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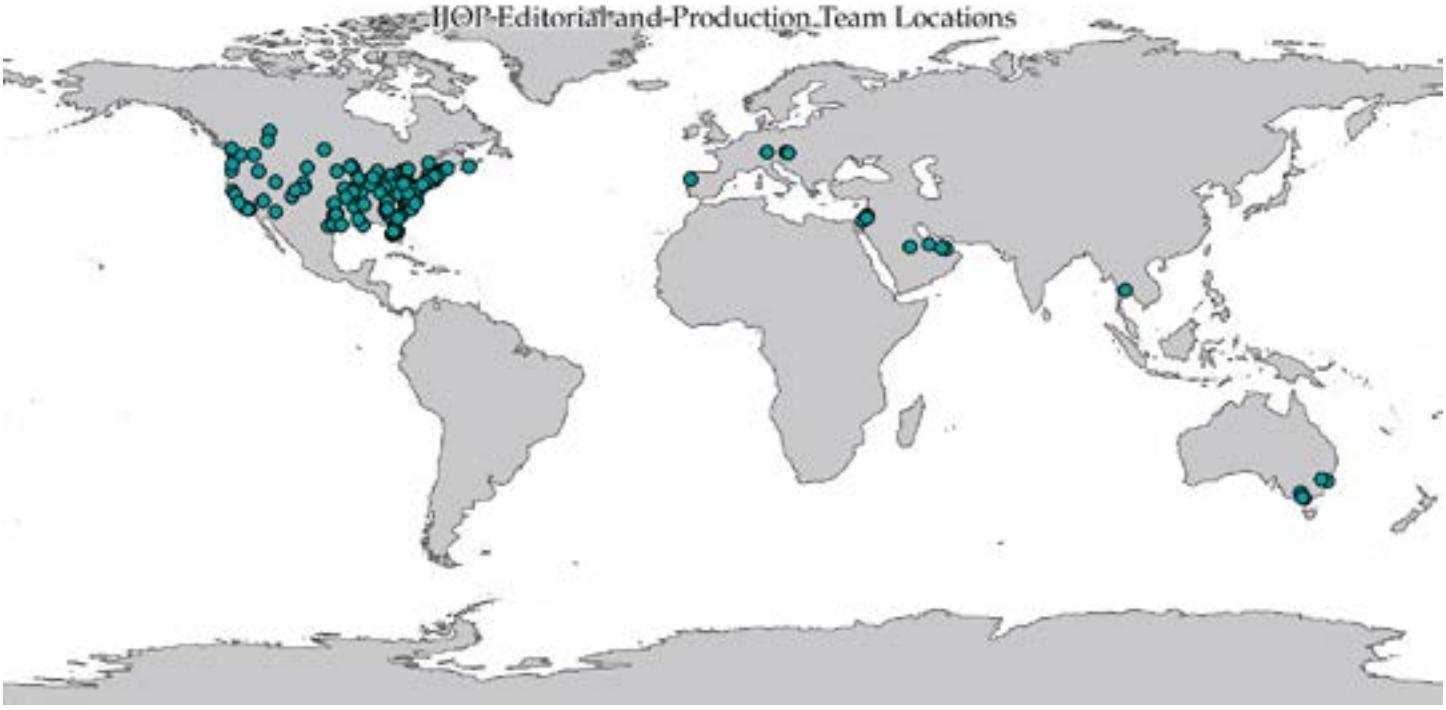

