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RESEARCH REPORTS

MAPPING THE EVOLUTION OF PARAMEDICINE EDUCATION: INSIGHTS, TRENDS, AND RECOMMENDATIONS FOR PRIMARY HEALTHCARE PREPAREDNESS

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ABSTRACT

Paramedicine education faces challenges in aligning curriculum with evolving practice. Despite updates, our study reveals minimal change since 2018, especially post-transition from the Council of Ambulance Authorities to Paramedicine Board of Australia accreditation. Updates in cultural competency and interprofessional education are noted, but primary healthcare integration remains inadequate, showing a critical gap between education and practice needs. This study assesses the alignment of paramedicine curricula in Australian higher education with evolving practice scopes, focusing on essential components for primary healthcare preparedness. Using a sequential meta-synthesis approach, integrating consensus evaluation via the Delphi method (2018) and RESPIGHT care model analysis (2024), the study examines paramedic curricula from 2018 to 2024. Data from sixteen Australian higher education institutions offering paramedicine programs. Sixty-eight paramedic academics participated in the Delphi study, providing expert insights into curriculum design and alignment. Using the RESPIGHT framework, data extraction and analysis focused on key components crucial for paramedic readiness. The study evaluated alignment with contemporary practice standards and identified curriculum design gaps. Findings indicate varying degrees of alignment across institutions, with limited integration of primary healthcare components. The study highlights the need for ongoing refinement in curriculum design to meet evolving practice demands.

BACKGROUND

The relevance of curriculum in paramedicine education has long been debated, with advocates stressing the need for a contemporary and dynamic curriculum to meet the profession's evolving demands (Weber et al., 2021). Recent literature highlights that graduates must possess functional expertise and the ability to navigate uncertain environments (Ericsson et al., 2022; Reay et al., 2018). O'Meara et al. (2014) previously called for dynamic curricula that adapt to paramedicine's rapid evolution, a concern echoed across various contexts (Spelten et al., 2023).

Newton et al. (2020) reinforce the call for adaptability by emphasizing the accelerated pace of curriculum changes driven by employer demands and technological advancements. This highlights the need for swift adaptation to keep educational programs current. The paramedicine education sector is encouraged to regularly update course materials and validation processes to align with stakeholder expectations and stay abreast of clinical advancements.

Newton et al. (2020) highlight the necessity for swift curriculum adaptations due to employer demands and technological advancements. Historically, paramedic education varied significantly across training programs, prompting a shift to higher education to standardize curricula and competencies (Brooks et al., 2018). As paramedic practice evolves, especially regarding primary health care, curriculum adaptations and national standards become essential to align with contemporary healthcare delivery models (Newton et al., 2020).

Several models have been proposed to outline the professional capabilities necessary for paramedics (Newton et al., 2020; Eaton et al., 2021; Australasian College of Paramedic Practitioners, 2022), yet variability remains in the specific knowledge and skills required for paramedicine students (Shannon et al., 2022). Addressing this gap is crucial for new graduates to effectively contribute to their organizations. Integrating work experience and clinical exposure is vital for developing practical skills.

These insights are significant as they stress the importance of curriculum alignment in preparing healthcare professionals for integrated primary care roles. By addressing educational gaps, healthcare programs can improve responsiveness to healthcare system needs, leading to better patient outcomes.

The primary objective of this research was to examine the development of paramedicine program curricula in Australian higher education institutions since 2018. To achieve this objective, the study addressed the research questions focused on identifying the critical elements of an effective paramedic curriculum that adequately prepares graduates for employment in primary healthcare settings. How well do Australian higher education institutions' paramedicine curricula align with the evolving scopes of practice in paramedicine, particularly in preparing graduates for primary healthcare roles, based on an analysis from 2018 to 2024?

CONCEPT/DESCRIPTION

The research employed a sequential meta-synthesis design, which was chosen for its ability to systematically integrate and interpret findings from multiple studies coherently (Figure 1) (Butler-Henderson et al., 2020). This approach allows for a comprehensive exploration of the research topic by building upon the insights gained from each phase of the synthesis process.

In the context of the described research approach, the sequential meta-synthesis method involves synthesizing findings from multiple studies, each with its interpretations and perspectives. This aligns with the constructivist view that knowledge is constructed through the interaction of researchers with the data and the interpretations they make based on their understandings and perspectives (Mills et al., 2006).

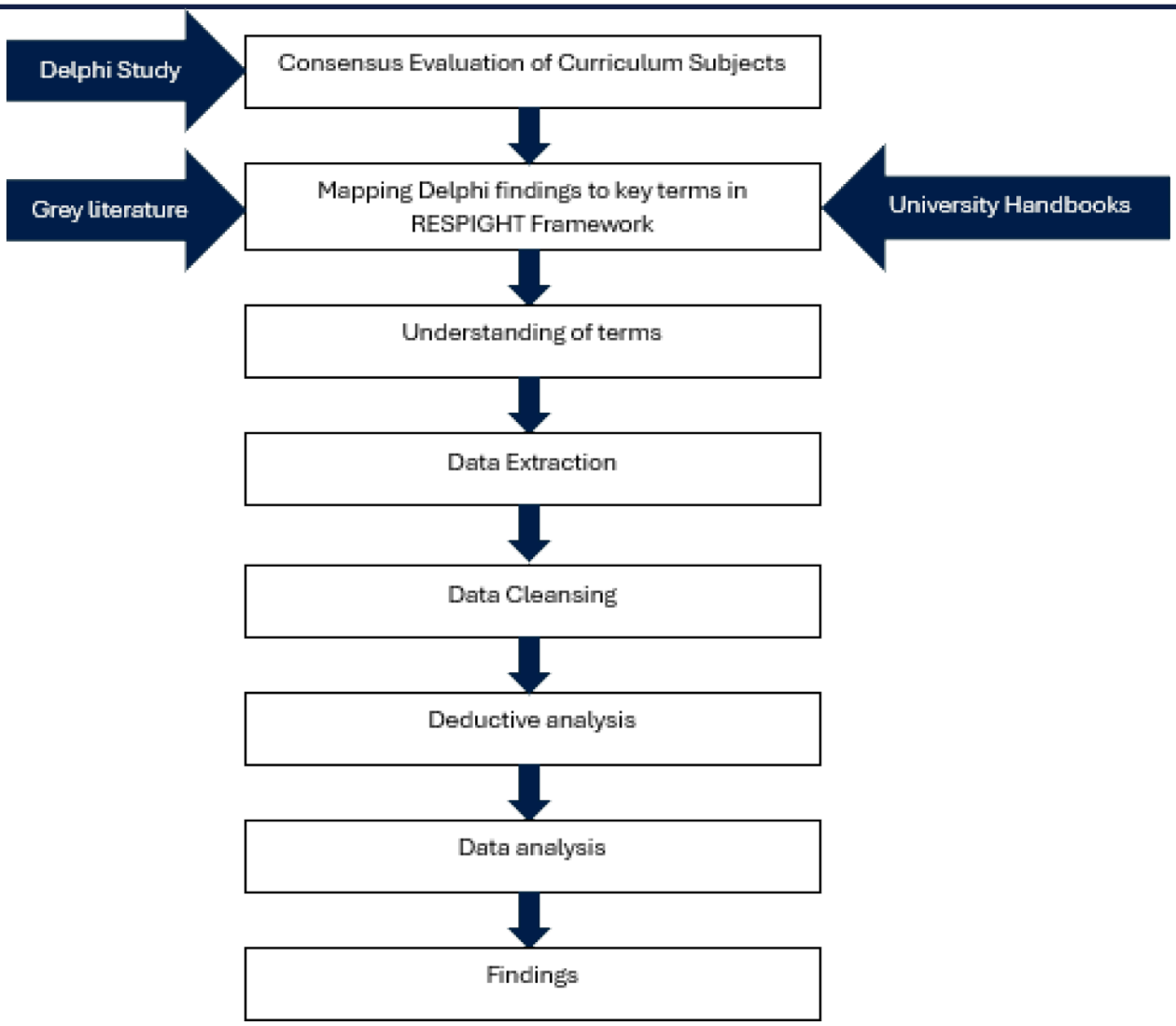

Figure 1. Progress and sequence of methods.

The choices made in the methodological approach were guided by the aim of achieving a comprehensive understanding of the evolution of paramedicine program curricula. Each step in the sequential meta-synthesis process was designed to build upon the previous one, with the findings from each phase informing the development of subsequent stages. This iterative process allowed for a nuanced exploration of the research questions and facilitated the identification of key themes and patterns across studies.

Following the CREDES guideline for rigorous and transparent reporting of Delphi studies, this section outlines the methodology employed in this study (Jünger et al., 2017). In adherence to the CARDA guideline for methodological transparency in document analysis, this section delineates the approach adopted in this study. Despite guidance to improve the rigor of document analysis across various fields, there is a notable absence of clear directives concerning its methodological conduct and reporting standards for peer-reviewed publication.

Step One - Consensus Evaluation of the Curriculum Subjects.

Justification

Delphi studies are reliable for projecting future information scope, making them suitable for examining the paramedic curriculum (Green, 2014). This method, applied without prior research, aligns with constructivist ontology to identify key curriculum elements. Capturing data in 2018 establishes a baseline for tracking curriculum evolution, aiding future comparisons and trend analysis.

Planning and Design

The Delphi process included three data collection rounds (Figure 2). The first round involved paramedic academics identifying crucial units of study through free-text survey responses. In the second round, participants ranked these units using a Likert scale. The third round had participants re-evaluate mean scores from the second round, achieving consensus.

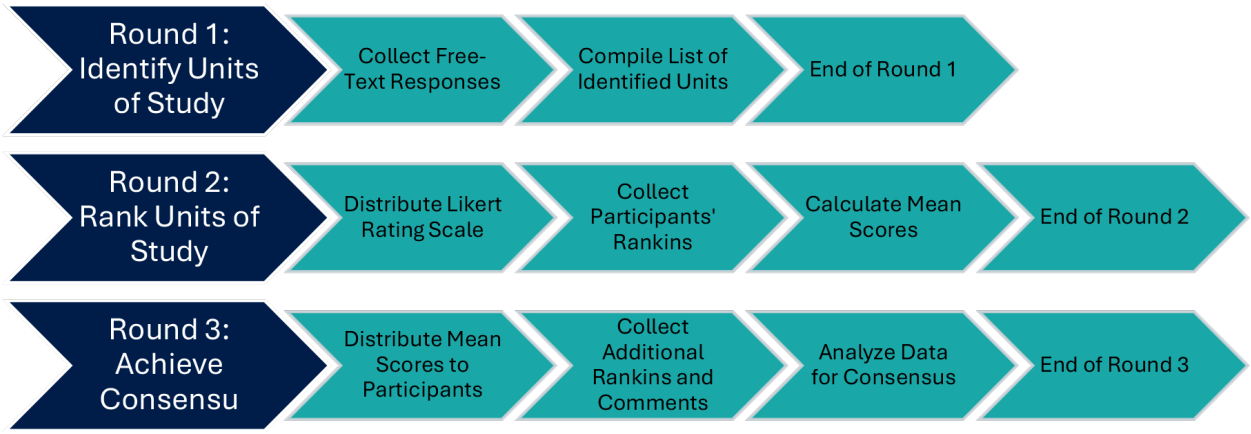

Figure 2. Flow chart Illustrating the stages of Delphi process.

Study Conduct

Maintaining process integrity required a thorough review and piloting of materials for the expert panel. Independent perspectives from public health and paramedicine experts were sought to ensure fairness and effectiveness. The primary author's external position minimized bias, ensuring research integrity and valid consensus.

Reporting

Paramedic academics from 18 universities in Australia and New Zealand were contacted through the Network of Paramedic Academics (NAPA). The expert panel's insights, from clinical and academic environments, informed the study units essential for preparing students as autonomous paramedics. Data collection in 2018 provided a baseline for monitoring curriculum developments and educational priorities, ensuring continuous improvement in paramedic education.

1	Unit of study not important, very unlikely to enhance clinical judgement ability of students to make them road ready
2	Unit of study not very important, unlikely to enhance clinical judgement ability of students to make them road ready
3	Unit of study possibly important may be likely to enhance clinical judgement ability of students to make them road ready
4	Unit of study important, most likely to enhance clinical judgement ability of students to make them road ready
5	Unit of study extremely important, very likely to enhance clinical judgement ability of students to make them road ready

Table 1. Likert scale used within the Delphi study.

Step Two – Mapping Findings from the Delphi Study to Key Terms

Establishing a framework for analyzing paramedicine curriculum data ensures systematic evaluation. In our study, the 2018 Delphi findings were mapped to the RESPIGHT care model in 2024 for a structured analysis. The RESPIGHT model covers various aspects of paramedicine education, such as emergency response, community engagement, primary healthcare, and integration with health services.

Using NVivo software, we organized data according to the RESPIGHT framework categories. This systematic review used open coding to uncover new themes, though no new sub-themes emerged. Axial coding clarified relationships between codes, providing a comprehensive data view. NVivo's comparative features revealed patterns and differences, showing the stability or evolution of curriculum elements over time.

Mapping the 2018 Delphi findings to the RESPIGHT framework allows for a longitudinal curriculum assessment, identifying strengths and weaknesses. This comprehensive mapping guides future curriculum development to better prepare students for the evolving demands of paramedicine practice.

The RESPIGHT framework ensures a balanced evaluation of paramedicine education, highlighting the need for regular updates to keep pace with healthcare changes. This approach promotes relevant and effective paramedicine education.

Step Three – Understanding of Terms

We needed to establish a systematic framework to define the terminologies used in paramedicine university handbooks for our meta-synthesis. In Australian universities, terms like 'degree,' 'program,' and 'course' are often used interchangeably to describe overall educational experiences, while 'subject' or 'unit' refers to specific topics. To effectively compare university degrees, we first standardized institutional definitions. Consequently, we adopted the terms 'course' for overall educational experiences and 'subject' for specific topics within those courses.

Step Four – Data Extraction

The data extraction process for our sequential meta-synthesis involved systematically collecting and comparing findings from the 2018 Delphi study with the categories of the RESPIGHT framework in 2024. This method ensures a comprehensive analysis of the evolution in paramedicine education over time. Figure three outlines each step in the data extraction and analysis process for the sequential meta-synthesis, helping to visualize the systematic approach taken to compare the 2018 Delphi findings with the RESPIGHT framework in 2024.

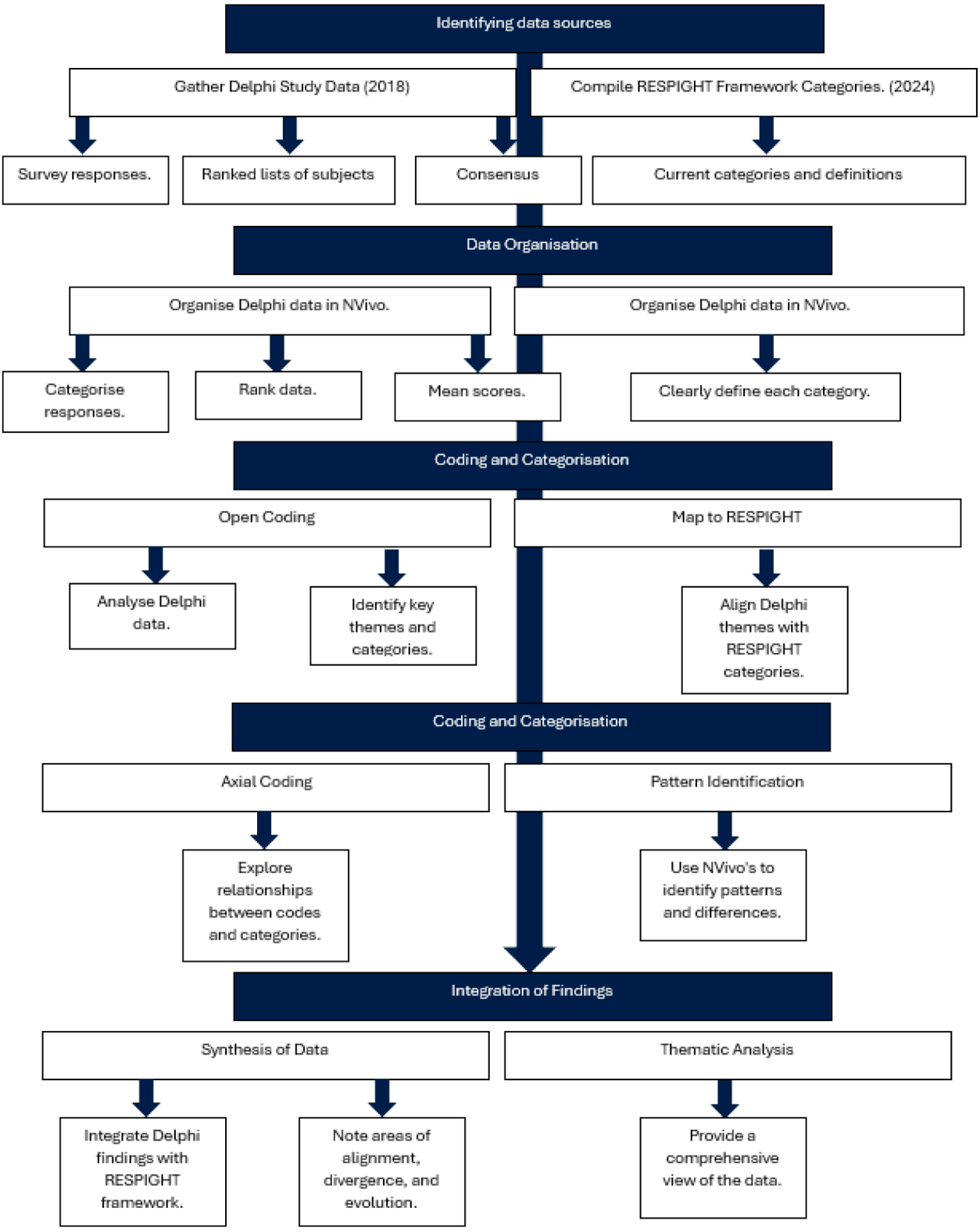

Figure 3. Overall process of data capture.

Step Five – Data Cleaning

Data cleaning is essential to ensure the accuracy and relevance of data before mapping it to the RESPIGHT framework. This process involves reviewing, refining, and validating the dataset to eliminate errors and enhance analysis quality.

The initial step in data cleaning involved thoroughly examining all statements from the 2018 Delphi study, including participant responses, rankings, and comments. The primary objective was to identify and eliminate any duplicate statements. Duplicates often arose when different statements conveyed similar ideas or used identical keywords or phrases. Care was taken to retain each unique statement only once, ensuring the dataset remained concise and focused.

Next, statements containing multiple distinct keywords or themes were addressed. These statements were separated into individual, unique statements as needed. This refinement was crucial for accurately categorizing and mapping each statement to the relevant aspects of the RESPIGHT framework.

After refining the dataset to eliminate duplicates and clarify statements with multiple keywords, each statement's overall relevance was assessed. This detailed analysis confirmed that every piece of data directly contributed to the study's objectives of comparing the findings from the Delphi study to the categories outlined in the RESPIGHT framework. If necessary, statements were re-categorized to ensure alignment with the appropriate RESPIGHT categories, ensuring the dataset accurately represented the diverse aspects of paramedicine education outlined by the framework.

Once satisfied with the dataset's content and relevance, a comprehensive validation process was conducted. This involved confirming the completeness of the dataset, ensuring no critical data was missing, and performing a final quality check to verify the accuracy and integrity of the remaining statements.

Subsequently, the cleaned and validated dataset was organized using NVivo software. This organizational step included assigning each statement to its corresponding RESPIGHT categories, facilitating a seamless transition to the next phase of the analysis. Finally, a final review of the dataset within NVivo was conducted to ensure all statements were correctly categorized and prepared for detailed comparative analysis against the RESPIGHT framework.

This systematic data cleaning and preparation process laid the foundation for extracting meaningful insights and drawing informed conclusions from the meta-synthesis study.

Step Six - Deductive Analysis Approach for Thematic Interpretation and Validation

In the next phase of our study, we used deductive analysis to refine and validate the themes identified from the initial thematic analysis, comparing the 2018 Delphi study with the RESPIGHT framework. Starting with the initial thematic review, we aimed to uncover additional relevant statements that aligned with these themes but had not surfaced initially. These newly identified statements were added to a comprehensive spreadsheet, categorised by theme for data management and analysis.

Validated statements were then confirmed to align with the overarching themes and incorporated into the overall analysis. This integration ensured all relevant insights were considered, providing a comprehensive view of the data. The final dataset, including these additional insights, was used to draw informed conclusions and make recommendations for the paramedicine curriculum in relation to the RESPIGHT framework.

Step Seven – Data Analysis

In our study, the RESPIGHT model of care is a robust framework for analysis, offering a holistic perspective on various facets of paramedicine education. By integrating the findings from the Delphi study, we enhance the depth of our analysis by exploring the evolving scopes of practice within the field. Additionally, we conducted a document analysis of university handbooks across Australia to assess the evolution of curricula, further enriching our understanding of paramedicine education.

This methodological approach ensures a comprehensive and multifaceted examination of the optimal paramedic curriculum subjects. To contribute to the depth of our analysis, we utilised two distinct methods: the Delphi process and analysis of the RESPIGHT model and university handbooks. The Delphi process allows us to capture expert opinions and insights, providing valuable input from practitioners and stakeholders. Integrating the RESPIGHT model and document analysis offers broader contextualization and historical perspectives on the evolution of paramedic curricula, shedding light on trends and developments over time.

The convergence of findings from these diverse methods strengthens the validity and reliability of our research outcomes. By triangulating data from multiple sources and perspectives, we mitigate the risk of bias and enhance the credibility of our conclusions. This rigorous approach underlines the robustness of our study and increases confidence in the generalizability and applicability of our findings to the field of paramedicine education.

Ethics Approval

The Delphi study protocol was approved by the CQUniversity University Human Research Ethics Committee (Reference H17/07-142) in December 2017. No ethics was required for the document analysis of the handbooks as these were available within the public domain.

RESULTS

Consensus Evaluation of the Subjects

During the first round of the Delphi study, 96 paramedic academics affiliated with the NAPA group were initially identified as potential participants. The data collection process commenced with electronic correspondence sent to this group of academics. In the first round of data collection, 48 individuals responded, yielding a response rate of 50% from the targeted sample. Participants were tasked with listing all the curriculum components (subjects, units, topics) they believed were essential in preparing students to become competent, independent, and safe practitioners while remaining adaptable to the evolving practices of paramedicine (Table 2). This round stayed open for 14 days and was accessible through an online survey distributed via Survey Monkey, ensuring participants' anonymity while acknowledging their identity as paramedic academics.

