exercise. *Emergency Medicine Journal*, 25(10), 693-697.
16. Teuben, M. R., & van der Veen, S. (2019). Investigating PHTLS® algorithms' impact on pre-hospital care efficiency. *Trauma Surgery & Acute Care Open*, 4(1), e000304.
17. Thompson, J., & Blanchard, I. (2018). EHAC Medical Working Group best practice advice on the role of air rescue and pre-hospital critical care at major incidents. *Journal of Trauma and Acute Care Surgery*, 85(6), 1234-1240.
18. Trimmel, M., & Ristl, R. (2018). Success rates of pre-hospital difficult airway management: A quality control study evaluating an in-hospital training program. *European Journal of Anaesthesiology*, 35(8), 557-563.
19. Watts, S., & Houghton, C. (2004). An evaluation of the use of guidelines in prehospital management of brain injury. *Journal of Neurosurgery*, 100(3), 314-318.