Subjects
Introduction bioscience
Biochemistry
Chemistry
Foundation of Basic Sciences
Pharmacology
Anatomy and Physiology
Pathophysiology
Medical Physiology
Pathophysiology of Issues in Primary Care
Microbiology and infection prevention
Maternal and child health
Pathways of Care in Healthcare
Marginalised Groups in Society
Psychology
Drugs of Abuse
Chronic disease management
Mental health care of patients
Trends in epidemiology
Special and vulnerable populations, including care of patients with disabilities
Health models and the role of paramedicine
Alternate care pathways
Minor Injuries and Minor Illnesses (MIAMI)
Remote and Extended Care
Basic Lab Values Interpretation in Emergency
Medicine and Family Medicine: Blood values,
imaging, POCUS, ECGs
Clinical Assessment (data interpretation)
ECG interpretation
Advanced electrophysiology and ECG interpretation
Law and Ethics
Understanding Decision Making
Cultural Considerations
The legal premise for paramedic practice
Ethical considerations in practice
Resolving personal, ethical and legal dilemmas
Patient Assessment (assessing the
patient, not the machine)
Acute Medical emergency assessment and treatment
Trauma, Environmental emergency and envenomation assessment and treatment
Consolidated Paramedic Practice (capstone)
Medical diagnoses and the complex diagnostic Assessment
Paediatric emergency care assessment
Common Issues of Growth/ Lifespan Issues

Subjects
Acute Medical emergency treatment
Applied pharmacology in paramedic practice
Scene Control
Manual Handling
Clinical Placement/WIL
Self Defence
Practical skills
Basic life support: Includes CPR with AED, basic first aid management, Haemorrhage control and a basic systematic approach
Manual handling
Paediatric emergency management
Treatment Modalities in Emergency Medicine
Human Factors: teamwork
Clinical leadership
Clinical education
Praxis including reflective learning models
Mentoring
Research training/Fundamentals of research
Evidence-based practice
Research project
Introducing the profession
Communications
Foundations of Paramedic Clinical Practice
Medical Terminology, documentation and basic ambulance systems
Clinical communication skills
Professional practice
Paramedic Practitioner Health (Diet, Exercise, Sleep, Injuries)
Stress and Distress: What it is, how it affects us
Occupational Health and Safety

Table 2. Curriculum subjects identified in Stage One of the Delphi study.

In the second round of the Delphi study, participants rated the importance of each curriculum component (subjects, units, topics) using a Likert scale. Importance was defined as the elements of the curriculum that equip graduates with the skills and knowledge needed for their roles in paramedicine. This round had a 71% response rate from 68 paramedic academics the goal was to reach expert consensus on key curriculum elements to enhance student attributes and competence.

In the third round, participants reviewed and could revise their previous scores. They were presented with the scores from the second round, including group mean scores, and could adjust their scores or add new comments over 14 days via SurveyMonkey. Notably, no scores were changed in this round.

The Delphi study provided valuable insights into essential curriculum components for paramedicine education. Categories within the RESPIGHT model achieved high scores and consensus among participants, offering significant guidance for developing comprehensive curricula that meet the evolving demands of the paramedic profession.

Mapping Findings from the Delphi Study to Key Terms

The responses received during the Delphi study were categorized into the recognized categories underpinned by the RESPIGHT framework, which include Response to Emergencies, Engaging with Communities, Situated Practice, Primary Healthcare, Integration with Health, Aged Care, and Social Services, Governance and Leadership, Higher Education and Treatment and Transport (see Table 3).

The Delphi study achieved consensus on 20 subjects distributed across the seven identified categories (Table 4). These findings provide valuable recommendations for inclusion in curriculum development. The subjects identified span a wide range of areas, catering to the diverse needs of paramedic education. Furthermore, 48 more subjects did not reach a consensus.

Data Analysis

To assess the compatibility of curricula with the RESPIGHT framework, we reviewed educational programs from sixteen institutions, focusing on subjects relevant to the RESPIGHT categories. Each subject was evaluated for clear synopses and learning outcomes. Subjects lacking comprehensive synopses or defined learning outcomes were excluded to maintain assessment rigor. Content outside the RESPIGHT framework, such as science-related topics like biochemistry, was generally disregarded unless relevant within the higher education category.

We employed deductive coding techniques, using RESPIGHT search terms and literature-derived codes to identify prevalent themes and trends. This approach allowed us to distil extensive information into meaningful categories for comprehensive analysis.

Our evaluation covered 377 subjects across 19 degrees offered by 16 universities. One university's curriculum lacked accessible online information, potentially limiting our assessment depth for that institution. After coding, 125 subjects were deemed invalid due to non-compliance with the RESPIGHT framework, leaving 252 subjects for further analysis.

Category	Subjects	
Response to Emergencies	Introduction to Bioscience Biochemistry Chemistry Foundation of Basic Sciences Pharmacology Anatomy and Physiology Pathophysiology Medical Physiology Microbiology and Infection Prevention Clinical Assessment (data interpretation) ECG Interpretation Advanced Electrophysiology and ECG Interpretation Patient assessment(assessing the patient, not the machine)	Acute Medical Emergency Assessment and Treatment Trauma, Environmental Emergency, and Envenomation Assessment and Treatment Consolidated Paramedic Practice (Capstone) Paediatric Emergency Care Assessment and Treatment Applied pharmacology in paramedic practice Practical Skills Basic Life Support (CPR with AED, Basic First Aid, Haemorrhage Control) Paediatric Emergency Management Treatment Modalities in Emergency Medicine Clinical leadership
Engaging with Communities	Marginalised Groups in Society Psychology Drugs of Abuse Mental Health Care of Patients	Special and Vulnerable Populations, including care of patients with disabilities Communication
Situated Practice	Maternal and child health Cultural considerations Clinical Placement/WIL	Self Defence Mentoring
Primary Healthcare	Pathophysiology of Issues in Primary Care Pathways of Care in Healthcare Chronic Disease Management Trends in Epidemiology Public Health Health Models and the Role of Paramedicine Alternate Care Pathways	Minor Injuries and Minor Illnesses Remote and Extended Care Basic lab values Medical diagnosis and the complex diagnostic assessment Common issues of growth/lifespan issues
Integration with Health, Aged Care, and Social Services	Law and Ethics Understanding Decision Making Legal Premise for Paramedic Practice Ethical Considerations in Practice	Resolving Personal, Ethical, and Legal Dilemmas Human Factors: Teamwork Professional Practice
Higher Education	Clinical education Praxis, including Reflective Learning Models Research Training/Fundamentals of Research	Evidence-Based Practice Research Project Introducing the profession
Treatment and Transport	Scene Control Manual Handling Foundations of Paramedic Clinical Practice Medical Terminology, Documentation, and Basic Ambulance Systems Clinical Communication Skills	Paramedic Practitioner Health (Diet, Exercise, Sleep, Injuries) Stress and Distress: What it is, how it affects us Occupational Health and Safety Consolidated Paramedic Practice (Capstone)

Table 3. Medication disposal characteristics.

Table 5 presents the percentage breakdown of units aligned with RESPIGHT categories, providing insights into subject content distribution within the curricula and highlighting areas of alignment and divergence from the framework. This detailed examination offers valuable insights into the overall mapping process, the compatibility of educational programs with the RESPIGHT framework, and areas for potential enhancement.

Category	n	Consensus (n) % Likert score 1	Consensus (n) % Likert score 2	Consensus (n) % Likert score 3	Consensus (n) % Likert score 4	Consensus (n) % Likert score 5
Response to Emergencies						
Pharmacology	68				(16) 23.53%	(52) 76.47%
Anatomy and Physiology					(10)14.71%	(58) 85.29%
Pathophysiology				(2) 2.94%	(8) 11.77%	(58) 85.29%
Medical physiology				(2) 2.94%	(24) 35.29%	(42) 61.77%
Clinical assessment				(6) 8.82%	(22) 32.35%	(40) 58.83%
ECG interpretation					(2) 2.94%	(66) 97.06%
Advanced electrophysiology and ECG interpretation				(4) 5.88%	(44) 61.76%	(22) 32.36%
Patient assessment (assessing the patient, not the machine)					(2) 2.94%	(66) 97.06%
Acute medical emergency assessment and treatment					(10) 14.71%	(58) 85.29%
Trauma, environment emergency, envenomation assessment and treatment					(18) 26.47%	(50) 73.53%
Consolidated paramedic practice (capstone)				(10) 14.71%	(16) 23.52%	(42) 61.77%
Paediatric emergency care and assessment			(2) 2.94%	(2) 2.94%	(14) 20.59%	(50) 73.53%
Applied pharmacology in paramedic practice			(2) 2.94%	(2) 2.94%	(14) 20.59%	(50) 73.53%
Practical skills				(2) 2.94%	(20) 29.41%	(46) 67.65%
Basic life support includes CPR, AED, first-aid management, haemorrhage control, and a systematic approach.				(4) 5.88%	(4) 5.88%	(60) 88.24%
Paediatric emergency management				(4) 5.88%	(14) 29.41%	(50) 73.53%
Clinical leadership				(4) 5.88%	(24) 35.29%	(40) 58.83%
Primary Healthcare						
Medical diagnosis and the complex diagnostic assessment	58			(4) 6.90%	(14) 24.12%	(40) 68.98%
Integration with Health, Aged Care, and Social Services						
Human factors: teamwork	68				(34) 50.00%	(34) 50.00%
Treatment and Transport						
Scene control	68		(2) 2.94%	(6) 8.82%	(20) 29.41%	(40) 58.83%

Table 4. Subjects that reached consensus.

Categories	Percentage
Response to emergencies	63.49% (n = 160)
Engaging with communities	3.97% (n = 10)
Situated practice	10.32% (n = 26)
Primary Healthcare	7.14% (n = 18)
Integration with health, aged care and social services	9.13% (n = 23)
Governance and leadership	4.76% (n = 12)
Treatment and transport	1.19% (n = 3)
Invalid	33.15% (n = 125)

Table 5. RESPIGHT factors across undergraduate paramedicine units.

Overall Findings

The comparison between the RESPIGHT framework and the Delphi study highlights significant disparities in their scope and emphasis on paramedic practice and education. The RESPIGHT framework provides a holistic perspective, addressing critical dimensions such as emergency response, primary healthcare, governance, clinical skills, community engagement, and situational awareness. Its emphasis on integrating paramedics into broader healthcare systems and addressing cultural competence reflects the evolving expectations of paramedic roles in diverse contexts.

In contrast, the Delphi study takes a narrower approach, focusing primarily on expert consensus regarding foundational clinical topics such as pharmacology, anatomy, ECG interpretation, and clinical assessment. While these are undeniably important, the study reveals substantial gaps in consensus for critical areas like trauma assessment, clinical leadership, and community-based care. These disparities suggest a fragmented understanding of the broader competencies required for contemporary paramedicine, underscoring a need for further research and dialogue to address these gaps.

Notably, the RESPIGHT framework uniquely prioritizes community engagement and situational practice, while the Delphi study remains centered on emergency response. The absence of consensus in 48 subjects from the Delphi study further highlights areas of uncertainty that require targeted investigation. This underscores the need for future research to focus on underexplored yet essential domains, such as interdisciplinary collaboration, leadership development, and paramedic roles in primary healthcare.

Using the RESPIGHT framework, the Delphi study identified important themes in paramedic education, such as emergency response, community engagement, practice in real-world settings, primary healthcare, integration with health services, governance and leadership, higher education, and treatment and transport. These findings, organised into seven categories and 20 subjects, provide crucial recommendations for developing curricula that address various needs in paramedic education. However, the study also revealed 48 subjects without consensus, suggesting areas needing further exploration.

Analysis of educational programs across 16 institutions revealed varying degrees of alignment with the RESPIGHT framework. While some curricula effectively integrate aspects like primary care and governance, others lack sufficient emphasis on areas such as community engagement and leadership. These discrepancies indicate an urgent need for a more standardized and comprehensive approach to curriculum development, ensuring alignment with industry demands and preparing graduates for multifaceted healthcare roles.

DISCUSSION

This study highlights the evolving landscape of paramedicine education, revealing both progress and persistent challenges. A critical comparison of the RESPIGHT framework and the Delphi study highlights disparities in their scope and priorities, which have significant implications for curriculum development and healthcare preparedness.

Aspect	RESPIGHT Framework	Delphi Study	
Response to Emergencies	63.49% (n = 160)	Pharmacology	76.47%
		Anatomy and Physiology	85.29%
		Pathophysiology	85.29%
		Medical physiology	61.77%
		Clinical assessment	58.83%
		ECG interpretation	97.06%
		Advanced electrophysiology and ECG interpretation	61.76%
		Patient assessment	97.06%
		Acute medical emergency assessment and treatment	85.29%
		Trauma, environmental emergency, envenomation assessment and treatment	73.53%
		Consolidated paramedic practice (capstone)	61.77%
		Paediatric emergency care and assessment	73.53%
		Applied pharmacology in paramedic practice	73.53%
		Practical skills	67.65%
		Basic life support includes CPR, AED, first-aid management, haemorrhage control, and a systematic approach	88.24%
		Paediatric emergency management	73.53%
		Clinical leadership	58.83%
Engaging with Communities	3.97% (n = 10)	- Not addressed	
Situated Practice	10.32% (n = 26)	- Not addressed	
Primary Healthcare	7.14% (n = 18)	- Medical diagnosis and the complex diagnostic assessment: 68.98% agreement	
Integration with Health, Aged Care, and Social Services	9.13% (n = 23)	- Human factors: teamwork: 50.00% agreement	
Governance and Leadership	4.76% (n = 12)	- Not addressed	
Treatment and Transport	1.19% (n = 3)	- Scene control: 58.83% agreement	
Invalid	33.15% (n = 125)	- Not applicable	

Table 6. Correlation of expert consensus and RESPIGHT framework across undergraduate paramedicine units.

The RESPIGHT framework's holistic perspective, emphasizing community engagement, situational practice, and integration into primary healthcare, reflects the expanding role of paramedics beyond emergency response. However, its utility as a guide rather than a formal standard limits its influence on curriculum design, contributing to inconsistencies across institutions. This gap suggests a need for more robust mechanisms to ensure the integration of RESPIGHT principles into educational programs.

Conversely, the Delphi study's narrower focus on foundational clinical topics, while valuable, exposes a lack of consensus in critical areas such as trauma assessment and clinical leadership. These gaps not only highlight missed opportunities for interdisciplinary collaboration but also risk under-preparing graduates for the complexities of modern healthcare environments. The absence of emphasis on community engagement and broader healthcare integration further limits its relevance to the current demands on paramedics.

The findings also reveal significant misalignment between educational programs and industry needs, particularly in primary healthcare preparedness and leadership training. With paramedics increasingly operating in community-based and non-emergency settings, this misalignment risks perpetuating workforce gaps in critical areas. Furthermore, the lack of national consistency in curriculum design exacerbates disparities, undermining efforts to equip graduates with the skills necessary to navigate diverse healthcare challenges.

These results call for urgent action to address these gaps. Strengthening educational standards, embedding community engagement and leadership into curricula, and fostering interdisciplinary collaboration are critical for preparing paramedics for their evolving roles. Without these measures, the field risks lagging behind healthcare demands, ultimately compromising the quality of patient care and equity in service delivery.

LIMITATIONS

The analysis is based on data from a specific subset of institutions and subjects within Australia, potentially limiting the representation of the diverse range of paramedicine programs and curriculum approaches globally. The Delphi study employed a consensus threshold of 90%, which some may consider high. This criterion was centred around subjects deemed high or very high in preparing students for future employment, potentially influencing the outcomes. While the study acknowledges significant changes in paramedicine education since data collection, it primarily focuses on demonstrating that core aspects of paramedic education have not substantially changed, potentially overlooking newer developments.

CONCLUSION

The findings reveal critical disparities in how paramedic education frameworks address the evolving role of paramedics in emergency and primary healthcare. While the RESPIGHT framework offers a comprehensive and forward-looking perspective, the Delphi study's narrower focus on foundational clinical topics exposes gaps that hinder the development of a holistic paramedic education.

A notable shortcoming is the limited integration of primary healthcare principles, cultural competence, and interdisciplinary collaboration in many current curricula. Given the increasing reliance on paramedics in community-based healthcare, it is imperative to prioritize these elements in future curriculum design. To bridge the identified gaps, the following recommendations are proposed:

1. Curriculum Development:
    - Integrate principles of primary healthcare, cultural competence, and interdisciplinary collaboration into existing and future paramedic curricula.
    - Address areas of weak consensus from the Delphi study, such as trauma assessment and clinical leadership, through targeted educational modules.
2. Research Initiatives:
    - Conduct follow-up Delphi studies to refine areas of disagreement and explore emerging topics, such as the role of paramedics in preventative healthcare and chronic disease management.

- Investigate the long-term impact of community engagement and situational awareness training on patient outcomes.

3. Policy and Governance:
   - Develop national guidelines to promote alignment with frameworks like RESPIGHT, ensuring consistency in addressing the broader competencies required of paramedics.
   - Encourage collaboration between accrediting bodies, academic institutions, and healthcare organizations to establish shared priorities.

By combining insights from the RESPIGHT framework and the Delphi study, curriculum developers and policymakers can create a balanced educational approach. This will ensure that paramedics are equipped not only for emergency response but also for the expanding scope of primary healthcare. Such alignment is essential for improving patient outcomes, healthcare equity, and the overall preparedness of paramedics to meet contemporary and future healthcare challenges.

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RESEARCH REPORTS

AN ASSESSMENT OF PREHOSPITAL CLINICIAN EDUCATION AND EXPERIENCE AROUND THE DELIVERY OF BAD NEWS

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ABSTRACT

Objectives: Emergency Medical Services (EMS) clinicians are often tasked with the delivery of bad news including making death notifications and informing loved ones about the termination of resuscitations. Existing trainings for breaking bad news are based around palliative care conversations in dramatically different clinic or hospital settings. We hypothesize that prehospital clinicians are not receiving formal training in the skill of breaking bad news and the delivery of bad news can have harmful mental health repercussions. The goals of this study were to: determine if prehospital clinicians are receiving training on delivering bad news, how frequently they are doing so, and to explore negative consequences potentially arising from these experiences.

Methods: We conducted an electronic, cross-sectional survey of U.S. EMS clinicians. Items assess EMS clinicians' experiences around training related to breaking bad news, frequency of delivering bad news, and experiences of mental health consequences from doing so.

Results: 1113 participants responded, representing all 50 US states. 84% (933/1111) of participants reported having delivered bad news at least several times in the last year with 42% (422/1001) reporting receiving no education around this topic. 96% (953/991) of participants reported that additional training would be helpful. 54% (528/964) of participants reported experiencing some adverse mental health symptoms (intrusive thoughts, lost sleep, emotional difficulty) in the last year related to delivering bad news and 7% (71/964) experienced these effects frequently.

Conclusion: EMS clinicians are frequently responsible for delivering bad news, and more than half report adverse mental health symptoms associated with this task. Despite the frequent occurrence and associated emotional trauma, EMS clinicians report insufficient or no training at all in how to deliver bad news. The development and implementation of educational curriculum and mental health support around the delivery of bad news is necessary.

INTRODUCTION

Background and Importance

In the complex and dynamic world of prehospital medicine, clinicians are faced with innumerable challenges. Among these is the daunting task of the delivery of bad news to patients and their families. This ranges in intensity, from the notification of serious illness or injury, to notification of a death or a decision to

terminate an active resuscitation. This has been part of EMS clinicians' responsibilities for decades, but little research exists around this topic. In 2011, the National Association of EMS Physicians (NAEMSP) took an official position that "Emergency Medical Services (EMS) providers should be able to utilize evidence-guided methodology for the termination of resuscitation in nontraumatic cardiopulmonary arrest" (National Association of EMS Physicians, 2011). Roughly 350,000 prehospital cardiac arrests occur every year in the US alone (Benjamin et al., 2019). As the practice of terminating prehospital cardiac arrest becomes a national standard, delivering the bad news of failed resuscitation efforts and a patient's death is likely falling on the shoulders of our EMS clinicians. While no data exists on how many EMS agencies are currently practicing prehospital termination of cardiac arrest, there are entire statewide agencies such as in Maine where a termination of resuscitation protocol exists. A recent study analyzing data from 1,514 EMS clinicians found that 77% of ALS providers reported at least one adult death notification in the past year (Campos et al., 2021). As hospitals continue to strain under high patient censuses, there may be increased pressure for agencies to adopt EMS field termination policies, further increasing the need for delivery of bad news by EMS clinicians.

The current national EMS education standard does not include education around the subject of breaking bad news. At the level of EMT-basic, clinicians receive teaching on the subject of "Dealing with Death and Dying" including teaching on the stages of grief after loss i.e. denial, bargaining, etc. (National Emergency Medical Services Education Standards, 2022). At the paramedic level, there is no mandated education mandated specific to the delivery bad news (National Emergency Medical Services Education Standards, 2009). US-based research examining whether prehospital clinicians are receiving training on how to deliver bad news is scant. A single 2021 study found that only about half of EMS clinicians reported undergoing death notification training as part of their initial EMS education with fewer receiving additional continuing education on the subject (Campos et al., 2021).

Another burden facing EMS clinicians is the emotional ramifications associated with delivering bad news. This is an inherently stressful task and several small studies have shown that even in simulated environments delivering bad news by physicians can lead to significant stress responses and reports of increased burnout (Brown et al., 2009). There is also a correlation between poor communication and increased burnout among physicians in simulated situations (Brown et al., 2009). It is certainly possible that EMS clinicians may experience ill effects from delivering bad news, but this has yet to be assessed.

Goals of Investigation

The goals of this study were to describe the current educational landscape, frequency of bad news delivery, and potential adverse experiences for prehospital clinicians around the topic of breaking bad news. This study will help to assess how frequently EMS clinicians are breaking bad news, if they have received training on the subject and if they feel this training was adequate. Ultimately, we hope to determine if there are any sequalae related to breaking bad news and establish the need for additional education and best practice guidelines around this topic.

STUDY DESIGN

A cross-sectional study design was utilized to collect self-report data from EMS clinicians including emergency medical responders, emergency medical technicians at the basic, advanced, and paramedic levels, and physicians who identified as EMS clinicians. Data was only collected for participants over the age of 18 who reported living in the US or one of its territories. The survey was distributed electronically using Qualtrics survey software and was self-administered by participants. The primary means of distribution was through posting the survey link on the social media platform Facebook on various EMS related "groups". Several thousand direct emails were also distributed to EMS clinicians located in the state of Maine where addresses were obtained via public record requests. No response rate data was collected as there was no way to see how many people were exposed to the survey via social media groups. The study was determined to be exempt by the Maine Health Institutional Review Board.

SURVEY

We developed a 16-item survey tool with items representing the following domains: demographics (age, gender identity, current state), EMS background, career vs volunteer status, practice environment, experiences breaking bad news, confidence in breaking bad news, training on breaking bad news, and impact of breaking bad news. Items about provider experience with breaking bad news included questions such as "In the last year, have you had to tell a family member that their loved one has died?" Additional questions assessing provider confidence in their ability to break bad news and their assessment of how such incidents went utilized a Likert-type scale. Participants were asked about prior training on breaking bad news, the adequacy of any training received, and if they were interested in receiving additional training. Clinicians were queried about the presence of troublesome symptoms over the last year including repeatedly replaying a conversation in their head afterwards, lost sleep, or emotional struggles after delivering bad news. One open-ended item was included to provide participants with an opportunity to share any additional information.

DATA ANALYSIS

Data was collected using Qualtrics survey software (Qualtrics, Seattle, WA) and were then downloaded into SPSS v. 27 (SPSS, Inc., Chicago, IL) statistical software for analysis. As participants were free to skip any question, surveys with partial data were included; only surveys with no responses were excluded from analysis. Descriptive statistics were used to describe participant characteristics and quantitative responses are summarized using numbers and percentages. Continuous data for groups were compared using one-way analysis of variance and the Sheffé test for post hoc comparisons. Comparisons of proportions were made using chi-square or Fisher's Exact Test, as appropriate for the data and we accepted a threshold of 0.05 as statistically significant. We took a qualitative descriptive approach to analyzing responses to the single open-ended item (Sandelowski, 2000). Responses to this item were first read by the team to establish a general feel for the data. Following the initial reads, the researchers selected related bits of text by re-reading the responses and highlighting all of the text relevant to the topic of the survey question. The research team then evaluated for common themes that cut across responses. This work was completed in a reflexive manner, whereby the research team continually read,

re-read, coded and re-coded bits of text as new insights about the data emerged during the process of constant comparison (Strauss & Corbin, 1998).

RESULTS

A total of 1118 participants provided at least partial data for analysis. Participant demographic characteristics are summarized in Table 1. Respondents represented all fifty states of the United States and Puerto Rico.

Participants were asked to consider their experiences over the course of the last year when responding to survey items regarding the frequency with which they are charged with breaking bad news. The majority of participants [84% (933/1111)] endorsed having delivered bad news at least several times during the year. Furthermore, 35% (393/1116) reported breaking bad news 6 or more times in the last year. Eighty-six percent (896/1046) of participants reported sharing that a loved one had died during the year and 24% (256/1046) reported doing so 6 or more times.

Many participants reported receiving no education on the subject of breaking bad news (42%, 422/1001). Of those who did report receiving training, 44% (256/582) shared that their training occurred while in EMT or paramedic school. Only 9% (52/582) of respondents endorsing receipt of training reported that it occurred at an employer or volunteer service. About one quarter of participants [24% (142/582)] reported receiving training both as part of their EMS education and at their job or volunteer service. Of clinicians with less than 5 years of experience, 48% (66/138) reported receiving some training while in school, while EMS clinicians with greater than 10 years of self-reported prehospital experience reported receiving education on the subject as part of their EMS education 37% (260/688) of the time, a statistically significant difference (x^2=4.85, df=1, p=0.028). Little variation was noted when comparing exposure to education on breaking bad news by geographic location with 40% (146/336) of rural clinicians, 43% (159/369) of suburban clinicians, and 43% (114/265) of those practicing in urban locations reporting no education in this area (x^2=0.01, df = 2, p=0.995). Of respondents who had received education, only 26% (226/869) reported their training and education was sufficient. The great majority [96% (964/1002)] report-

Characteristic	N (%)
Gender	
Male	685 (61%)
Female	413 (37%)
Nonbinary, transgender, agender or another gender identity	11 (1%)
Unknown	9 (1%)
Age (Mean 41 years, range 17-81 years)	
17-30	259 (24%)
31-40	293 (27%)
41-50	263 (24%)
51-60	183 (17%)
61-70	84 (8%)
71-80	11 (1%)
>80	1 (0.1%)
Professional Role	
First Responder	10 (0.9%)
EMT	341 (31%)
EMT – Advanced	64 (6%)
Paramedic	636 (57%)
Physician	9 (0.8%)
Nurse	23 (2%)
Other	34 (3%)
Employment Model	
Volunteer	99 (9%)
Employed	843 (75%)
Both	176 (16%)
Primary Setting Type	
Urban	287 (26%)
Suburban	424 (38%)
Rural	399 (36%)
Years of Experience	
Less than 2 years	35 (3%)
2-5 years	165 (15%)
6-10 years	160 (15%)
More than 10 years	747 (68%)
Notes: Not all categories sum to 1118 due to missing data. EMT = emergency medical technician.	

Table 1. Demographic characteristics of study participants.

ed that additional training would be helpful, with 51% (519/1002) reporting this training would be "very helpful."

Clinicians generally reported high levels of confidence around breaking bad news on a scale of 0 (not confident at all) through 10 (completely confident). The mean confidence score for all clinicians was 7.15 points (SD 2.03), 95% CI: 1.02-7.27. Mean confidence scores increased with participants' years of practice experience as shown in Table 2, with the lowest confidence scores being reported by participants with less than 2 years of experience (mean 5.11, SD 2.50, 95% CI: 4.10-6.13) and the highest scores reported by those with more than 10 years of practice (mean 7.54, SD 1.88, 95% CI: 7.40-7.68). In one-way analysis of variance, these differences were statistically significant (F=34.712, p<0.001), with post-hoc analysis demonstrating significant differences when comparing each experience level group (p<0.05 for each comparison) except when comparing the 2-5 year vs. 6-10 year groups (p=0.819).

Years of Experience	Confidence Mean (95% CI)	Comparison Group	Mean Difference	SE	95% CI	*p*-value
< 2 years	5.11 (4.10 – 6.13)	2-5 years	-1.17	0.411	-2.32 - -0.020	0.044
		6-10 years	-1.39	0.413	-2.54 - -0.233	0.010
		>10 years	-2.43	0.387	-3.51 - -1.34	<0.001
2-5 years	6.29 (5.97 – 6.61)	6-10 years	-0.22	0.224	-0.843 – 0.411	0.819
		>10 years	-1.56	0.173	-1.74 - -0.771	<0.001
6-10 years	6.50 (6.17 - 6.84)	>10 years	-1.04	0.176	-1.53 - -0.548	<0.001
> 10 years	7.54 (7.40 – 7.68)					

Notes: SE = standard error; CI = confidence interval. One-way analysis of variance: F = 34.712; p < 0.001. Post-hoc analysis with Scheffé's test.

Table 2. Participant self-report confidence in delivering bad news.

When queried about experiencing negative sequelae (intrusive thoughts, lost sleep, emotional difficulty) after delivering bad news, 54% (523/964) of clinicians reported these effects and 7% (71/964) experienced these effects frequently. Clinicians with less experience seemed to experience these effects more frequently, with clinicians who had less than 5 years' experience reporting some negative sequalae 70% (115/164) of the time with 11% (18/164) experiencing those effects frequently. Clinicians with ≥ 10 years' in practice reported suffering negative sequelae 50% (333/664) of the time and reported being affected frequently by negative sequelae at almost half the rate of their less experienced colleagues at 6.6% (44/664).

A single open-ended item prompted, "If you feel comfortable doing so, please use this space to share an experience you have had with breaking bad news to a patient or family and the emotional impact it had on you. This experience could be good or bad." This elicited a total of 302 written responses. Qualitative findings supported and clarified quantitative responses through emergence of several themes. Major themes included the high emotional impact around calls involving the death of a child. Frequently deaths from suicide or deaths where there was an extreme grief reaction from family were mentioned for their emotional impact as well. Other themes included difficulty in breaking bad news after a death in the first responder's own life as well as knowing the person who died or their family. Two more common themes of note were that clinicians fre-

quently expressed what they felt worked well when breaking bad news to families and general concerns over lack of education and feeling unprepared to approach these situations. Exemplary quotes are noted in Table 3.

DISCUSSION

Our study showed a diverse sample, representing EMS clinicians from across the United States of various ages, experiences, practice style (volunteer vs career), geographic location and practice settings. The results of this study demonstrate that EMS clinicians are frequently responsible for delivering bad news. The vast majority of clinicians (86%) reported preforming at least one death notification in the last year with almost a quarter

Major Theme	Illustrative Quotations
The death of a child and notifying parents is extremely difficult	Always pediatric or infant deaths are troublesome. It's not delivering the news that is emotional, it is the death event itself.
	I've had several cases where I've had to tell a mother that her child or infant died and that is terrible. The scream that mother let out immediately after hearing her child is dead still rings in my ears.
	I had to inform a distraught mother that in spite of our best efforts, her infant could not be resuscitated. By appearance, the mother had rolled over onto the infant during sleep and asphyxiated her. The mother kept shrieking 'It's my fault' and my efforts to calm and comfort her were met with minimal success. I have observed many instances of death and extreme suffering over the course of a 40-year EMS career. The primal sounds produced by this distraught mother were unpleasantly memorable.
	The hardest of these conversations is telling a family member that their child has died. This is because I'm a parent.
	I've been an EMT and paramedic for over 35 years. Telling a parent that their child has died have been the incidents of greatest emotional impact to me over the years.
Breaking the news of death by suicide or when there are extreme grief reactions is a challenge	Young adult suicides by violent means has an impact on the whole team.
	I recently had to confirm to a family that the husband had passed due to suicide. The screams and cries of the wife still stick with me. She couldn't even call her parents. She asked me to do it. She was shaking and sobbing. I still don't know if I made the right choice or not.
	I had to tell a mother that her teenage child hung himself. I couldn't really think of anything to say to the mother other than, 'I'm sorry' which sounded so insufficient. I held her hand and let her cry because what else could I do? The emotions hit pretty hard and I still think about it often, even years later.
	I had a 14-year old who overdosed; her mom was devastated and she just wanted me to know she was a good kid and she was being bullied a lot over the last 2 years. I felt so bad for this family and I still think about them to this day.
	Two days ago, I had to tell a 20-year-old male that his dad had shot himself in an attempt at suicide. I then said that he was successful. I felt afterwards that this was not a great way to break the news.
	I remember every single situation, seemingly random assortments of details while on the scene, and a lot of the sounds of crying/screaming/etc. from families many years after the event(s).
	I cannot get out of my head is the blood curling cry from a woman in when I informed her that her spouse was dead. Every time I have to break the news to another or when people talk about bad calls all I can hear is her voice.
It is hard to deliver bad news to those you know or when you know the person who has died	I personally had to break the news to my mother that my own father had passed away after resuscitation attempts. It still haunts me a bit; it's been almost two years.
	The family happened to be a close family friend that had seen me grow up and I had been friends with her kids for most of my childhood. I will never forget the conversation and can recall every single detail by memory only. I've seen her multiple times in the community and only recently has she been able to talk to me again.
	I led a late night/early morning code on a man in his 30s or 40s. The patient was a friend, fellow firefighter/EMT and former co-worker and had married into a family with whom I am friendly. When we had run through the ACLS algorithm without any positive change, I stepped away to phone a doc to ask for a death pronouncement. When I turned to the wife and her parents, who had been watching everything from the kitchen area, I failed badly. I spoke to them, but they did not understand. In my memory, it was a nightmarishly long time before I could make myself understood. When I recall this incident, several vivid mental pictures pop right up.

Table 3. Major themes and exemplar quotes.

Major Theme	Illustrative Quotations
We lack education or preparation to deliver bad news	I hate relaying bad news to family. I am wholly untrained and unprepared for this. It does the family a disservice and makes me feel terrible.
	Any time I've had to break the news I always end up feeling awkward and I will replay the whole conversation and feel like I said the wrong thing, said something stupid, or could have said something better/had a better response.
	I would have liked to have better crisis intervention training in my initial training. I sought out training later after having to do a death notification and feeling unprepared.
	I feel like training is not accessible or talked about in the EMS realm and should be. I also feel that the majority of EMS providers, myself included prior to continuing education and professional counseling, have profound compartmentalization skills and don't fully process the grief associated with delivering bad news in the adrenaline dump phase.
	I have felt that my peers were not equipped to deliver bad news effectively or empathetically. It is a skill that needs to be taught, honed, and valued.
Having strategies that work is helpful in delivering bad news	Allowing the family to see the attempts to resuscitate the patient (if they want to) is a very important aspect of helping them understand what happened, what was done, and to get closure.
	Each one has taught me something and I refine my approach and language each time I have to in an attempt to develop best practice.
	I always tell the family their loved one is dead. I do so after I've outlined the care that was rendered. I always offer a hug. I can't remember anyone declining this. Very important part of our job.
	I always give bad news the same way. I reintroduce myself, state my position, explain what has happened and the outcome.
	I am usually the one on any call that handles the family. Everything from being with them while the crew is working on the patient, letting them know their loved one is dead, calling the funeral home, trying to make the body presentable for the family while they wait for the funeral home to arrive and I usually help removed the deceased and then remain with the family until I feel it is OK to leave.
	I absolutely use the words 'dead,' 'death,' or 'died.' Empathy is key.
	I have found that in most cases being straightforward with people is the best way to deal with delivering bad news and most people appreciate that you do this.
	I feel like the act of explaining the resuscitation process to the family is so important to the family, but it's not something many people feel comfortable with.
	I was taught and have found that explaining treatment and using definitive statements 'he is dead' is the best course.

Table 3 (continued). Major themes and exemplar quotes.

(24%) of clinicians reporting that they told a family that a loved one had died six or more times in the last year. Breaking bad news appears to be a regular part of work for many EMS clinicians and more commonplace than previously noted in the literature (Campos et al, 2021). One thing that should be taken into account is that this study was primarily conducted in January and February of 2022 on the tail end of the Delta variant of COVID 19. This was a year of great strain on the health care system which may have impacted the amount of people dying at home or may have potentially affected the frequency at which EMS clinicians may have been tasked with breaking bad news.

In regards to EMS clinicians education around breaking bad news the vast majority of those who received training around this topic found it to be insufficient. Furthermore 42% of EMS clinicians received no training at all. There are likely many factors that play into this lapse in education. Perhaps a major factor is in part due to current standard methodologies of delivering bad news taught to medical professionals are not designed for the prehospital environment and likely only of limited applicability. Examples include SPIKES and the BREAKS methodologies (Baile et al., 2000; Narayanan et al., 2010). The SPIKES protocol was the earliest to be developed and is a six-step protocol that was developed for the delivery of bad news to patients with cancer (Baile et al., 2000). While some aspects of this protocol may be applicable many of the other components would be

challenging to accomplish in the prehospital environment. For example, the initial "S" stands for "setting up the interview," where an office-based physician might ensure a calm, quiet environment where everyone can sit at eye level to discuss the topic at hand. This is a significant departure from what EMS clinicians experience when called to cardiac arrest where they have little to no control over the environment. There is a protocol known as GREIV_ING that is designed around death notifications specifically in the emergency department which is likely more applicable to what EMS clinicians face in the field, but again is designed around the specific needs of the emergency physician and may not be wholly applicable to the prehospital setting.

It does appear EMS clinicians with less than five years' experience (48%) received training at higher rates than those with greater than 10 years' experience (37%) a difference that was statistically significant. This suggests that there may be a push amongst EMS educators to increase education amongst their younger cadre. Practice environment i.e. urban vs rural seemed to have little effect on who was receiving this education. Across all clinicians (1094) had an average confidence level 7.15 out of 10 with a standard deviation of 2.00 however this confidence reporting was much lower amongst EMS clinicians with less experience. For example, clinicians with less than two years' experience on average reported significantly lower confidence scores (5.11) than clinicians with greater than 10 years' experience (7.54) when it came to breaking bad news. This suggests that as clinicians gain more experience in their career, they may become more comfortable in their ability to have these conversations.

Overall clinicians who have received training around the subject of breaking bad news seem to not feel this was sufficient with only 26% reporting that it was sufficient and 96% reporting additional training would be helpful. Reportedly 51% of clinicians felt this training would be "very helpful". This data strongly suggests that EMS clinicians are interested in learning more around this topic. It is plausible that this stems from some of the issues discussed in the beginning of this study and the lack of a protocol, standardized training or system designed to meet the specific needs of EMS clinicians. This data suggests that that not only are many clinicians not receiving education, those who do, do not find it sufficient and the vast majority are interested in receiving additional training.

There is evidence indicating clinicians can be trained in the delivery of bad news. Both medical students and emergency medicine residents demonstrated significant improvement in their ability to break bad news as well as other factors such as improved communication skills and self-efficacy after only a two to four-hour training (Servotte et al., 2019; Hobgood et al., 2009). An additional study utilizing the earlier mentioned GREIV_ING framework demonstrated that after a single 90-minute course, paramedics demonstrated increased confidence and competency in breaking bad news (Hobgood et al., 2013). While limited other studies exist around breaking bad news in regards to EMS providers it is entirely possible that further trainings could be developed and implemented successfully around this topic.

This study also demonstrates that breaking bad news may be exhibiting a heavy toll on EMS clinicians emotionally. With 54% of clinicians experiencing negative sequelae we defined as intrusive thoughts, lost sleep and emotional difficulty within the last year. Notably 7% of respondents reported experiencing these effects frequently. This suggests that breaking bad news may be having an effect on many EMS clinicians' mental health

and may even be impacting EMS clinicians' quality of life. This appears to be most prominent amongst clinicians with less than five years' experience where more than 1 in 10 reported these effects frequently, with 70% of this cohort reporting feeling these effects at some point in the last year. While more experienced clinicians had lower rates than their greener counterparts, still 50% reported negative sequelae at some point in the last year. The open-ended responses (Table 3) help to demonstrate the significant impact these experiences have had on some clinicians. Mental health is a hot topic in EMS as clinicians are burning out, leaving the field and tragically taking their lives at unprecedented rates. A 2019 study published in JEMS by Rosenberger found among 1,547 EMS clinicians more than 60% either strongly agreed or agreed to the statement "I feel burned out in my EMS work,". In that same study 36% of EMS clinicians responded reported they agreed to the statement, "I don't want to do EMS work anymore." (Rosenberger et al,. 2019). EMS clinicians' rates of suicidal ideation are reportedly as high at 27% (Lula et al., 2020), with EMS clinicians being 1.39 times more likely to die by suicide then the general public (Vigil et al., 2018). Providing additional education around the subject of breaking bad news may be one avenue in which we can help improve EMS provider mental health by reducing the negative experiences associated with this difficult work.

There are several points that should be noted when considering the findings of this study. First, data collected for this study was completed primarily by posting on our survey link on EMS-based Facebook groups. Given this, it is unclear what our actual response rate for the survey was. Some of these groups have thousands of members but it is unclear how many people saw the survey and then elected to take it or how social media algorithms affected who saw these survey links to begin with. Less than 10% of respondents came from direct emails, which should be noted. Another potential source of bias in our results is that the preamble posted on social media indicated the survey was about "breaking bad news". This may have attracted EMS clinicians who are interested in the topic or who have had recent experiences with breaking bad news, potentially biasing who was most willing to take the survey. Despite these limitations this survey method was able to garner a large response rate representing a wide swathe of EMS clinicians throughout the country in a way no other study has yet to do.

CONCLUSIONS

Our study identified that EMS clinicians are tasked with the delivery of difficult news with great frequency and endorse adverse emotional and mental health impacts associated with this. Despite the frequency of this task, we found that EMS clinicians have insufficient or no training at all and feel that they would benefit from it. Existing education tools for this communication skill are available, but are hospital/office based and do not consider the unique challenges of the prehospital setting. The lack of a standard training a part of licensure requirements, perhaps represents the under recognition of its importance for clinicians. Future effort should be made to highlight the importance of this topic and skill. Research is needed to determine the most effective curriculum to teach EMS clinicians how deliver difficult news.

Our study also casts a light on the adverse mental health effects that are associated with delivery of bad news. With many of our clinicians reporting intrusive thoughts, loss of sleep, and emotional disturbance. Research is needed to identify ways to mitigate these mental health consequences. Specifically, whether formal training on the delivery of

breaking bad news reduce the mental health consequences that are associated with these interactions. Recognizing the emotional trauma that can occur when a clinician has to deliver bad news, such as the death of a loved one is of great importance. Efforts need to be made to provide mental health resources such as access to counseling and professional debriefing to our EMS clinicians.

DATA SET

The data set is maintained in Tufts University Qualtrics. The data that support the findings of this study are available from the corresponding author, ZBT, upon reasonable request and with IRB approval.

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RESEARCH REPORTS

FROM AMBULANCE TO THE ICU: A RETROSPECTIVE COHORT STUDY ON EMS VASOPRESSOR USE REVEALS KEY DIFFERENCES

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ABSTRACT

Objective: Vasopressors are critical for patients experiencing shock. This observational study aims to characterize the usage of vasopressors by EMS, and to assess how vasopressor usage differs between transport and hospital environments.

Methods: A retrospective cohort study was performed from December 2019 to December 2022. Inclusion criteria were adult patients who received vasopressor infusions during transport by a large, multi-site air and ground ambulance service. These patients were followed for 12 hours after hospital admission to determine which vasopressors they required in the inpatient setting. Patients who received high-dose norepinephrine, defined as infusions higher than 0.3 µg/kg/min, were also analyzed as a subgroup.

Results: A total of 1212 patients were enrolled in this study. The vasopressor most used was norepinephrine, which was administered to 1013 (83.6%) patients. Epinephrine was administered to 163 (13.4%) patients. Vasopressin was administered to 103 (8.5%) patients, while 60 (5.0%) received dopamine. In total, 505 (41.7%) of patients received multiple vasopressors during EMS transport: two vasopressors in 409 (33.7%) and three or more in 102 (8.4%). Most patients who received vasopressors during transport continued to require vasopressors six hours after admission (n = 836, 69.0%). High-dose norepinephrine was administered to 108 (10.7%) patients during transport, 39 (5.5%) patients six hours after admission, and 16 (2.5%) patients 12 hours after admission. For these patients requiring high-dose norepinephrine, supplemental vasopressors were used in 51 (47%) patients during transport, 33 (85%) patients six hours after admission, and 14 (88%) patients 12 hours after admission. While 163 (13.4%) patients received epinephrine infusion during EMS transport, none of these patients required epinephrine infusion in the hospital ($p < 0.001$).

Conclusions: Multiple vasopressors were employed by EMS during transport, with norepinephrine being the most frequent. Other common choices for vasopressors included epinephrine and vasopressin. Most patients who received vasopressors during transport continued to require vasopressors after admission. Compared to the hospital setting, the transport setting more frequently uses high-dose norepinephrine, and is less likely to use additional vasopressors to supplement high-dose norepinephrine. The transport setting also makes greater use of epinephrine.

INTRODUCTION

Shock is a life-threatening condition characterized by inadequate oxygen delivery to cells and tissues (Baran et al., 2019; Vincent & De Backer, 2013). Shock is associated with high in-hospital mortality, with rates between 33% and 52% (Bloom et al., 2022; Jones et al., 2004; Poloujadoff et al., 2006; Wang et al., 2011). Prompt recognition and treatment of shock is therefore essential to improve outcomes (Jouffroy et al., 2022).

Fluid resuscitation and vasopressor administration are the standard treatments for patients experiencing various states of hypotension (Evans et al., 2021; Feldman et al., 2020). In the past, the initiation of vasopressors by EMS was rare due to the perceived need for central venous access and unavailability of infusion pumps (Quinn et al., 2022). However, recent research has shown that these agents can be safely administered through peripheral IV lines, and infusion pumps have been made more accessible to EMS crews (Araiza et al., 2022; Quinn et al., 2022; Raynovich et al., 2013; Tian et al., 2020). The usage of vasopressors in the hospital setting is well-studied (Gaviria-Mendoza et al., 2021; Jentzer et al., 2020; Thongprayoon et al., 2016). However, there is sparse data on vasopressor usage in the EMS setting. Administering vasopressors during transport presents several challenges, including lack of invasive hemodynamic monitoring, limited storage space for medications, and difficulties in preparing medications for administration (Feldman et al., 2020). Given these limitations, it is hypothesized that considerable differences in the choice and dosing of vasopressors may exist between EMS providers and hospital ICU teams.

Gaining a better understanding of vasopressor utilization during EMS transport would be valuable and insightful for both EMS crews and ICU teams. From the EMS perspective, this will help with decisions about which vasopressors are best to stock in order to improve readiness for treating patients who require vasopressor support. The primary objective of this study is to assess the utilization of various vasopressor agents by EMS. The secondary objectives are to compare vasopressor usage based on transport type and origin, and to compare vasopressor administration in the EMS versus hospital setting.

METHODS

Study Setting – Large multi-site multi-state air and ground ambulance service

The study ambulance service is hospital-affiliated and offers critical care services from one airplane base, three helicopter bases, and ground bases in 15 cities. The service also conducts interfacility transports from hospitals both affiliated and unaffiliated with the ambulance service's affiliated hospital system. The hospital affiliated with the study ambulance service is a level I adult and pediatric trauma center, a comprehensive stroke center, and a STEMI Receiving Center. Between December 2019 and December 2022, 1605 patients (0.70% of total transported) received vasopressor infusions during transport by RAS.

The study ambulance service operates in Minnesota and Wisconsin. In Minnesota, paramedics are allowed to practice at the scope determined by the agency director without additional oversight from state regulatory agencies. In Wisconsin, laws permit paramedics to initiate only epinephrine, norepinephrine or phenylephrine. Specially licensed am-

bulance services, including the study ambulance service, are also permitted to maintain and titrate medications during interfacility transport.

The study ambulance service has detailed guidelines regarding the usage of vasopressors. Epinephrine, norepinephrine, and infusion pumps are universally available to critical care transport crews and advanced life support (ALS) crews. Critical care transport teams are staffed by a critical care registered nurse with a second crew member who is either another critical care registered nurse or a critical care paramedic. Advanced Life Support ambulances are staffed with either a two-paramedic crew or a paramedic-EMT crew. All nurses and paramedics undergo training in initiating and titrating these vasopressors (Mayo Clinic Process/Medical Direction Committee, 2023). While push-dose epinephrine is permitted in limited circumstances, it is only used as a bridge to vasopressor infusions.

For patients started on vasopressors prior to interfacility transport, crews are authorized to continue and adjust these medications, based on orders from the referring physician or based on standing orders in patient care guidelines (Mayo Clinic Process/Medical Direction Committee, 2023). Once the transport begins, crews are limited to using the vasopressors available in the vehicle, consisting of those stocked by the ambulance service and those sent by the referring facility.

ALS crews are authorized to independently initiate vasopressors in patients who have a return of spontaneous circulation following cardiac arrest (Mayo Clinic Process/Medical Direction Committee, 2023). For all other situations, crews need authorization through medical consultation via phone or radio. Crews are permitted to administer epinephrine and norepinephrine through peripheral IV lines, if a central line is not available. According to patient care guidelines, both vasopressors should started at 0.05 µg/kg/min, with a maximum dose of 1 µg/kg/min (Mayo Clinic Process/Medical Direction Committee, 2023).

Hospital ICU teams at the Mayo Clinic adhere to guidelines that limit both epinephrine and norepinephrine to 0.3 µg/kg/min, as doses in excess of this have been associated with poorer outcomes (Domizi et al., 2020; Mayo Clinic Enterprise IVAG Workgroup, 2022). Hospital ICU teams also have access to additional vasopressors, life support devices and interventions not available in the prehospital environment.

Study Design

A retrospective cohort study was performed including data collected over three years from December 2019 to December 2022. Inclusion criteria were adult patients who received vasopressor infusion during transport by the study ambulance service. The following medications were classified as vasopressors and used for chart abstraction: dobutamine, dopamine, epinephrine, milrinone, norepinephrine, phenylephrine, and vasopressin.

Patients who had no available matching hospital records were excluded from this study. These include patients who were transported to unaffiliated hospitals, as well as unidentified patients who were registered under a placeholder name. Patients with inaccurate registration information causing mismatched EMS and hospital records were excluded as well.

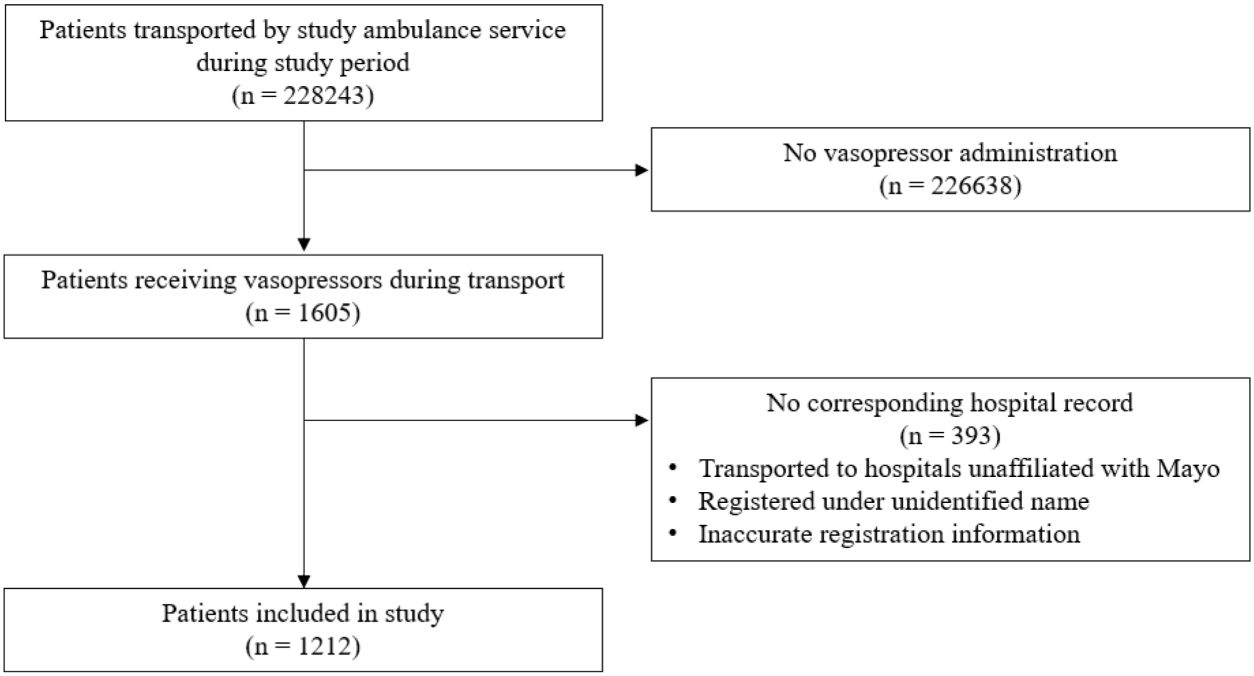

Figure 1: Inclusion and exclusion flowchart.

The flow diagram for inclusion and exclusion are displayed in Figure 1.

Patients transported multiple times by the study ambulance service were counted multiple times for data analysis reasons, as these were documented as separate EMS runs.

Patient care data was extracted from ambulance service electronic medical records. Information obtained included demographic information, run type (scene vs. interfacility), transport facility of origin (Mayo Clinic-affiliated vs. unaffiliated), medical information, and suspected causes of hypotension. Vasopressor administration data was collected from hospitals at the time of admission, 6-hours post-admission, and 12-hours post-admission.

Doses of norepinephrine or epinephrine higher than 0.3 µg/kg/min were defined as high doses. Patients are deemed to have received high-dose norepinephrine or epinephrine if they exceeded that rate at any time during transport.

Ethics approval was granted through the Mayo Clinic Institutional Review Board, under IRB 22-012805.

Statistical Analysis

Numeric features were summarized with medians and interquartile ranges (IQRs); categorical features were summarized with frequency counts and percentages. The types of vasopressors administered to patients were compared between origin of EMS transport and between pre-hospital and hospital settings (admission, 6-hours post-admission, and 12-hours post-admission) using Chi-squared and Barnard's unconditional exact tests. Differences in vasopressor administration were summarized with rate differences (RDs) and 95% confidence intervals (CIs). The dosage of norepinephrine administered was also compared between pre-hospital and hospital settings using Kruskal-Wallis tests. Pairwise post-hoc comparisons between settings were performed using Wilcoxon rank-

sum tests with a false-discovery rate p-value correction to account for multiple comparisons. All tests were two-sided and p-values less than 0.05 were considered significant. Analysis was performed using R version 4.2.2.

RESULTS

EMS Vasopressor Usage

There were 1605 patient care records involving patients receiving vasopressors from RAS; 393 were excluded because no corresponding hospital record was identified. A final cohort of 1212 patients was established for review.

A summary of patient demographics and overall vasopressor use is shown in Table 1. Of the 1212 patients, the median age was 67 years (IQR 56 - 76), and 695 (57.3%) were male. Fifty-one patients (4.2%) were pediatric patients.

Septic shock was the most common indication for vasopressor administration, accounting for 47.0% of all cases. Cardiogenic shock was the second most common, comprising 25.3% of cases, with cardiac arrest specifically representing 9.1%. Multifactorial shock accounted for 8.7% of cases, while nontraumatic hemorrhage made up 5.2%.

Among vasopressors used by EMS, norepinephrine was the most frequently administered (83.6%), followed by epinephrine (13.4%), vasopressin (8.5%), dopamine (5.0%), milrinone (3.8%), phenylephrine (1.8%), and dobutamine (1.1%).

Most patients (n = 701, 57.8%) received only a single vasopressor during transport. Approximately one-third of patients (n = 409, 33.7%) received two vasopressors. The remainder (n = 102, 8.4%) required three or more vasopressors.

EMS Norepinephrine Dosing

EMS norepinephrine use is shown in Table 2. The median dose of norepinephrine was 0.10 µg/kg/min (IQR: 0.05 – 0.20). High-dose norepinephrine was administered to 108 (10.7%) patients. There were also six (0.6%) patients who received norepinephrine at 1 µg/kg/min or higher, exceeding the limit explicitly recommended by ambulance service guidelines.

	N = 1212
Age, years	
Median (Q1, Q3)	67 (56, 76)
Sex, n (%)	
Female	500 (41.3%)
Male	695 (57.3%)
Transgender	1 (0.1%)
Unknown/Did Not Disclose	16 (1.3%)
Race, n (%)	
American Indian/Alaskan Native	5 (0.4%)
Asian	14 (1.2%)
Black or African American	21 (1.7%)
Hispanic or Latino	22 (1.8%)
White	818 (67.5%)
Unknown/Did Not Disclose	332 (27.4%)
Indications, n (%)	
Sepsis	570 (47.0%)
Non-Arrest Cardiac Indication	196 (16.2%)
Cardiac Arrest	110 (9.1%)
Multifactorial	105 (8.7%)
Nontraumatic Hemorrhage	63 (5.2%)
Other/Unknown	167 (13.8%)
EMS Origin, n (%)	
Mayo Clinic	956 (78.9%)
OSH	233 (19.2%)
Scene	23 (1.9%)
Vasopressor Administered, n (%) *	
Norepinephrine	1013 (83.6%)
Epinephrine	163 (13.4%)
Vasopressin	103 (8.5%)
Dopamine	60 (5.0%)
Milrinone	46 (3.8%)
Phenylephrine	22 (1.8%)
Dobutamine	13 (1.1%)
Total Different Vasopressors Administered	
Median (Q1, Q3)	1 (1, 2)
Patients on 2 vasopressors	409 (33.7%)
Patients on 3 or more vasopressors	102 (8.4%)
* Percentages do not add up to 100%, as many patients received multiple vasopressors	

Table 1. Summary of patient demographics, visit characteristics, and overall vasopressor use.

None of the patients in our study received epinephrine infusions in excess of 0.3 µg/kg/min.

	EMS (N = 1013)
Average Dose (IQR) µg/kg/min	0.10 (0.05, 0.20)
Patients given dose > 0.3 µg/kg/min	108 (10.7%)
Patients given dose > 1.0 µg/kg/min	6 (0.6%)

Table 2. Norepinephrine dosing.

EMS Vasopressor Usage by Run Type (Scene vs. Interfacility)

Vasopressor usage was compared between patients by run type, as either unplanned emergency transport from the scene or prearranged interfacility transport (Table 3). Norepinephrine was the most widely used vasopressor for both groups, with epinephrine being the second most widely used. However, patients being transported from the scene were more likely to be on epinephrine (35% vs. 13%; RD = 21.7%, 95% CI: 1.1 to 43.5%; $p = 0.039$), while interfacility transport patients were more likely to receive norepinephrine (84% vs. 61%; RD 23.2%, 95% CI: 2.5 to 44.5%; $p = 0.039$).

Vasopressor	Scene (N = 23)	Interfacility (N = 1189)	Rate Difference (95% CI)	*p*-Value
Norepinephrine	14 (61%)	999 (84.0%)	23.2% (2.5%, 44.5%)	0.028
Epinephrine	8 (35%)	155 (13.0%)	-21.7% (-43.5%, -1.1%)	0.039
Vasopressin	0 (0%)	103 (8.7%)	8.7% (-12.0%, 29.5%)	0.42
Dopamine	2 (9%)	58 (4.9%)	-3.8% (-24.5%, 16.9%)	0.72
Milrinone	0 (0%)	46 (3.9%)	3.9% (-17.0%, 24.8%)	0.73
Phenylephrine	0 (0%)	22 (1.9%)	1.9% (-18.9%, 22.6%)	> 0.99
Dobutamine	0 (0%)	13 (1.1%)	1.1% (-19.6%, 21.8%)	> 0.99
* Percentages do not add up to 100%, as some patients received multiple vasopressors				

Table 3. Administration of vasopressors by transport type.

Interfacility Transport Vasopressor Usage by Facility of Origin

Patients undergoing prearranged transport between healthcare facilities were further divided based on whether the transport originated at an affiliated hospital or unaffiliated hospital (see Table 4). In both groups, norepinephrine was the most widely used, while epinephrine was the second most widely used. Patients being transported from affiliated hospitals were more likely to be receive norepinephrine ($p < 0.001$). Patients being transported form unaffiliated hospitals were more likely to receive milrinone ($p < 0.001$).

	Mayo-Affiliated (N = 956)	Unaffiliated (N = 256)	*p*-Value
Norepinephrine	816 (85.4%)	183 (71.5%)	< 0.001
Epinephrine	123 (12.9%)	32 (12.5%)	0.96
Vasopressin	88 (9.2%)	15 (5.9%)	0.11
Dopamine	41 (4.3%)	17 (6.6%)	0.16
Milrinone	22 (2.3%)	24 (9.4%)	< 0.001
Phenylephrine	18 (1.9%)	4 (1.6%)	0.94
Dobutamine	12 (1.3%)	1 (0.4%)	0.32
* Percentages do not add up to 100%, as some patients received multiple vasopressors			

Table 4. Administration of vasopressors during interfacility transport by hospital of origin.

EMS vs. Hospital Vasopressors

Differences in vasopressor usage between the EMS and hospital settings are shown in Table 5. Of the 1212 patients who received vasopressors

during EMS transport, 1033 (85.2%) continued to receive vasopressors at time of admission. Similar patterns were observed at 6 hours and 12 hours after admission, with 69.0% and 60.3% of patients continuing to receive vasopressors respectively.

	EMS (N = 1212)	Admission (N = 1033)	6-Hr Post-Adm (N = 836)	12-Hr Post-Adm (N = 731)	*p*-Value
Norepinephrine	1013 (83.6%)	907 (87.8%)	714 (85.4%)	630 (86.2%)	0.040
Epinephrine	163 (13.4%)	0 (0%)	0 (0%)	0 (0%)	< 0.001
Vasopressin	103 (8.5%)	153 (14.8%)	270 (32.3%)	268 (36.7%)	< 0.001
Dopamine	60 (5.0%)	39 (3.8%)	47 (5.6%)	37 (5.1%)	0.29
Milrinone	46 (3.8%)	27 (2.6%)	43 (5.1%)	48 (6.6%)	< 0.001
Phenylephrine	22 (1.8%)	12 (1.2%)	8 (1.0%)	5 (0.7%)	0.12
Dobutamine	13 (1.1%)	0 (0%)	0 (0%)	0 (0%)	< 0.001
* Percentages do not add up to 100%, as some patients received multiple vasopressors					

Table 5. Frequency of vasopressor usage by setting.

Norepinephrine was the most commonly used vasopressor in both EMS and hospital settings. It was administered to over 80% of patients in both groups, though its usage was slightly lower in EMS compared to the hospital ($p = 0.040$). Epinephrine, the second most frequently used vasopressor in EMS, was not administered to any patients in the hospital setting ($p < 0.001$). Vasopressin ranked third in EMS usage but was the second most commonly used vasopressor in the hospital, with significantly higher administration in the hospital setting ($p < 0.001$). Other vasopressors, including dobutamine, dopamine, milrinone, and phenylephrine, were used infrequently in both settings.

The median dose of norepinephrine administered by EMS was 0.10 µg/kg/min, slightly higher than the median dose in the hospital (0.07–0.08 µg/kg/min, $p < 0.001$). Figure 2 illustrates the doses of norepinephrine used in EMS and hospital settings, while Figure 3 tracks the patients on norepinephrine across these settings.

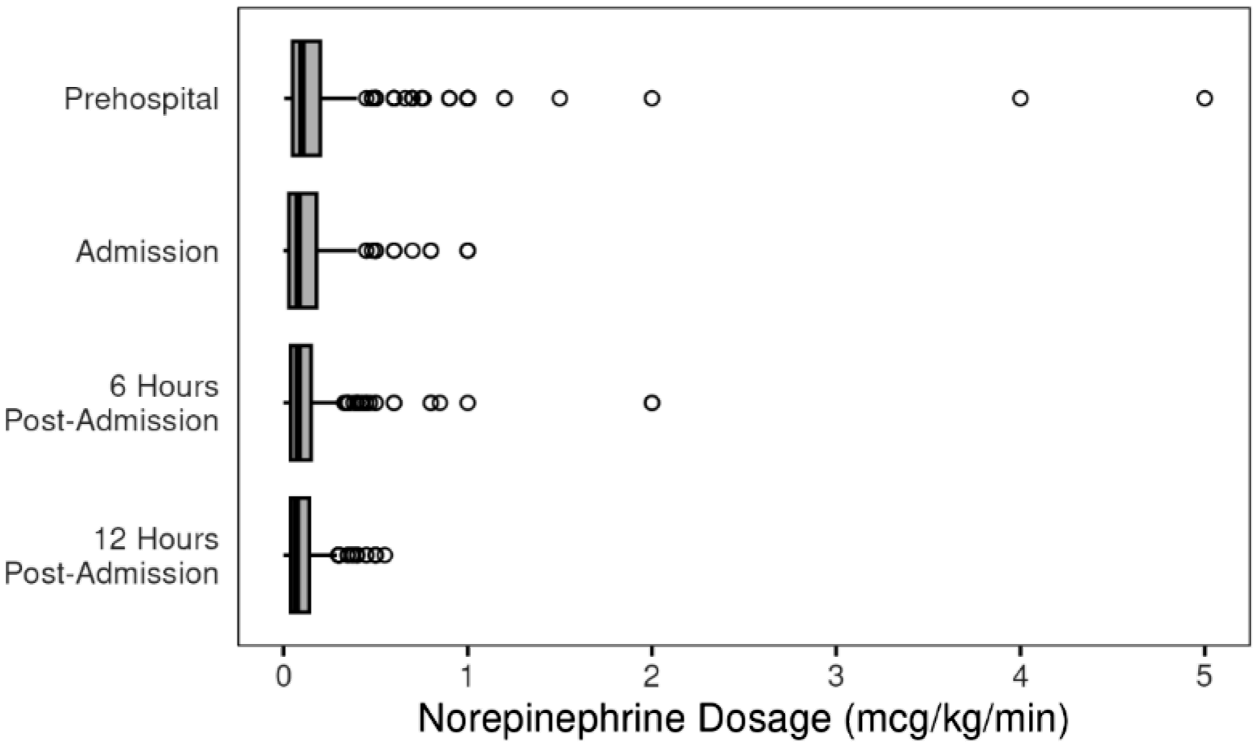

Figure 2: Dosage of norepinephrine by setting

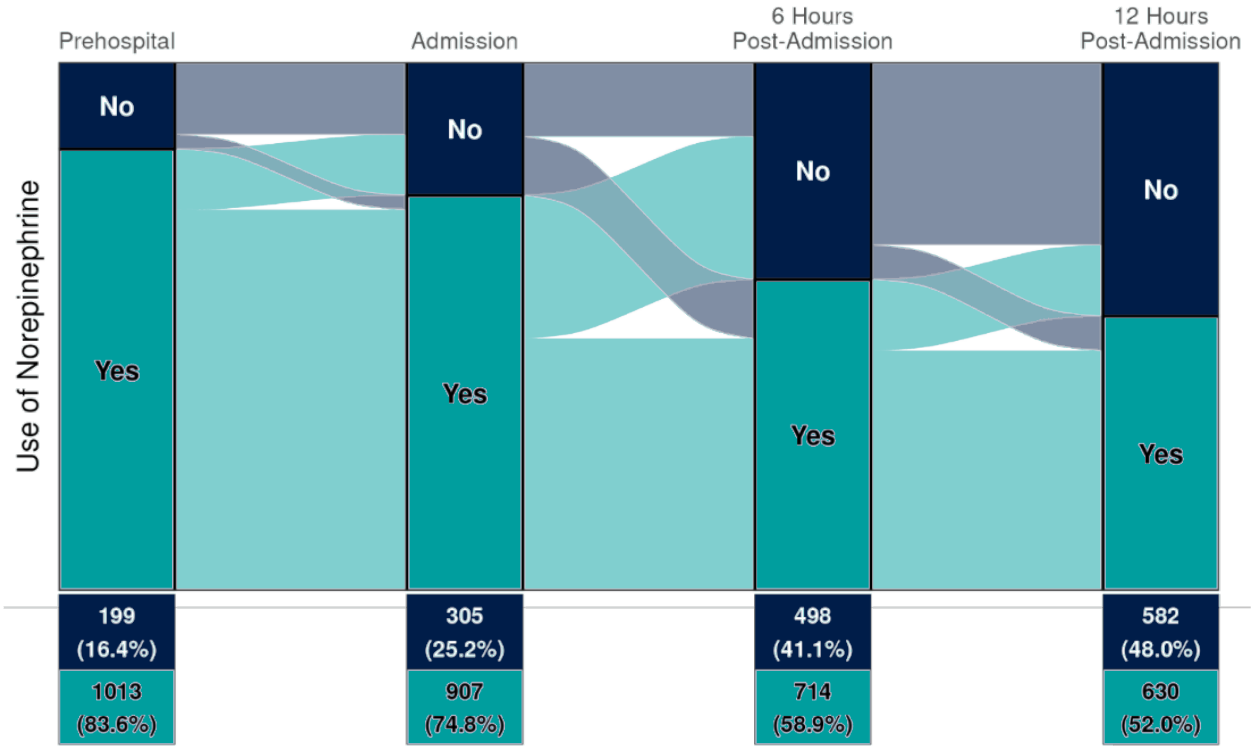

Figure 3: Continued administration of norepinephrine across settings.

	Prehospital/EMS (N = 1013)	Admission (N = 907)	6-Hr Post-Adm (N = 714)	12-Hr Post-Adm (N = 630)	*p*-Value
Median dose (Q1, Q3)	0.10 (0.05, 0.20)	0.08 (0.03, 0.18)	0.08 (0.04, 0.15)	0.07 (0.04, 0.14)	< 0.001
Norepinephrine Threshold: 0.3 µg/kg/min					
Patients given dose > 0.3 µg/kg/min	108 (10.7%)	44 (4.9%)	39 (5.5%)	16 (2.5%)	< 0.001
Other vasopressors during the same period for patients given > 0.3 µg/kg/min norepinephrine					
Epinephrine	30 (27.8%)	0 (0%)	0 (0%)	0 (0%)	
Vasopressin	14 (13.0%)	20 (45.5%)	30 (76.9%)	11 (68.8%)	
Dopamine	2 (1.9%)	2 (4.5%)	1 (2.6%)	2 (12.5%)	
Milrinone	0 (0%)	1 (2.3%)	0 (0%)	0 (0%)	
Phenylephrine	3 (2.8%)	0 (0%)	2 (5.1%)	1 (6.2%)	
Dobutamine	2 (1.9%)	0 (0%)	0 (0%)	0 (0%)	
Combined	51 (47.2%)	23 (52.3%)	33 (84.6%)	14 (87.5%)	< 0.001
Norepinephrine Threshold: 1.0 µg/kg/min					
Patients given dose > 1.0 µg/kg/min	6 (0.6%)	0 (0%)	2 (0.3%)	0 (0%)	0.025
Other vasopressors during the same period for patients given > 1.0 µg/kg/min norepinephrine					
Epinephrine	2 (33%)	---	0 (0%)	---	
Vasopressin	0 (0%)	---	1 (50%)	---	
Combined	2 (33%)	---	1 (50%)	---	
* Percentages do not add up to 100%, as some patients received multiple vasopressors					

Table 6. Frequency of norepinephrine doses exceeding max recommended rate.

EMS patients were also more likely to receive high-dose norepinephrine ($p < 0.001$). Additional data on usage of high-dose norepinephrine is shown in Table 6. During EMS transport, 108 patients (10.7%) received high-dose norepinephrine. Upon hospital admission, this number decreased to 44 patients (4.9%), and at 12 hours post-admission, only 16 patients (2.5%) still required high-dose norepinephrine.

EMS patients on high-dose norepinephrine were less likely to receive supplemental vasopressors ($p < 0.001$). During EMS transport and admission, supplemental vasopressors were used in 51 (47%) and 23 (52%) patients respectively. At 6 and 12 hours after admission, 33 (85%) and 14 (88%) patients were receiving supplemental vasopressors.

There were six cases (0.6%) in which EMS exceeded the recommended norepinephrine maximum of 1.0 µg/kg/min. It was less common for this limit to be exceeded in the hospital setting, with only two (0.3%) patients doing so ($p = 0.025$).

DISCUSSION

EMS Vasopressor Use

Norepinephrine was the most widely used agent by a large margin in both the EMS and hospital environments. However, the relative usage of norepinephrine, along with the usage of other vasopressors, still differed significantly with regards to transport type, transport origin, and environment.

Vasopressor Usage, Choice, and Transport Characteristics

The predominant use of norepinephrine is likely due to a combination of clinical and practical concerns. The most common causes of shock are septic shock and cardiogenic shock, which account for 62% and 16% of shock cases respectively (Chen et al., 2020). Norepinephrine is recommended as the first-line agent for septic shock, per Surviving Sepsis Campaign guidelines (Evans et al., 2021). In cardiogenic shock, norepinephrine is also associated with lower mortality and lower rates of refractory shock, when compared to dopamine or epinephrine (De Backer et al., 2010; Feldman et al., 2020; Levy et al., 2018). From a practical standpoint, norepinephrine is widely available, and vials have a long shelf-life of 18 months (Pfizer, 2022). Due to these factors, norepinephrine has been identified as a "one-size-fits-all" vasopressor, which would meet the needs of most shock patients encountered by EMS (Feldman et al., 2020).

It was rare for EMS crews to exceed the maximum norepinephrine dose of 1 µg/kg/min established in ambulance service guidelines, with this occurring in less than 1% of patients receiving norepinephrine. Our data may raise concerns that a strict limit on norepinephrine dosing at 0.3 µg/kg/min, similar to that used by hospital ICU teams, may be impractical during transport, as more than 10% of patients received norepinephrine doses above this rate (Domizi et al., 2020; Mayo Clinic Enterprise IVAG Workgroup, 2022).

Epinephrine, the second most used vasopressor by EMS, also has distinct advantages. Epinephrine is considered the first-line agent in anaphylactic shock, remains the mainstay of ACLS, and is used to treat bradycardia and hypotension after a return of spontaneous circulation (Brown et al., 2020; Campbell et al., 2014; Lokesh et al., 2018; Smida et al., 2024). Among the 163 patients who received epinephrine during EMS transport,

59 (36.2%) had cardiac arrest, while 18 (11.0%) were being treated for anaphylaxis. In our study, patients being transported from the scene were more likely to be administered epinephrine than patients undergoing interfacility transport. This difference could be due to the higher incidences of cardiac arrest cases amongst patients being transported from the scene. In our study, cardiac arrest accounted for 73.9% of scene transports, compared to 7.8% in the interfacility transport group. The epinephrine maximum dose of 1 µg/kg/min was never exceeded.

Vasopressin was the third most widely used vasopressor used by EMS, administered to 8.5% of patients. Surviving Sepsis Campaign guidelines recommend vasopressin for septic shock refractory to norepinephrine monotherapy (Evans et al., 2021). The combination of vasopressin and norepinephrine has been shown to have a lower risk of arrhythmia, when compared to norepinephrine alone (McIntyre et al., 2018; Nagendran et al., 2019). However, the Surviving Sepsis Campaign guidelines do not recommend vasopressin as the sole vasopressor in septic shock (Evans et al., 2021). Vasopressin is considered more dangerous to administer through peripheral access, so its usage is often restricted to patients with central lines (Kahn et al., 2002; Munroe et al., 2022). Vasopressin can also be expensive and scarce, further limiting its utility in EMS (Rivosecchi et al., 2024; Sizemore et al., 2022).

The fourth most widely used vasopressor, dopamine, was administered to 5.0% of patients. Dopamine, which had previosuly been carried by ambulance service critical care teams, was once the most widely used EMS vasopressor in the United States, according to data from the National EMS Information System in 2017 (V3 EMS Data Cube). However, it has since fallen out of favor. Two systematic reviews comparing dopamine to norepinephrine in septic shock indicated that dopamine was associated a higher incidence of arrhythmias and higher mortality (Avni et al., 2015; De Backer et al., 2010). One systematic review also found that dopamine is also associated with higher mortality in cardiogenic shock (De Backer et al., 2010). As such, Surviving Sepsis Campaign discourages the use of dopamine when norepinephrine is available, and the American Heart Association has also advised against dopamine in ischemic cardiogenic shock (Evans et al., 2021; O'Gara et al., 2013).

The inotropes milrinone and dobutamine were the fifth and seventh most widely used vasopressors in our study, being used in 3.8% and 1.1% of patients respectively. Although both are used in the management of cardiogenic shock, they are associated with higher risks of arrhythmias and mortality (Abraham et al., 2005; Cuffe et al., 2002; Petersen & Felker, 2008). The American Heart Association guidelines on cardiogenic shock only recommend inotropes after hemodynamic stabilization for most types of cardiogenic shock (van Diepen et al., 2017). Similarly, the Surviving Sepsis Campaign only recommends inotropes for very specific cases of septic shock associated with myocardial dysfunction (Evans et al., 2021). A recent randomized controlled trial comparing milrinone to dobutamine found no significant differences in outcomes (Mathew et al., 2021). Our study found that patients being transferred from unaffiliated hospital systems were more likely to receive milrinone than patients being transported from affiliated hospitals. The cause of this variation remains unclear, but it could reflect differences in institutional protocols.

Lastly, phenylephrine was the sixth most widely used vasopressor in our study. Although previous Surviving Sepsis Campaign guidelines from 2012 recommended phen-

ylephrine in some very limited cases of septic shock, the newest guidelines from 2021 make no mention of phenylephrine (Dellinger et al., 2013; Evans et al., 2021). By increasing systemic vascular resistance and afterload, phenylephrine may compromise cardiac function in many shock states, leading to worsening hemodynamics (Ducrocq et al., 2012; Thiele et al., 2011). Studies on neurogenic shock have also shown that phenylephrine use is associated with increased arrhythmias (Inoue et al., 2014; Readdy et al., 2015).

EMS vs. Hospital Usage of Vasopressors

Several intriguing phenomena emerged when comparing EMS vasopressor usage with hospital vasopressor usage. First, vasopressors were usually continued after EMS transport. Second, EMS was more likely to use high-dose norepinephrine, while being less likely to use supplemental vasopressors. Third, EMS made significantly greater use of epinephrine.

Most patients who received vasopressors from EMS continued to require vasopressors after hospitalization, with a majority continuing to require vasopressors at 12 hours. These results are consistent with a previous study on ICU vasopressor administration, which found that the median duration of vasopressor administration through peripheral IV access was 19 hours (Lewis et al., 2019). The gradual decrease in the percentage of patients receiving vasopressors over time in our data was likely due to patients being weaned off pressors as the underlying causes of their hypotension were addressed.

More than 10% of norepinephrine patients in the EMS setting received high-dose norepinephrine, compared to 2.5% to 5.5% in the hospital setting. Many guidelines on shock management recommend the initiation of a supplemental agent when norepinephrine requirements exceed 0.3 µg/kg/min (Evans et al., 2021; Mayo Clinic Enterprise IVAG Workgroup, 2022; Mayo Clinic Process/Medical Direction Committee, 2023). In our study, patients who require high-dose norepinephrine in the hospital are often placed on supplemental vasopressors, employed in 52.3% to 87.5% of such cases. In contrast, EMS employs supplemental vasopressors in less than half of such cases.

These differences in norepinephrine dosing and the use of supplemental vasopressors likely stem from multiple factors. Patients transported by EMS are often in a more acute phase of illness, with greater hemodynamic instability. This heightened instability would necessitate higher doses of norepinephrine to maintain target mean arterial pressures. Additionally, the resource and time constraints of the EMS transport setting may hinder the initiation of supplemental vasopressors. In contrast, the ICU setting provides additional personnel and pharmacy resources, allowing for more controlled titration and the timely introduction of supplemental vasopressors as needed.

Another key factor contributing to differences in norepinephrine dosing and supplemental vasopressor use would be the accessibility of supplemental vasopressors. EMS crews are limited to the vasopressors they stock or those provided by a referring hospital. Epinephrine and norepinephrine are the only two vasopressors stocked by the study ambulance service. While some patients are loaded into the ambulance with supplemental vasopressors already running, continuing these vasopressors once the initial dose is exhausted requires additional supply from the referring facility. In the absense of additional vasopressors, EMS crews may compensate by increasing the dosing of the primary

vasopressor. To ensure safe patient transport, it is essential that EMS crews have access to adequate supplies of vasopressors for the anticipated duration of the transport.

The use of epinephrine varies significantly between the EMS and hospital settings, likely due to its immediate availability for EMS personnel. Cases of cardiac arrest and anaphylaxis may also contribute to these differences. EMS crews are more likely to encounter patients immediately after cardiac arrest, and to treat patients in the acute phase of anaphylaxis (Lee et al., 2018). Epinephrine infusions act rapidly, with most patients experiencing resolution of anaphylaxis symptoms within six minutes (Fujizuka et al., 2022). Many cardiac arrest and anaphylaxis patients would have been weaned off epinephrine infusions during EMS transport.

Both epinephrine and vasopressin are deemed effective supplements to norepinephrine in septic shock, with similar survival and arrhythmia risks (Menich et al., 2019). However, vasopressin is generally preferred in the hospital setting. A recent systemic review and meta-analysis demonstrated that vasopressin supplementation is associated with reduced mortality and reduced incidence of atrial fibrillation in patients with distributive shock (McIntyre et al., 2018). The higher cost and central access requirements associated with vasopressin less of a barrier to use in the hospital setting.

Significance

To our knowledge, this is the first observational study to examine vasopressor use throughout a large EMS system without restriction to a specific indication. Moreover, this study also follows patients after EMS transport to characterize vasopressor usage after admission to the ICU. While a previous study has examined the usage of vasopressors across multiple EMS systems, it was limited to only two vasopressors and cases of cardiac arrest (Smida et al., 2024). Our broader study has important implications for clinicians, EMS medical directors, healthcare policymakers, and other EMS systems. As EMS crews continue to transport critically ill patients, there is an increasing need for a quantitative and systematic approach to analyzing the vasopressors used, as well as the factors that affect vasopressor usage. Our data may facilitate the development and implementation of future guidelines on EMS vasopressor usage and direct other EMS systems on which vasopressors to carry and stock.

Previous efforts at identifying a "one-size-fits-all" vasopressor have concluded that norepinephrine can treat the most frequently encountered causes of prehospital shock (Feldman et al., 2020). While norepinephrine was the most used vasopressor in both the EMS and ICU settings, our study also shows that a "one-size-fits-all" approach may fail to meet the needs of many patients. More than 40% of patients in our study required multiple vasopressors, and 16.4% of patients did not receive any norepinephrine during transport. It is not known whether patient outcomes would be impacted by having additional vasopressors available.

Our study yields several positive and promising results. It demonstrates that most vasopressor infusions during EMS transport were continued during and after admission to the hospital, and it was rare for crews to exceed the recommended limit in their guidelines. EMS crews are able to employ a wide variety of vasopressors, beyond those stocked in their ambulances. The choice of vasopressors used by EMS largely aligns with the latest healthcare research and guidelines.

However, our study also identifies several areas for improvement. Due to logistical constraints, the study ambulance service only stocks epinephrine and norepinephrine. While these were the most widely used vasopressors in our study, more than 20% of patients received other vasopressors. This highlights the challenges faced when determining how to stock an ambulance, given the space constraints and regulatory limitations. Hospital ICU teams could better prepare patients for transport by ensuring processes exist to provide EMS crews with adequate supplies of medications for known or anticipated patient needs during transport.

The optimal vasopressors for an EMS system to stock would depend on several factors, including the population served, the transport times, regulatory considerations and the capabilities of its personnel. In the case of the study ambulance service, which already carries epinephrine and norepinephrine, the addition of vasopressin may be the most beneficial, because it was the next most-used vasopressor and is considered the best adjuct to norepinephrine for septic shock. (Evans et al., 2021). However, in one state where the study ambulance service provides care, this would be prohibited by state regulation. Improving access to vasopressin in the EMS setting could help reduce the usage of high-dose norepinephrine and ensure better stability and outcomes for septic shock patients who do not respond to norepinephrine alone, but this would have financial, educational, logistic and regulatory implications.

LIMITATIONS

This study is limited by its retrospective and observational nature. This study is largely descriptive, with all inferential statistics unadjusted for potential confounders and without a prespecified analytic plan. Thus, all inferences are exploratory and hypothesis-generating for future studies.

Only a small number of patients were being transported from the scene, limiting analysis with respect to unplanned emergency transport from the scene. This study does not seek to analyze the effect of the underlying diagnosis, available IV access, or type of EMS crew involved. The study was also done within a single EMS system. Our results are not generalizable to EMS systems that extensively use push-dose vasopressors or those without access to IV pumps.

The retrospective nature of this study limits our ability to determine the specific factors influencing vasopressor selection and dosing in prehospital shock management. Similarly, we could not assess the blood pressure thresholds prompting vasopressor initiation or patient responses to infusion. A detailed analysis of vasopressor preferences based on shock etiology falls beyond the scope of this paper.

The inclusion and exclusionary criteria also led to some limitations. Patients were included when they received vasopressors during transport, regardless of the underlying disease process. There were several cases in which patients received vasopressors for reasons other than shock, such as airway protection in asthma. There were also several cases in which patients only developed hypotension after being started on sedation medications. Acutely ill patients transported from the scene are often registered under placeholder names by EMS, which may differ from names used by the hospital. These discrepancies could have caused more acutely ill patients to be excluded from our study,

decreasing the number of patients being transported from the scene and biasing the results.

While our paper seeks to identify differences in the ways that vasopressors are employed by EMS and hospitals, the analysis is still inferential. We also did not have a pre-registered or pre-established plan for data analysis.

CONCLUSION

This study identifies the most common vasopressors employed by EMS. The most ubiquitous vasopressor was norepinephrine, which was used in over 83% of patients. Other common choices for vasopressors by EMS included epinephrine and vasopressin. Although norepinephrine and epinephrine were the most widely used regardless of run type or transport facility of origin, these factors still had a significant effect on the choice of vasopressor agent. Compared to the hospital, EMS crews were more likely to use high-dose norepinephrine, more likely to use epinephrine, and less likely to use supplemental vasopressors.

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REVIEWS

PREHOSPITAL EXTRA-CORPOREAL CARDIOPULMONARY RESUSCITATION: A SYSTEMATIC REVIEW OF PATIENT SELECTION CRITERIA AND DISPATCH PROTOCOLS

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ABSTRACT

Introduction: Out-of-hospital cardiac arrest remains a global health problem. There is emerging evidence that the use of extra-corporeal membrane oxygenation during resuscitation [ECPR], may help to improve outcomes. Several prehospital services around the world are now able to provide on-scene ECPR. However, the early identification of patients is a key factor in enabling this level of response to OOHCA. This systematic review aims to identify prehospital ECPR systems and describe their patient selection criteria and dispatch processes.

Methods: A systematic literature search of the MEDLINE and Embase databases was performed between the dates of 4th April 2024 and 11th April 2024. Study registries were also reviewed to identify the protocols of ongoing or planned studies. Additionally, forwards and backwards reference tracing of eligible literature was performed to identify further articles.

Results: A total of ten studies were identified. When combined, criteria involving premorbid conditions were the most frequently utilised, present in eight out of ten included studies. Age, the requirement for a witnessed cardiac arrest, resuscitation-related factors and ECPR-related factors were used in seven studies. The use of an aetiology or presenting rhythm related criteria were reported in five studies. The dispatch processes for ECPR teams were varied and included both helicopter and ground-based services. ECPR was planned to be performed on scene in nine systems, and one described the use of a rendezvous strategy.

Conclusions: Variability in the selection criteria and dispatch processes used by the identified ECPR services is likely to be reflective of the variation in geographical distribution, team composition and transport modes of prehospital EPCR services. Many eligibility criteria can be determined during emergency call receipt or shortly after resource arrival, highlighting the potential for improved screening by emergency medical dispatchers and non-specialist resources. The simple mnemonic 'PACE' (presenting rhythm, age, comorbidities, ECMO possible within 60 mins) to aid in evaluating key criteria on arrival is provided.

INTRODUCTION

Out-of-hospital cardiac arrest [OOHCA] remains a global health problem and significant cause of mortality (Chin et al., 2022). In the United Kingdom, just 7.8% of patients survive to 30 days following OOHCA (Resuscitation Council UK, 2024). There

is emerging evidence that the use of extra-corporeal membrane oxygenation [ECMO] during resuscitation, also known as extra-corporeal cardiopulmonary resuscitation [ECPR], may help to improve outcomes in patients requiring prolonged resuscitation, or those who do not respond to standard therapy (Adams et al., 2022; Low et al., 2023). The time from onset of cardiac arrest to initiation of ECPR has been demonstrated to be a contributing factor in outcomes (Sim et al., 2024). To reduce this timeframe, several prehospital services around the world are now able to provide ECPR on scene or at a rendezvous point before hospital arrival. However, the logistics involved in providing ECPR-capable teams to OOHCA are complex and require a proactive approach to dispatch to minimise delays (Stretch and Singer, 2024). Therefore, the early identification of patients who may benefit from on-scene ECPR is a key factor in enabling this level of response to OOHCA.

During cardiac arrest there is an immediate decrease and cessation of blood flow. This causes significant cellular hypoxia and systemic metabolic dysfunction (Gilhooley et al., 2019). Initiating ECPR via venous-arterial ECMO [VA-ECMO] offers a medium to deliver blood flow during resuscitation and thus mitigates against the harms from an abrupt cessation of perfusion whilst reversible causes are addressed (Inoue et al., 2020). VA-ECMO is the most common method of delivering ECPR, in which cannulation of a large vein and artery is undertaken either by a percutaneous ultrasound and Seldinger approach, or a direct surgical approach (De Charrière et al., 2020). In the setting of resuscitation, the femoral vein and artery are commonly used. Blood is extracted via a cannula in the femoral vein into the ECMO circuit. It then passes through an oxygen exchange membrane prior to being warmed and re-circulated into the systemic circulation via the femoral artery (Figure 1). This essentially bypasses the function of the patient's own heart and lungs.

AIMS AND OBJECTIVES

To help inform the dispatch protocols of future prehospital ECPR systems, the aims and objectives of this review are:

- To identify ongoing or planned prehospital EPCR programmes
- To describe the patient selection criteria of ongoing or planned prehospital ECPR programmes
- To describe the dispatch processes utilised for prehospital ECPR teams

METHODS

This systematic review is structured using the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). A systematic literature search of the MEDLINE and Embase databases was performed between the dates of 4th April 2024 and 11th April 2024. The search terms utilised are displayed in Table 1. MEDLINE was searched using the PubMed advanced search platform and Embase was searched using Ovid. Study registries were also reviewed to identify the protocols of ongoing or planned studies. Additionally, forward and backward reference tracing of eligible literature was performed to identify further articles. The inclusion and exclusion criteria are displayed in Table 2. Two reviewers undertook title and abstract screening to identify articles suitable for full-text review. A third reviewer was available to provide a final decision in the event of discrepancies. Data abstraction was performed by both

reviewers. The following data items were collected: reference details, location, case identification process, team composition, mode of transport, site of ECPR initiation, inclusion criteria and exclusion criteria.

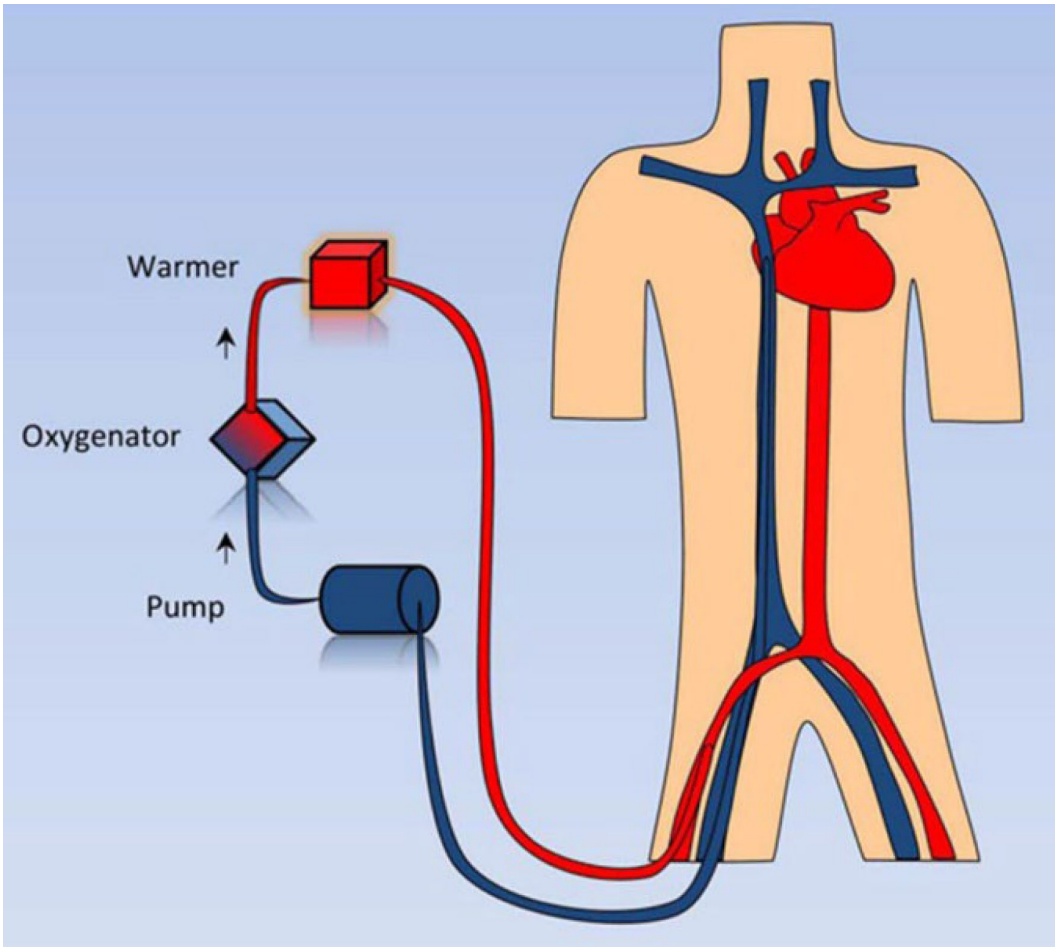

Figure 1: VA-ECMO via femoral arterial and venous cannula. Reproduced from Lawler et al. (2015).

Prehospital OR out of hospital
AND
ECMO OR extracorporeal membrane oxygenation OR extracorporeal cardiopulmonary resuscitation OR ECPR

Table 1. Search terms.

Inclusion	Exclusion
Published since 01/01/2014	Studies or protocols for in-hospital ECPR
Published in English language	Full-text unavailable
Studies or protocols for EPCR performed on scene or at a rendezvous point prior to hospital admission	
Full-text availability	

Table 2. Literature inclusion and exclusion criteria.

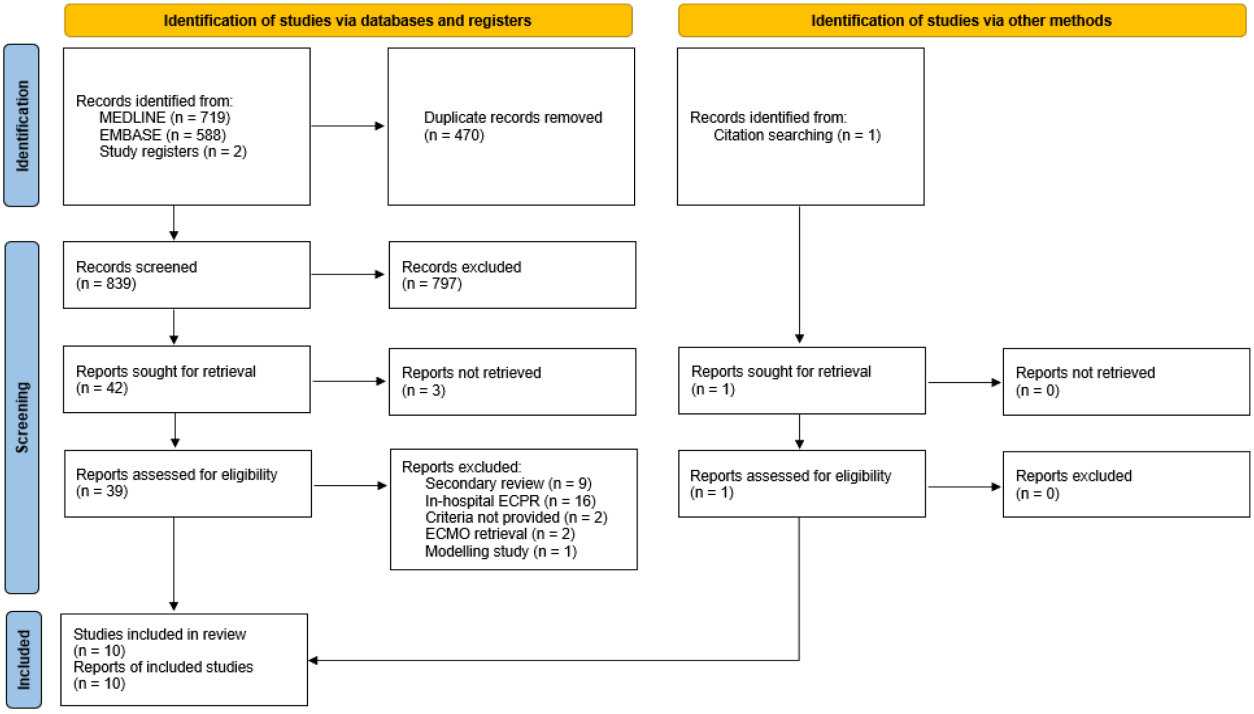

Figure 2: PRISMA flowchart

Reference	Age	Presenting rhythm	Witnessed OHCA	Bystander CPR	Aetiology	Resuscitation duration	Absence of comorbidities	Arrest-ECPR initiation time	Other
Lamhaut et al., 2017	18-65				Medical	>20 mins	Yes	ECMO team on site before 40th minute of resuscitation	ETCO2 >10mmhg
Singer et al., 2020 'Sub30'	>18		Yes	Yes	Presumed cardiac	>20mins or failure to sustain ROSC			
Bartos et al., 2020	18-75	VF/VT				No ROSC following 3 shocks		Transfer to RVP <30mins	LUCAS available
Petermichl et al., 2021			Yes	Yes				<60mins ALS	
Hutin et al., 2022	18-65					>20 mins	Yes	ECMO team on site before 40th minute of resuscitation	ETCO2 >10mmhg
Pozzi et al., 2022		VF/VT	Yes	Yes					
Leivaditis et al., 2023			Yes				Yes		Patients with primary hypothermia or intoxication also eligible
Richardson et al., 2023 'CHEER3'	18-65	VF/VT/ PEA	Yes					<45mins unless periods of ROSC or signs of life during resuscitation	<5mins no flow
Richardson et al., 2024 'PACER'	18-70	VF, VT, PEA	Yes	Yes		>20mins & <45mins			Within ECPR team hours (Mon-Fri 0900-1700), within 25 mins of EMS response
Ali et al., 2024 'ON-SCENE'	18-50	VF/VT OR high suspicion of PE	Yes OR signs of life (gasping/ movement)			>20mins & <45 mins			

Table 3. Inclusion criteria.

Reference	Major/ life-limiting comorbidities	Presenting rhythm	Advanced directive/ DNAR	Percutaneous cannulation not possible	Unwitnessed OHCA	Sustained ROSC	ETCO2	Other
Lamhaut et al., 2017	Yes							> 5 mins no flow, cardiac arrest during transportation
Singer et al., 2020 'Sub30'	Yes						<1.3kPa	Known or visibly pregnant, no signs of life & evidence of ineffective CPR suggested by absence of electrical activity at 20mins
Bartos et al., 2020	Yes		Yes					Significant bleeding, nursing home resident
Petermichl et al., 2021	Yes		Yes		Yes			Traumatic injury with uncontrolled bleeding
Hutin et al., 2022	Exclusion criteria not described							
Pozzi et al., 2022		Non-shockable						
Leivaditis et al., 2023	Yes		Yes		Yes			
Richardson et al., 2023 'CHEER3'	Yes			Femoral cannulation not possible		Sustained ROSC with haemodynamic recovery		<20mins ALS
Richardson et al., 2024 'PACER'	Yes	Asystole	Yes	Yes		Yes		
Ali et al., 2024 'ON-SCENE'	Yes		Yes	No clear echographic visualisation of femoral artery or vein			<1.2kPa	Able to transfer to EPCR capable centre <30mins

Table 4. Exclusion criteria.

Reference	Age related	Witnessed event	Presenting rhythm	Premorbid condition	Aetiology	Resuscitation factors*	ECPR factors**
Lamhaut et al., 2017	Yes			Yes	Yes	Yes	Yes
Singer et al., 2020 'Sub30'	Yes	Yes		Yes	Yes	Yes	
Bartos et al., 2020	Yes		Yes	Yes	Yes	Yes	Yes
Petermichl et al., 2021		Yes		Yes	Yes		Yes
Hutin et al., 2022	Yes			Yes		Yes	Yes
Pozzi et al., 2022		Yes	Yes				
Leivaditis et al., 2023		Yes		Yes	Yes		
Richardson et al., 2023 'CHEER3'	Yes	Yes	Yes	Yes		Yes	Yes
Richardson et al., 2024 'PACER'	Yes	Yes	Yes	Yes		Yes	Yes
Ali et al., 2024 'ON-SCENE'	Yes	Yes	Yes	Yes		Yes	Yes
Definitions: *Minimum resuscitation or ALS duration, absence of ROSC after a defined point, sustained ROSC, minimum ETCO2 value **ECPR team availability, percutaneous cannulation not possible, ECPR initiation not possible within a defined timeframe							

Table 5. Combined selection criteria.

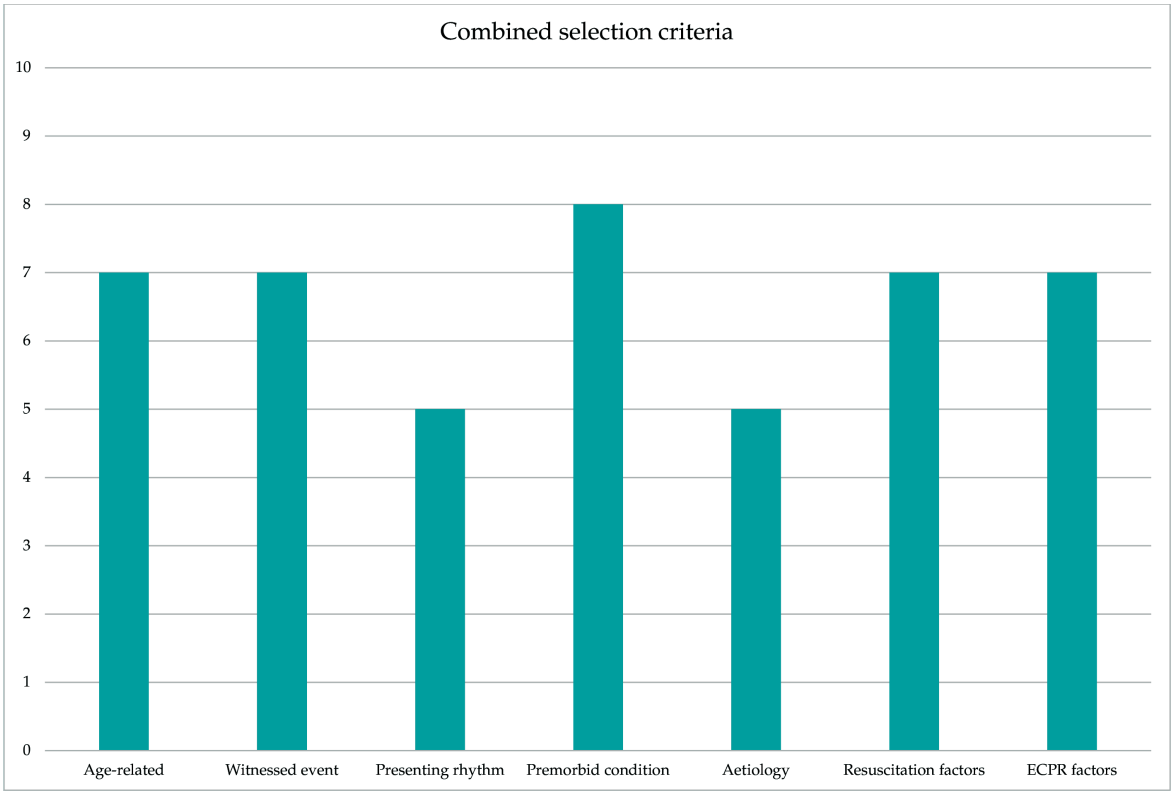

Figure 3: Combined selection criteria.

Reference	Location	Team composition	Case identification	Mode of transport	Site of EPCR initiation
Lamhaut et al., 2017	Paris, France	Dedicated ECPR team (emergency physician/intensivist, nurse anaesthetist and paramedic)	Proactively dispatched to all witnessed OHCA under 70 years old	Ground	On scene
Singer et al., 2020 'Sub30'	London, United Kingdom	Dedicated ECPR team (Advanced Paramedic, senior physician in prehospital care, two senior physicians in ECMO)	Calls screened by Advanced Paramedic Practitioner Desk	Ground	On scene
Bartos et al., 2020	Minnesota, USA	Dedicated 'mobile ECMO team'. One senior cannulating physician (interventional cardiology, emergency medicine or critical care), one sterile assistant, and one non-sterile assistant (critical care experienced Paramedics, nurses or physicians)	Central dispatcher notified by attending EMS Paramedic team. Mobile ECMO team and EMS rendezvous at agreed ED for ECMO initiation.	Ground	Following RVP with EMS at three pre-planned ED sites
Petermichl et al., 2021	Regensburg, Germany	Hospital-based ECPR team.	Simultaneous activation of ECPR team alongside EMS response to potentially eligible cases.	Ground	On scene
Hutin et al., 2022	Paris, France	Dedicated ECPR team (emergency physician/intensivist, nurse anaesthetist and paramedic)	Dispatched in conjunction with other EMS to witnessed OHCA	Helicopter	On scene
Pozzi et al., 2022	Lyon, France	Dedicated EPCR team (EMS physicians who had completed an 18-month period of surgical training with a cardiac surgery team)	Not stated	Ground	On scene
Leivaditis et al., 2023	Kaiserslauten, Germany	'Medical Intervention Car' (Anaesthesiologist, cardiac surgeon and clinical perfusionist)	MIC team notified within 5 minutes of arrival of EMS	Ground	On scene
Richardson et al., 2023 'CHEER3'	Melbourne, Australia	Dedicated three-person team consisting of two intensive care physicians (trained in US-guided femoral cannulation and ECMO initiation), and an experienced ICP (trained in ECMO circuit priming and pump management)	Automatic dispatch to suspected OHCA. Screening of potentially eligible cases by ICP using call data and situation reports from scene.	Ground	On scene
Richardson et al., 2024 'PACER'	Victoria, Australia	Not stated	Not stated	Ground	On scene
Ali et al., 2024 'ON-SCENE'	Nationwide, The Netherlands	Physician-led HEMS team	HEMS team activated by dispatcher using details from initial 112 call	Helicopter	On scene

ICP = Intensive Care Paramedic, EMS = Emergency Medical Services, OHCA = Out-of-hospital cardiac arrest, HEMS = helicopter emergency medical service

Table 6. ECPR team dispatch process.

RESULTS

Identification of Eligible Studies

The study identification process is displayed by a PRISMA flowchart (Figure 2). Application of the search strategy yielded 1,307 articles and two studies within study registries. 470 duplicates were removed, leaving 839 for title and abstract screening. 39 reports were selected for full text review. One additional article was identified via citation searching. Nine articles were excluded as they were secondary reviews of an existing ECPR system, sixteen described selection criteria for in-hospital ECPR, two did not provide any inclusion or exclusion criteria, two described the use of ECMO retrieval teams and one was a modelling study with hypothetical selection criteria. A total of ten studies were selected for final inclusion.

Inclusion Criteria

The total number of selection criteria utilised ranged from three to six. Age-related criteria were the most frequently included and were specified in seven (70%) articles. Upper age cut-offs ranged from 50 (Ali et al., 2024) to 75 years (Bartos et al., 2020), with 65 years being the most frequently utilised (n=3). All systems with age criteria required patients to be aged 18 or older. The requirement for the cardiac arrest being witnessed was also reported in seven articles (70%). Bystander CPR was only required in four. Presenting shockable rhythms (ventricular fibrillation or pulseless ventricular tachycardia) were reported in five inclusion criteria, and two of these studies also included PEA. A minimum duration of conventional resuscitation was required in six articles. Five articles had inclusion criteria for the onset of cardiac arrest to ECPR initiation. Additional criteria described included ETCO2 >10mmHg (n = 2), the availability of mechanical CPR (n = 1), the presence of primary hypothermia or intoxication (n = 1) and cases occurring during the operating hours of the ECPR team (n = 1).

Exclusion Criteria

The absence of major or life-limiting comorbidities was the most frequently described eligibility criteria identified within this review, with eight articles requiring this. Examples of comorbidities included advanced heart failure, COPD, terminal illness, advanced malignancy and severe frailty (Richardson et al., 2023; Singer et al., 2020). Similarly, the presence of an advanced directive or DNAR was listed as an exclusion criteria five times. Two ECPR systems excluded patients with unwitnessed OHCA, and two listed trauma or significant bleeding as exclusion criteria.

Combined Selection Criteria

When combined, patient selection criteria involving premorbid conditions were the most frequently utilised, in eight out of ten included studies (Table 5 and Figure 3). Age-related, the requirement for a witnessed cardiac arrest, resuscitation-related factors and ECPR-related factors were used in seven studies. The use of an aetiology or presenting rhythm related criteria were reported in five studies.

Dispatch Processes

Nine articles described prehospital ECPR systems operating in large urban populations, with just one nationwide service identified (Ali et al., 2024). Eight articles described the use of ground-based teams, and two reported on the use of helicopter-based teams (Hutin et al., 2022; Alli et al., 2024). The process for case identification was available in eight articles, with six utilizing a proactive approach to dispatch upon receipt and screening of the emergency call. Two systems dispatched an ECPR team following an initial update from attending resources (Bartos et al., 2020; Leivaditis et al., 2023). The use of a dedicated ECPR team was described in six articles, with one reporting the provision of ECPR by a physician-led HEMS team (Alli et al., 2024) and one reporting the dispatch of a hospital-based team (Petermichl et al., 2021). ECPR was planned to be performed on scene in nine systems, while one described the use of a rendezvous strategy (Bartos et al, 2020).

DISCUSSION

In this review, an age-based criterion was frequently utilised, with 7 out of 10 articles including this requirement. Age is a well-established prognostic factor in cardiac arrest and may serve as a surrogate measure of comorbidities, decreasing cardiac or pulmonary physiological reserve, and frailty (Wissenberg et al., 2015; Fernando et al., 2020). This review identified a wide heterogeneity of ages eligible for ECPR between 18 and 75 years with various upper age cut-offs utilised (50, 65, 70, and 75 years). This may suggest a disparity or paucity of evidence regarding the age criterion for ECPR. Several studies have examined age and the association between survival and neurological outcomes following cardiac arrest and ECPR. Chahine et al. (2023) identified age as a dependent factor associated with favourable neurologically intact survival, with those aged 20-39 years having a reported survival rate of 51% (n = 21/41), whereas a significant decline in favourable survival was seen in those aged 70-79 years (22.6% n= 12/53). These findings were echoed within a systematic review examining 29 ECPR protocols and associated outcomes by Tran et al. (2023). Despite the higher rates of favourable survival seen in younger patients, Kikuta et al. (2021) demonstrated than ECPR could be successfully applied in older patients if careful prognostic and selection criteria are applied. Prognostic factors such as a lack of comorbidities, agonal breathing, and short cannulation times were associated with more favourable outcomes in older patients. This may suggest ECPR may be a useful tool if applied in carefully selected patients without the use of age cut-offs.

The presence of major or life-limiting comorbidities was the most frequently utilised exclusion criterion, featuring in eight protocols. Determining the presence and prognosis of comorbidities may be difficult in the prehospital setting, due limited access to patient records and the need to prioritise expedient resuscitative interventions in eligible patients. The remote review of electronic patient clinical records during the response phase, prior to provider arrival, may expedite and inform decision making. Additionally, the use of validated comorbidity assessments may aid the creation of standardised assessment criteria, and thus guide clinicians in making eligibility decisions. The Charlson Comorbidity Index [CCI] may represent a suitable option, and has been found to accurately predict the long-term outcomes of patients in medical, surgical, trauma and intensive care settings (Charlson et al., 2022). The CCI assigns a value to the presence of each of

eighteen conditions to provide a numerical score, all of which can be rapidly established by prehospital clinicians through clinical assessment and history taking.

The case identification and dispatch processes for prehospital ECPR teams, and subsequent location of ECPR initiation, appear to be variable and require careful system-specific considerations. These factors are highly influenced by team composition, prehospital systems and geography. Currently three locations for initiating ECPR currently exist within the literature: at scene, after moving the patient to a rendezvous location, or following transfer directly to an ECPR centre (Song et al., 2023). One factor which has significant influence over ECPR outcome is the time from collapse to cannulation (Downing et al., 2022; Tran et al., 2023). Experienced ECMO teams require approximately fifteen to twenty minutes to perform cannulation and establish flow, and the benefit of ECPR is lost after low flow periods of one hour. Therefore the current consensus is to initiate ECPR within 40 minutes of cardiac arrest. Teams should select and refine case identification processes that minimise the time from dispatch to cannulation to maximise the efficacy of ECPR (Leung et al., 2024). Early dispatch processes, such as simultaneous activation of an ECPR team with first responders, while carrying the risk of a potentially high stand-down rate, may be necessary to reach patients in a quick timeframe. This approach is not without risk, as over dispatch may result in missed ECPR patients if the team is committed to delivering care for non-ECPR eligible patients, or initiating ECPR too early when ROSC could have been established with conventional ALS (Richardson et al., 2023).

The mode of ECPR team transport also warrants further consideration. Within this review, eight out of the ten included ECPR services utilised a ground-based response. This is likely to be influenced by the fact that ECPR services are often established in highly populated urban areas, with several articles describing dispatch of a dedicated ECPR team from a centralised hospital location. Within our review, just two systems described the use of a helicopter-based ECPR team. As systems aim to improve equity of care and provide ECPR coverage to a larger population over a larger geographical area, a helicopter-based ECPR service may be advantageous. As demonstrated by ter Avest et al. (2022), the air transfer of patients for in-hospital ECPR from semi-rural locations is not feasible. This has led to investigation into how bringing ECPR to the patient via a helicopter-based service may increase eligibility (Gottula et al., 2024). However, this approach has a significant impact on cost-effectiveness and requires additional logistical considerations. As highlighted by Hutin et al. (2022) in their description of a helicopter-borne ECPR team, just 30% (n = 12) of patients received ECPR, with the team being cancelled prior to arrival in 23 out of 40 activations. The 'On-Scene' trial, featuring a nationwide HEMS-based system in The Netherlands, described by Ali et al. (2024), is ongoing and its findings may influence further helicopter-based ECPR services.

Future Research

In the United Kingdom, the prehospital response to OOHCA often involves the dispatch of a specialist or advanced critical care paramedics with frequent exposure and experience in prehospital resuscitation. Due to the locality of these resources, they are often on scene prior to the arrival of HEMS based enhanced care teams. After initial identification of potentially eligible patients and dispatch of a HEMS-based ECPR team, advanced critical care paramedics may be able to confirm eligibility, establish ALS and begin to

'prepare' the patient and environment for ECPR initiation. This may also include the deployment of mechanical CPR to facilitate relocation of the patient to a rendezvous point where ECPR can be initiated. Additionally, similarly to the arrangements described by Singer et al. (2020), the presence of an advanced paramedic at scene to optimise cardiac arrest management allows ECMO/ECPR specialists to concentrate solely on establishing ECPR. Future research should explore the impact of co-deployment of specialist paramedics on ECPR selection and initiation. Furthermore, services should explore the feasibility of a process for facilitating direct communication between the attending clinicians and enroute ECPR team. This may help to reduce the time prior to committing to, or deciding against, ECPR initiation. Consequently, this may reduce the time spent on scene confirming eligibility or stand down resources from unsuitable cases at an earlier point, maximising their availability.

'PACE' Mnemonic

Our review has demonstrated that much of the information required to assess patient suitability for ECPR can be determined during initial emergency call receipt or following the arrival of first responders. A mnemonic has been created to aid dispatch staff and initial responders in identifying potentially eligible patients. Providing updates containing this information to dispatch centres may help improve the timeliness and accuracy of prehospital ECPR team dispatch.

Figure 4: 'PACE' mnemonic for initial assessment by non-specialists or first responders.

LIMITATIONS

Our review has several limitations. Firstly, the search strategy used may not have identified studies utilizing other terminology. To reduce the risk of missing relevant articles, search terms were decided by consensus between reviewers, and pilot tests to identify known literature were undertaken. Secondly, searches were only performed for articles published in the English language which may exclude relevant literature in other languages. However, the results indicate ECPR systems in a range of countries were identified. Thirdly, clinical outcomes were not identified. The decision not to include these was made as it was felt the heterogeneity of included studies would prevent meaningful comparison.

CONCLUSION

This review has identified common patient selection criteria across ten prehospital ECPR systems, including patient age, initial presentation characteristics, and the absence of comorbidities. Variability in the specific parameters of these is likely to be reflective of the variation in geographical distribution, team composition and transport modes of prehospital ECPR services. Many of the frequently utilized eligibility criteria can be determined during emergency call receipt or shortly after resource arrival, highlighting the potential for improved screening by emergency medical dispatchers and non-specialist resources

to reduce ECPR team dispatch times. A simple mnemonic to aid with evaluating key criteria on arrival is provided. Future research should evaluate the impact of prehospital screening tools on dispatch and ECPR initiation times.

ETHICS

Ethics approval was not sought for this study as it is a secondary review. All included studies received their own ethics approval.

REGISTRATION AND PROTOCOL

This review was not registered, and a protocol was not prepared prior to completion.

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IMPROVEMENT PROJECT REPORTS

MEDICATION SAFETY AND OPIOID RISK SCREENING PROGRAM DELIVERED BY COMMUNITY PARAMEDICS

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ABSTRACT

Objective: To describe the program and associated outcomes of an innovative medication safety and opioid risk screening program delivered by community paramedics
Methods: The study was conducted within a health system community paramedic program in North America. Community paramedics employed a medication safety questionnaire and opioid risk assessment tool during home visits, offering tailored interventions based on individual patient risks. Data collection and analysis were facilitated through REDCap and the health system's electronic health record.
Results: Analysis of 435 patient screenings revealed notable findings. A meaningful portion of patients used opioids for pain management, with a subset identified at high risk for opioid misuse or overdose. While most patients stored medications safely, disposal practices varied, highlighting a need for education and intervention. Discrepancies in service provision between service areas identified multiple possible barriers and solutions.
Conclusion: This research underscores the importance of proactive medication safety measures within community paramedicine and provides an example of a community paramedic program designed around community-based need, stakeholder collaboration, and program evaluation. Future efforts should focus on improving data collection methods, and advocating for sustainable funding to support comprehensive intervention strategies aimed at enhancing patient safety and well-being.

INTRODUCTION

Medications stored in homes are one of the leading causes of poisonings and fatalities in the United States, accounting for nearly half of all reported substance exposures (Picture of America, n.d.). The 2022 Annual Report of the National Poison Data System by America's Poison Centers found that more than 90% of all reported poisoning exposures occurred within an individual's home. Notably, among the top twenty-five substances associated with reported fatalities, twenty-two were prescription or over-the-counter medication (Gummin et al., 2023). Simultaneously, rates of excess medication storage at home are presumed to be increasing, with medication oversupply reports of 30-47%,

heightening the risk of medication-related poisonings and fatalities at home (Stroupe et al., 2000; Thorpe et al., 2009).

Among both general and vulnerable populations, substances belonging to the analgesic medication class, particularly opioids, have the highest associated risk of fatalities among medications that are stored at home (webPOISONCONTROL Data Analysis Dashboard, n.d.). Education and low cost/free equipment have been found most effective to promote safe medication use and prevent poisonings (Achana et al., 2015). The encounter between paramedics and individuals who use drugs can significantly impact patient outcomes through the healthcare system (Bolster et al., 2023).

Over the past two decades, community paramedics have emerged as frontline healthcare workers who are well-positioned to improve patient health outcomes by bridging the gap between primary healthcare and emergency healthcare through the provision of primary health care, health promotion, disease management, clinical assessment, and needs-based interventions. Community paramedic programs have been shown to decrease financial and physical pressures on the rural healthcare sector and improve patient outcomes (Agarwal et al., 2018; Bennett et al., 2018; Bolster et al., 2023; Martin and O'Meara, 2020).

Community paramedic programs initially emerged to expand healthcare services related to chronic disease management in rural and under-served communities and have evolved in North America to provide services aligned with community needs (Bennett et al., 2018; O'Meara et al., 2015; Martin & O'Meara, 2019). Community paramedic programs should be designed around community-based need, stakeholder collaboration, and program evaluation. Community paramedics are well-positioned to mitigate in-home medication safety and little guidance exists relating to the implementation of medication safety programs by community paramedics (Shannon et al., 2023).

The Opioid and Naloxone Education Program, also known as the ONE Program, was developed in 2018 by pharmacy faculty at North Dakota State University, focusing on primary and secondary prevention of opioid use disorder and accidental overdose in North American pharmacies. Trained pharmacists involved in the program screen patients for the risk of opioid misuse and overdose, providing upstream harm-reduction interventions including counseling, community support service information, and medication disposal education. Many positive outcomes have resulted from the ONE Program, including positive patient perceptions of opioid risk screening, changes in pharmacist stigma related to opioid use disorder, and outcomes associated with initiation of an opioid risk program (Eukel et al., 2020; Skoy et al., 2020; Werremeyer, Frenzel, et al., 2022; Werremeyer, Strand, et al., 2022).

Recently, the ONE Program translated its success into the home health setting by collaborating with home health providers to create and implement a new initiative to provide nurse-administered medication safety screenings at home health visits. The program focused on medication safety and opioid misuse and overdose prevention screening to further enhance the health of patients receiving care in their homes. The program showed increased rates of safe medication storage and disposal after the implementation of a medication safety program (Eukel et al., 2023).

Based on the success of this program and community-based need, the ONE Program was approached by a health system to collaborate to translate the home health medication screening initiative into community paramedicine home visits. The objective of this manuscript is to describe and evaluate the implementation of a medication safety and opioid risk screening program that aims at mitigating these risks through targeted education and interventions by community paramedics.

METHODS

The community paramedic program is part of an integrated health system in the upper Midwest in North America. The Community Paramedic Program has five central locations spanning three states, each serving a 45-mile radius. Each of the five community paramedic locations has the capacity to see between 25-30 patients per week, depending on the referral reason, complexity of the patient, and location of the patient.

Providers may refer a patient to the community paramedic program if they have home safety concerns, feel the patient is nonadherent, needs disease state education, frequent emergency department visits or hospitalizations, uncontrolled blood pressure, wound care, peripherally inserted central catheter (PICC) line care management, or intravenous (IV) medication administration. Patients are seen in their homes 1-3 times per week for a month or more depending on the patient needs. The goal is to help the patient improve health, reduce readmissions to the hospital or emergency department, and improve adherence with medications.

The year prior to this program, a medication safety and opioid risk assessment program was designed and implemented with home health services offered by local public health units (Eukel et al., 2023). Based on the positive outcomes of the home health work, the program was translated to community paramedics.

With this improvement pilot project, community paramedics completed a 50-minute training delivered online asynchronously. Training content included use of the program tools, patient education on safe medication storage and disposal, and opioid safety including risks for overdose and misuse and naloxone education. A toolkit provided program forms and tools, patient education materials, and frequently asked questions (Essentia Health, n.d.).

Community paramedics evaluated each newly-admitted patient using a medication safety questionnaire and corresponding outcomes worksheet as key tools for data collection on patient medication safety practices (Appendix A). These tools were designed to assess critical aspects of medication management in home settings. The questionnaire included targeted questions such as, “How is the patient storing his or her medications?”, “How has the patient been disposing of unused or expired medications?”, “Does the patient forget to take medications?”, and “Does the patient take medication for pain?” These inquiries enabled a comprehensive evaluation of four main areas: medication storage, medication disposal practices, medication adherence, and use of pain medications.

The community paramedic completed an evidence-based opioid risk assessment for patients taking an opioid medication to determine risk of opioid misuse and/or accidental opioid overdose. Risk for opioid misuse is based on the Opioid Risk Tool, which provides a numeric risk evaluation. Patients at high risk for opioid misuse score with an ORT >7

(Webster & Webster, 2005). The opioid risk screening has been used by the research team in various practice settings across North Dakota (Appendix B) (Skoy et al., 2020; Strand et al., 2022). All interventions provided were tracked using the outcomes worksheet (Appendix A).

A Triage Tool (Figure 1) helped to guide the community paramedics to determine which interventions to provide based on individual patient screening results. Interventions included provision of education and/or products based on patient need:

1. Education on medication storage, disposal, and adherence
2. Medication disposal product (Deterra®)
3. Daily pill organizers
4. Naloxone discussion
5. Risks of chronic use of opioids
6. Nasal naloxone distribution
7. Medication lockbox

The program was funded by the state's Department of Human Services through State Opioid Response funding. Funding supported the purchase of intervention supplies including daily pill organizers, medication lock boxes, medication disposal devices, and nasal naloxone. For patients outside of the grant funding service area, the health system provided pill organizers and identified alternative resources for the community paramedic to provide other supplies, including naloxone, through resources in their service area, such as a local pharmacy or public health department.

All screening form information and interventions provided collected from January 2022 to December 2022 were documented in REDCap (Research Electronic Data Capture), a secure, web-based application designed to support data capture for research studies (Harris et al., 2009). In January 2023 screening forms and data collection were built into the health system electronic health record.

De-identified patient information from REDCap and the health system electronic health record from January 2022 to July 2023 was cross-walked and combined into one secure Excel spreadsheet containing 636 patients. Review of data resulted in removal of 201 cases due to incomplete data. The final sample size was 435. The final sample was separated into a grant-funded and non-grant funded populations, 185 and 250, respectively, as differences in the availability of certain supplies resulting from the funding differences previously discussed. Excel was used for descriptive data analysis of the final data set. This study used the SQUIRE 2.0 framework to showcase a pilot care delivery innovation and program performance (SQUIRE 2.0 Guidelines, n.d.). The evaluation of this program was approved by the North Dakota State University IRB.

RESULTS

The median age of the 435 patients was 76 years old. A majority were female (60%). A total of 214 patients (50.1%) who had a home visit with a community paramedic used a prescription medication to manage their pain. Pain was managed with a prescription medication for 214 (50.1%). A total of 67 patients (15.4%) had their pain managed with an opioid. Of those who are using an opioid, 18 screened at high risk of opioid overdose and/or opioid misuse (26.9%) (Table 1).

Characteristic	Grant-funded Group[1] (N=185)	Non-grant Funded Group[2] (N=250)	Total (N=435)
Median Age (years)	77	75	76
Gender Female	125 (67.6)	137 (54.8)	262 (60)
Pain managed with prescription medication	106 (57.3)	108 (43.2)	214 (50.1)
Pain medication is an opioid	23 (12.4)	44 (17.6)	67 (15.4%)
If taking opioid, at high risk of opioid overdose or misuse	9 (39.1)	9 (20.5)	18 (26.9)

* All reported numbers are N (%)

[1] Received medication disposal product, daily pill organizer, and nasal naloxone at no cost directly from the community paramedic.

[2] Received medication disposal product, daily pill organizer, and nasal naloxone at no cost from available community resources, as suggested by the community paramedic.

Table 1. Patient demographics.

More than 80% of all patients served by community paramedics were storing their medications in a designated safe area. Over 13% of patients were storing their medications in an unsafe or undesignated area. Only 2.8% of these patients were actively storing their medications in a locked medication box (Table 2).

Medication Storage Method	Grant-funded Group[1] (N=185)	Non-grant Funded Group[2] (N=250)	Total (N=435)
Locked Box	6 (3.2)	6 (2.4)	12 (2.8)
Safe Designated Storage	157 (84.9)	207 (82.8)	364 (83.5)
Unsafe Designated Storage	19 (10.3)	19 (7.6)	38 (8.7)
Undesignated Area	5 (2.7)	17 (6.8)	22 (5)

* All reported numbers are N (%)

[1] Received medication disposal product, daily pill organizer, and nasal naloxone at no cost directly from the community paramedic.

[2] Received medication disposal product, daily pill organizer, and nasal naloxone at no cost from available community resources, as suggested by the community paramedic.

Table 2. Medication storage characteristics.

Of the 435 patients, 39.5% were disposing their unused medications using an approved method such as a medication disposal bag, providing ample opportunity for community paramedics education and intervention. A meaningful number of patients (42.5%) were not disposing their unused medications at all, and 17.9% of patients were disposing their medications in the trash (Table 3).

Medication Disposal Method	Grant-funded Group[1] (N=185)	Non-grant Funded Group[2] (N=250)	Total (N=435)
Not Disposing of Unused Medication	69 (37.3)	116 (46.4)	185 (42.5)
Disposing Medication in Trash	36 (19.5)	42 (16.8)	78 (17.9)
Disposing Medication Using Approved Measure	80 (48.5)	92 (36.8)	172 (39.5)

* All reported numbers are N (%)

[1] Received medication disposal product, daily pill organizer, and nasal naloxone at no cost directly from the community paramedic.

[2] Received medication disposal product, daily pill organizer, and nasal naloxone at no cost from available community resources, as suggested by the community paramedic.

Table 3. Medication disposal characteristics.

A total of 808 interventions were provided to the 435 patients. The most commonly provided interventions were medication adherence education (45.9% of patients), medication storage education (43.9% of patients), and medication disposal education (42.7% of patients). Grant-funded patients comprised 42.5% of total screenings but were provided with 63.7% of total interventions compared to 36.3% of interventions provided to non-grant funded participants while comprising 57.5% of total screenings. More than 60% of the grant-funded group received education on medication storage, medication disposal, and medication adherence, compared to around 30% of the non-grant funded group. The grant-funded group received all interventions at over twice the rate of the non-grant funded group. Over 50% of patients in the grant-funded group received a medication disposal device (Deterra) compared to 23% for the non-grant funded group (Table 4).

Intervention	Grant-funded Group[1] (N=185)	Non-grant Funded Group[2] (N=250)	Total (N=435)
Medication Storage Education	119 (64.3)	72 (28.8)	191 (43.9)
Medication Disposal Education	118 (63.7)	68 (27.2)	186 (42.7)
Medication Adherence Education	120 (64.8)	80 (32)	200 (45.9)
Received Deterra Bag	102 (55.1)	58 (23.2)	160 (36.8)
Received Pill Organizer	45 (24.3)	15 (6)	60 (13.8)
Received Medication Lockbox	10 (5.4)	1 (0.4)	11 (2.5)

* All reported numbers are N (%)

[1] Received medication disposal product, daily pill organizer, and nasal naloxone at no cost directly from the community paramedic.

[2] Received medication disposal product, daily pill organizer, and nasal naloxone at no cost from available community resources, as suggested by the community paramedic.

Table 4. Services provided by community paramedic (N = 435 patients).

A total of 18 patients (4.14%) were at high risk for opioid misuse or opioid overdose with 9 patients in the grant-funded group and 9 patients in the non-grant funded group. A total of 100% of the grant-funded population received naloxone and 22% received naloxone in the non-grant funded group (Table 5).

Opioid Screening Result	Grant-funded Group[1]	Non-grant Funded Group[2]	Total (N=435)
At High Risk of Opioid Misuse or Overdose	9	9	18
Received Nasal Naloxone	9 (100)	2 (22.2)	11 (61.1)

* All reported numbers are N (%)

[1] Received nasal naloxone at no cost directly from the community paramedic.

[2] Received nasal naloxone at no cost from available community resources, as suggested by the community paramedic.

Table 5. Naloxone provision (N = 18).

DISCUSSION

This evaluation assesses the effectiveness and implications of integrating medication safety and opioid risk screening initiatives into the practice of community paramedicine home visits (Shannon et al., 2023). Partnerships with community paramedics and phar-

macists or pharmacy-based programs, like the ONE Program, have shown to be a valuable (Crockett et al., 2017).

Community paramedics are well-positioned to create positive impact on patient care and population health. Provision of care in the home provides added benefits for many health-centered topics including medication safety and opioid harm reduction (Shannon et al., 2022, 2023). The success of the ONE Program's previous research provided a unique opportunity to bring an evidence-based medication safety program to community paramedic care provision (Eukel et al., 2023). Patients are referred to the community paramedic services due to high risk of frequent hospitalizations, frequent emergency department visits, medication adherence concerns, and needs for disease state education, making this population ideally positioned to gain positive value from this type of program.

The findings of this study underscore the ability of community paramedics as frontline healthcare providers to support medication safety. Through the utilization of screening tools and tailored interventions, community paramedics were able to identify patients at risk, deliver targeted education, and provide necessary resources such as medication disposal products and naloxone. These efforts are particularly crucial given the high prevalence of opioid use among patients receiving community paramedic care and the associated risks of misuse and overdose compared to the general population (Hales et al., 2020).

Through risk stratification, community paramedics successfully delivered education and interventions based on individual patient needs. For example, according to the triage tool, if patients were at high risk for opioid misuse or opioid overdose, they were to receive education on naloxone and offered nasal naloxone. A total of 18 patients were at high risk of opioid overdose or misuse, with 11 accepting naloxone. A 61% naloxone acceptance rate is significantly higher than other ONE Program intervention, with 5.81% in community pharmacies, 29% in local public health home health, and 6.9% in Medicare certified home health (Eukel et al., 2023; Skoy et al., 2021). Notably, 100% of patients in the grant-funded group were at risk of opioid overdose or opioid misuse accepted naloxone. These results can be further extrapolated to the findings of Hideo et al that leave behind naloxone led to more patients having naloxone administered prior to ambulance arrival which increased the chance of discharging the patients at the scene (Tohira, 2024).

Unused medications stored in the home can result in diversion, misuse, abuse, and accidental poisonings (Duvivier et al., 2017). Drug disposal products are an effective and convenient way for patients to dispose of unused medication (Cooper et al., 2021). A large proportion (43.5%) of program participants were not disposing of their unused medications, likely keeping a supply at home to use in the future at their own discretion. Community paramedics providing education on safe medication disposal to 43.9% of patients and a medication disposal product to 36.8% helps close this gap in improper medication disposal.

Differences were identified between the provision of interventions to a grant-funded and non-grant-funded populations. Interventions were provided to patients in the grant-funded group at over twice the rate as patients in the non-grant funded group

(Table 4). There are multiple possible explanations for these variations. While there is insufficient data to determine the exact cause, it is likely a combination of these factors.

One possible cause is differences in patient characteristics between the two populations. Patients in the grant-funded group consisted of a higher proportion of females (67.6% vs 54.8%) and those taking a prescription medication for pain (57.3% vs 43.2%). Those taking an opioid prescription were lower in the grant-funded group, but the risk of opioid overdose or misuse was higher. Extensive comparison of additional demographics of these populations was not completed due to IRB restrictions.

A likely major contributor to this difference in intervention provision is the accessibility of program supplies. Grant funding was available for patients in the grant-funded service area to receive free supplies such as medication disposal products and nasal naloxone directly from community paramedics. Community paramedics in non-grant funded locations had to utilize other sources that created additional burden to provide these supplies such coordinating with a local pharmacy to pick up and deliver the naloxone to the patient. These possible discrepancies highlight the importance of sustainable funding and resource allocation to support comprehensive medication safety initiatives, especially in regions with limited access to healthcare resources, consistent with other research (Achana et al., 2015).

This study has limitations. The study revealed challenges and opportunities for improvement in data collection and reporting within the community paramedicine setting. Limitations in data completeness and generalizability were noted with 435 of 636 entries (68.4%) being complete. The number of screenings with complete data resulted in smaller cohorts for many subsets such as patients taking an opioid who are at high risk of misuse or overdose, reducing data analysis to descriptive statistics. Efforts to streamline data entry processes and enhance collaboration between researchers and community paramedics are essential for optimizing future research efforts and ensuring the accuracy and reliability of findings.

This program focused on patients within one health system community paramedic program in the upper Midwest region. While this limited data collection, we believe its implications extend beyond one system. The successful integration of medication safety and opioid risk screening initiatives into community paramedicine and past integration with home health services underscores the potential for broader adoption and adaptation in diverse healthcare disciplines and locations (Eukel et al., 2023). Future research including additional community paramedic services in multiple health systems would improve assessment of program outcomes.

The pilot nature of this research assessed the impact of an innovative program led by community paramedics. Expanded implications and uptake of this program throughout other areas of the health system and/or other community paramedic programs will rely on these initial pilot results.

These findings emphasize the importance of interdisciplinary collaboration between healthcare providers, researchers, and community paramedicine in addressing complex public health challenges such as medication safety. Future research should focus on refining intervention strategies, expanding access to resources, and evaluating long-term impacts to further enhance the effectiveness and sustainability of medication safety pro-

grams within community paramedicine. This manuscripts answers the call from 7 countries to increase research and evaluation of community paramedicine programs with an emphasis on sharing best practices, data, and program evaluation (Shannon, et al., 2023).

CONCLUSIONS

This manuscript highlights the pivotal role of community paramedics in addressing medication safety and opioid-related risks within home settings. By integrating evidence-based screening tools and tailored interventions, community paramedics demonstrated their capacity to identify, educate, and support patients at risk of medication-related harm and advance safe medication use.

The effectiveness of proactive medication safety initiatives delivered by community paramedics is evidenced by improvements in medication storage and disposal practices and high naloxone acceptance rates. Moreover, the successful adaptation of the ONE Program's principles into community paramedicine emphasizes the value of interdisciplinary collaboration and knowledge translation in advancing public health objectives. Community paramedics can effectively identify and address medication-related risks, ultimately improving patient outcomes and advancing population health initiatives.

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APPENDIX A. MEDICATION SAFETY QUESTIONNAIRE AND OUTCOMES WORK-SHEET

Screening tool and tool to collect outcomes/interventions provided; used for each patient serviced by community paramedics.

How is the patient storing his or her medications?

- ☐ Medication is stored in locked box
- ☐ Medication is stored in safe designated area
- ☐ Medication is stored in unsafe designated area
- ☐ Medication storage not designated

Prior to today's interventions, how is the patient disposing of unused or expired medications?

- ☐ Medication not discarded
- ☐ Medication discarded in trash
- ☐ Medication disposal with approved measures:
  - ☐ Pharmacy MedSafe
  - ☐ Local public health unit
  - ☐ Police station
  - ☐ Kitty litter, coffee grounds, or other
  - ☐ Medication disposal product (Deterra, DisposeRx, etc.)
  - ☐ Other: _____

Does the patient forget to take medications?

- ☐ Never
- ☐ Occasionally
- ☐ Frequently

Does the patient take medication(s) for pain?

- ☐ No, not taking medication for pain
- ☐ Yes, taking medication for pain
  - ☐ Taking non-opioid for pain (Celebrex, NSAID, etc.)
  - ☐ Taking opioid for pain (oxycodone, OxyContin, fentanyl, hydrocodone, morphine, hydromorphone, methadone, codeine)

If yes, proceed to opioid screening

For **all patients**:			
Yes	No		Education about **medication storage** was provided to the patient
Yes	No		Education about **medication disposal** was provided to the patient
Yes	No		Education about **medication adherence** was provided to the patient
Yes	No		Patient was provided a Deterra bag for medication disposal
Yes	No		Patient was provided a pill organizer to assist with medication adherence
For patients **taking an opioid:**			
Yes	No		Patient was identified as at risk for **accidental opioid overdose** based on current disease states, current medications, or age *If yes, this was discussed with the client*
Yes	No		Today, client was identified with potential for **opioid misuse** *If yes, this was discussed with the client*
Yes	No	Not indicated for this patient	Naloxone was provided to the patient
Yes	No	Not indicated for this patient	1 in 4 brochure was provided for this patient
Yes	No	Not indicated for this patient	A medication lock box was provided for this patient

APPENDIX B. OPIOID RISK ASSESSMENT

Opioid risk assessment screening administered to all patients who are using an opioid.

ONE Rx
Opioid and Naloxone Education

Opioid Risk Assessment

Patient age:_____

YES NO Has the patient taken this or other opioid medications in the last 60 days?
Examples: Duragesic® (fentanyl), Oxycontin® (oxycodone), Vicodin® (hydrocodone), morphine

Opioid Misuse Risk Assessment

Put a check in the box next to those items which apply to the patient.

	Yes	F	M
Family history of substance abuse			
Alcohol		1	3
Illegal drugs		2	3
Prescription medication misuse		4	4
Personal history of substance abuse			
Alcohol		3	3
Illegal drugs		4	4
Prescription medication misuse		5	5
Age between 16 - 45 years		1	1
History of preadolescent sexual abuse		3	0
Psychological disease			
Examples: attention deficit disorder (ADD), obsessive compulsive disorder (OCD), bipolar		2	2
Depression		1	1

Total Score: _____

Accidental Overdose Risk Assessment

Circle the age the patient is in: 16-25 26-44 45-64 **Greater than 64**

Medical history: Circle all those which apply to the patient.

asthma depression anxiety COPD/emphysema sleep apnea liver disease kidney disease

While using this medication is there a chance the patient may consume any of the following?

YES NO Medication used to treat anxiety
Examples: Xanax® (alprazolam), Ativan® (lorazepam), Valium® (diazepam) Klonopin® (clonazepam)

YES NO Medication used to treat depression

YES NO Medication known as a muscle relaxer
Examples: Flexeril® (cyclobenzaprine), Skelaxin® (metaxalone)

YES NO Medication used to aid in sleep (prescription or over the counter)

YES NO Cough or cold medication

YES NO Alcohol

YES NO Are you currently taking other opioid medications?
Examples: Duragesic (fentanyl), Oxycontin (oxycodone), Vicodin (hydrocodone), morphine

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LITERATURE SURVEILLANCE

PARAMEDICINE LITERATURE SEARCH: DECEMBER 2024 - FEBRUARY 2025

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To help paramedicine professionals to keep abreast of the literature in our discipline, the Paramedicine Literature Search provides the results of a standardized search of the PubMed database. These search results will include articles from journals that many paramedicine professionals may already be familiar with. The search strategy is also designed to include articles in journals they may not be commonly monitoring, such an article about ambulance care for cancer patients that appeared in an oncology journal.

The formatting of the Paramedicine Literature Search allows the reader to scan the titles of articles and click into the article link, when provided, for additional details.

The authors have made a diligent effort in designing of the search strategy to balance sensitivity (i.e., getting all relevant articles in paramedicine) with the specificity (i.e., excluding articles not relevant to paramedicine). The balance is imperfect. As a result, it should be noted that the results do not include every relevant article and includes some non-relevant articles.

The search strategy is filtered to only include articles published in a time frame listed below. This will include articles with electronic and print publication dates in that date range. Some of the publication dates may fall outside of this range due to how the article metadata was indexed by the publisher.

The following results were obtained on April 10, 2025 from the PubMed website (https://pubmed.ncbi.nlm.nih.gov/) using the following search terms and Boolean logic:

"paramedic"[Text Word] OR "paramedics"[Text Word] OR "prehospital"[Text Word] OR "pre-hospital"[Text Word] OR "emergency medical technician"[Text Word] OR "emergency medical technicians"[Text Word] OR "Ambulance"[Text Word] OR "emergency medical services"[Text Word] OR "fire-rescue"[Text Word] OR "fire-rescue"[Text Word]

Search Filter: Publication range of December 1, 2024 to February 28, 2025.

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International Journal of Paramedicine

Published by the National EMS Management Association (USA)

GUIDELINES FOR AUTHORS

The *International Journal of Paramedicine (IJOP)* is a forum for scholarly contributions and state-of-the-art research relevant to patient care and the growth and advancement of paramedicine, including the areas of paramedic leadership, management, education, operations, culture, professional and clinical practice. The *IJOP* encourages exploration of paramedicine from diverse theoretical and practical views from all disciplines, including business and economics; the natural, basic, and applied sciences; and the humanities, social sciences, and arts. Priority will be given to submissions that use sound theoretical or conceptual frameworks, strong methodological design, and relevance to the international paramedic community. All methodologies such as quantitative, qualitative, mixed methods, and knowledge syntheses will be considered.

NEMSMA is a longtime collaborator with National Association of EMS Physicians in support of *Prehospital Emergency Care*. In continuation of that relationship, IJOP and PEC have established a collaborative relationship that will the facilitate the exchange of submissions in certain circumstances based in part on which journal may be the best fit for a particular manuscript.

GENERAL GUIDELINES AND NOTES

- The *IJOP* only publishes material in English. Please use Academic English.
- The *IJOP* accepts submissions in the following categories:
  - Case Studies (2,000 words)
  - Concepts (3,000 words)
  - Correspondence / Commentary (1,000 words)
  - Education (3,000 words)
  - Empirical Investigations / Original Research (4,500 words)
  - Methodology (2,000 words)
  - Quality Improvement Project Reports (3,000 words)
  - Reviews / Synthesis (4,000 words)
  - Special Reports (2,000 words)
  - Toolbox (1,500 words)

The word limits noted above are guidelines for the various submission types. Authors are encouraged to adhere to these guidelines and to be concise in their submissions.

- Merriam-Webster's Collegiate Dictionary (11th ed.) should be consulted for spelling.
- Contributions that explore non-clinical topics such as leadership, operations, education, professional practice, and the culture of paramedicine are strongly encouraged.
- Based on the international scope of the *IJOP*, contributions should provide a degree of generalizability and transferability to global settings and should have relevance to the *IJOP's* broad readership.
- *IJOP* discourages multiple publications derived from a single study.
- All original research submissions must have received approval from an Institutional Research Board (IRB) or Research Ethics Board (REB).
- Once a submission has been assessed for suitability by the editorial team, it will undergo a double-blind peer-review by independent, anonymized reviewers.

As part of the submission process, authors will be required to confirm that their submission complies with all of the items below. Submissions may be returned that do not adhere to these guidelines:

- The submission cannot be previously published or in the submission process of another publication (or an explanation has been provided in a cover letter to the Editor).
- The Author and Funding File and the Main Submission File are both in Microsoft Word document file format.
- An ICMJE Form for Disclosure of Potential Conflicts of Interest is submitted for each author.
- All illustrations, figures, and tables should be placed within the text at the appropriate points AND submitted as separate files in a high resolution format.
- Supplemental media files (e.g., spreadsheets, slides, audio or video files) may be included for reader access. The file should be hosted by the authors unless other arrangements have been made with the Editors.
- Where available, URLs for each reference have been provided.
- The text is double-spaced in a 12-point font.
- Page numbers and line numbering are used for the 'Main Submission File'
- The text adheres to the stylistic and bibliographic requirements outlined.
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    - Randomized trials
        - CONSORT and its extensions
            - https://www.equator-network.org/reporting-guidelines/consort/
    - Observational studies
        - STROBE and its extensions
            - https://www.equator-network.org/reporting-guidelines/strobe/
    - Systematic reviews
    - PRISMA and its extensions
        - https://www.equator-network.org/reporting-guidelines/prisma/
    - Study protocols
        - SPIRIT and the PRISMA-P extension
            - https://www.equator-network.org/reporting-guidelines/spirit-2013-statement-defining-standard-protocol-items-for-clinical-trials/
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            - https://www.equator-network.org/reporting-guidelines/stard/
    - Case reports
        - CARE and its extensions
            - https://www.equator-network.org/reporting-guidelines/care/
    - Clinical practice guidelines
        - AGREE and the RIGHT extension
            - https://www.equator-network.org/reporting-guidelines/care/
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        - SRQR and the COREQ extension
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  - ARRIVE
    - https://www.equator-network.org/reporting-guidelines/improving-bioscience-research-reporting-the-arrive-guidelines-for-reporting-animal-research/
- Quality improvement studies
  - SQUIRE and its extensions
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- Economic evaluations
  - CHEERS
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Note that there is a section in EQUATOR with guidelines specific to emergency medicine that may also be applicable to studies in paramedicine.

SUBMISSION FILES

The following describes the 'standard' submission files that should be uploaded via the *Journal* submission website for each manuscript. Please refer to the specific submission guidelines for each submission category for more specific instructions that may apply.

Author and Funding Information File

Author Information

- All authors of a manuscript should provide their full name with up to four post-nominals and up to two organizational affiliations and titles – exactly as they should appear in the publication.
- The email of all authors should also be included.
- If available, please include ORCiDs (http://orcid.org) numbers for each author.
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- Identify one author as the corresponding author. They will be shown as such when the article is published and will be the point of contact between the editorial team and the authors.
- If the work presented in the manuscript was presented at conference or published in abstract form, identify the name of the event, location, format, and date of presentation.
- Acknowledgements, where applicable, can be provided. Brevity is strongly encouraged.

Funding Information

- Please provide the details for any funding that supported the submitted work, to include all details required by your funding and grant-awarding bodies. The following template sentences are suggested:
  - For single agency grants: This work was supported by the [Funding Agency] under Grant [number xxxx].
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  - If a funding source was not involved, please confirm with a statement such as, "External funding was not used to support this work."

Main Submission File

To provide a high level of objectivity in the peer-review process *IJOP* uses a double blind process. The identities of the authors and their institutions are not revealed to the reviewers and the identifies of the reviewers are not revealed to the authors.

Due to the double blind review process, information about the authors and their institutions should not appear anywhere in the main submission file. This should include removal of identifying information in the 'properties' of the Microsoft Word (.doc or .docx) files that are submitted.

Please do not use extensive formatting of the document. Use single spaces between sentences. Separate paragraphs with a carriage return. Do not indent the first line paragraphs with tabs or added spaces.

Unless stated otherwise in the directions for a specific manuscript category, all submissions should include the following elements in the following order as a single document file, called the Main Document File.

Title

- Provide the suggested title for the published article. Please note that the title used for publication is subject to editorial team approval.

Abstract, Keywords, Disclosures / Conflicts, Presentations, and Acknowledgements

- Unless exempted or described differently in the directions for a specific submission category, abstracts MUST be limited to 300 words or less, including the section headers (e.g., Problem, Methods, etc.). Use structured abstracts when possible.
- Unless exempted or described differently in the directions for a specific submission category, this page will also include between three (3) and six (6) keywords or short phrases that will be used for title and search engine optimization. Keywords of paramedicine, EMS, and emergency medical services will be added by default and will not count towards the keyword count requirements.
- State any disclosures or conflicts for each author. This will be in addition to completion of the ICMJE Disclosure Forms for each author as described below. If the are no conlficts, please state 'none.'

Primary Manuscript Body

- The primary body of the manuscript will come next in the main submission file. The composition of the primary body of the manuscript may vary with the category of the manuscript. Refer to specific manuscript category descriptions for details.
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- Tables should be used to summarize large amounts of information rather than writing it out as a narrative. Tables may be created within the word processor or inserted from another program (e.g., Excel). If another program is used to create the table, please include the original source file as a supplementation media file submission. All tables should be inserted into this primary manuscript body file. They must be labelled sequentially, and referred to in the text. Table captions must include the table number and a name for the table at a minimum. Additional descriptive text may be added to the caption as needed to complement the reference to the table in the main body of the paper.
- Figures shall be inserted directly into the text at the appropriate position. These may be lower resolution images to simply show their correct placement. Figures must be labelled sequentially and referred to in the text. Figure captions must be included with the figure number and a name for the figure at a minimum. Additional descriptive text may be added to the caption as needed to complement the reference to the figure in the main body of the paper. In addition to including figures in the text, submit each figure as a supplemental media files in high resolution PDF, .jpeg, .tiff, or .png file formats, with a 300dpi minimum resolution.

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- Where applicable, the references for the manuscript come next. Use endnotes rather than footnotes. The APA style in-text reference marks and in endnotes must be used.
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GUIDELINES FOR CATEGORY-SPECIFIC SUBMISSIONS

Case Reports (≤2,000 words)

- These manuscripts share the experience of unusual clinical presentations, circumstances, or treatment approaches. Case reports should be structured as described in the Consensus-based Clinical Case Reporting Guideline (CARE; https://www.equator-network.org/reporting-guidelines/care/).

Concepts (≤3,000 words)

- These papers present a specific management or clinical concept, idea, or theory – and describes its practical application. If the paper presents a new concept, it may also suggest research, improvement projects, or pilot implementations of its application. Along with other standard submission file elements, the primary manuscript body pages file for Concept papers should contain:
  - Introduction - The introduction should describe the problem, issue, or circumstance that the concept is intended to address. Where applicable, address the current literature that demonstrates a gap and any pertinent background information.
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  - Discussion - Authors are encouraged to include a critical review of related research and a fulsome discussion that highlights how the concept contributes to the field of paramedicine. Address any limitations of the concept.

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- The Dialogues section will publish comments and questions from readers related to previously published articles. Along with other standard submission file elements, the primary manuscript body pages file for correspondence should include:
  - Subject Paper Information - Provide the title, name of the first author, and the *IJOP* issue for the paper that is the subject of the correspondence.
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Editorials (≤2,000 words)

- Editorials are a venue for the expression of opinion and perspective on topics relevant to the paramedicine community. They should make clear point(s) in a concise manner with a scholarly approach and tone. They should not be used for the presentation of data, findings, or research that has not been previously published.

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- These submissions explore a specific educational process, approach, or method. The paper should also discuss any issues to consider in its practical application.

Along with other standard submission file elements, the primary manuscript body pages file for Education papers should contain:

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- Description – Provide a description of the educational process, approach, or method and how it can be applied. Where applicable, provide sufficient detail and clarity of any methods or procedures and the setting and population to which the process, approach or method applies.
- Discussion - Authors are encouraged to include a critical review of related research and a fulsome discussion that highlights how the concept contributes to the field of paramedicine. Address any limitations of the concept.

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- The submission of manuscripts for empirical investigations / original research may be clinical or non-clinical. Several of the EQUATOR guidelines, described previously, may apply to any given study in this category. Please apply them as appropriate to your particular investigation.
- Authors may provide, or editors may suggest, that some information be provided as a supplemental file so that the main paper remains concise. The supplemental content may include data sets, images, video clips, and in-depth details on methodology. Along with other standard submission file elements, the primary manuscript body pages file for empirical investigations / original research should include elements as called for in the applicable EQUATOR guidelines.
- NEMSMA is a longtime collaborator with National Association of EMS Physicians in support of *Prehospital Emergency Care (PEC)*. In continuation of that relationship, *IJOP* and *PEC* have established a collaborative relationship that exchanges manuscripts in certain circumstances. Empirical investigations on clinical topics may be forwarded to *PEC* for their initial consideration with author consent.

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- This category of submissions provides deep explorations of methods used or may be used in research studies or improvement projects. These methods should be novel in some way that makes them of significant interest in their own right, separate from the studies in which they are utilized. These papers can also provide a more detailed description of the methods than would otherwise be appropriate in the primary research or improvement project manuscript. The primary paper's methods section may direct readers to a methodology paper in this category for more detailed descriptions of the methods it utilized.
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- *IJOP* acknowledges the importance of quality improvement activities to optimize EMS system performance and patient outcomes and welcomes manuscripts describing quality improvement projects.

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- In general, quality improvement project reports should describe the process being examined; the process change(s) that were tested; the baseline process performance level; the methods used for conducting process tests and evaluating the results; the results, including the post-intervention performance levels; any confounding variables and balancing measures; and the process change iterations as applicable.
- The manuscript discussions and conclusions should highlight what the external audience can learn from the reported experience, not just the activity's internal success or failure.
- Authors may provide, or editors may suggest, that some information be provided as a supplemental file so that the main paper remains concise. The supplemental content may include data sets, images, video clips, and in-depth details on methodology.

Reviews / Synthesis (≤4,000 words)

- *IJOP* invites the submission of reviews of all types, including those with and those without meta-analytic components. In addition to the guidelines for original research provided elsewhere in these guidelines, any submissions in this category should be consistent with the Prisma 2020 guidelines for reporting systematic reviews https://www.equator-network.org/reporting-guidelines/prisma/.

Toolbox (≤3000 words)

- These submissions will explain a tool or technique and describe its practical use. Where applicable, the articles may include a supplemental file or link that contains the tool and a data file where the reader may try out the tool.
- Along with other standard submission file elements, the primary manuscript body pages file for Toolbox papers should contain:

- Introduction - The manuscript shall include an introduction that provides an overview of the type(s) of projects that the tool or technique could be used for or the specifics of the project that it was actually used in.
- Description of the Tool / Technique – As the central focus on the paper, this section shall provide in an in-depth examination of the tool or technique and its mechanics. Describe how the tool or technique should be applied in context of a clinical, operational, or administrative setting.
- Discussion – Discuss the underlying rationale for the tool or technique and why it may be favored over other options.
- Provide a critique of related methods. Also include discussion of any limitations of the tool or technique.
- Exercise – Where applicable, describe how to use the tool or technique in conjunction with a sample data set or scenario.

Special Reports

- This submission category will be used for articles of a scholarly nature that do not fit into one of the other *IJOP* submission categories. Authors are encouraged to use the guidelines described in this document that seem to be most applicable to their Special Report, but consultation with the Editorial Team before manuscript submission is strongly encouraged.