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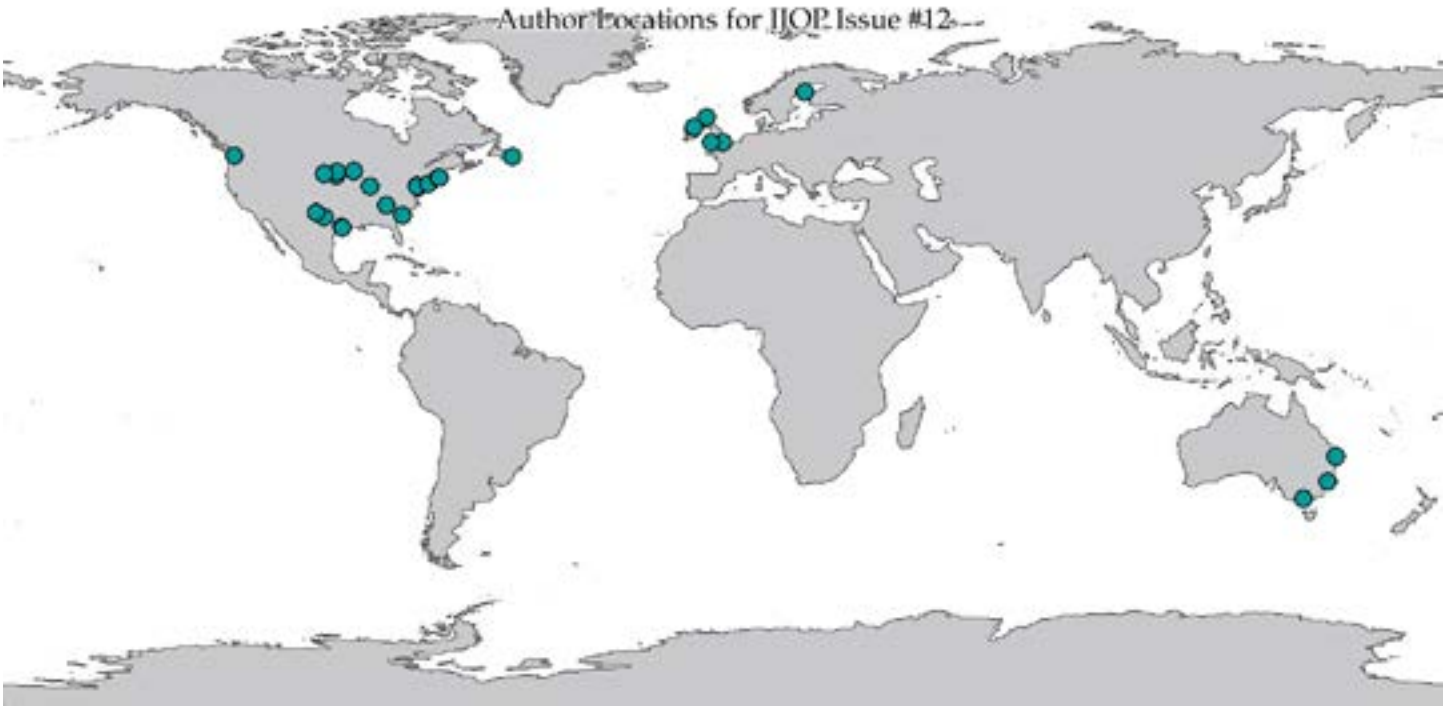

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EDITORIALS

ROLE AND CRITERIA FOR PUBLICATION OF CONCEPT PAPERS IN THE INTERNATIONAL JOURNAL OF PARAMEDICINE

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One of the goals of the *International Journal of Paramedicine (IJOP)* is to increase the range of scholarly work in our discipline. Many peer-reviewed journals have an almost exclusive focus on publication of empirical research and literature reviews. The vision for *IJOP* is much broader, as described by the range of sections laid out in our submission guidelines (https://internationaljournalofparamedicine.com/index.php/ijop/about/submissions). This editorial describes our vision for Concept Papers and explains the criteria by which they are evaluated in our peer review process.

Concept Papers are intended to present new concepts and ideas for consideration by the paramedicine community. The intention of the author may be to stimulate discussion and debate. They may also wish to encourage others to implement, test, or research the idea or concept—especially if the author does not have the means or opportunity to do so themselves or in appropriate settings.

With these goals in mind, a strong topic and manuscript for a concept paper should ideally meet several criteria: novelty and meaningfulness; elegance; insight; and generativity.

Novelty and Meaningfulness. Novelty refers to originality, distinct from what has previously been articulated in the literature. This may involve the introduction of new constructs or frameworks, the application of theories from other disciplines to paramedicine, or the reorganization of existing knowledge in ways that yield fresh insights. Importantly, novelty is not defined solely by being new; rather, it derives its value from coupling originality with meaningfulness. A novel conceptual contribu-

tion is therefore one that not only advances thinking in an original direction but also does so in a manner that is relevant, useful, and impactful for paramedicine research, education, and practice.

Elegance refers to the explanation of complex ideas and concepts with simplicity and clarity. An elegant framework presents complex challenges, such as system design or clinical decision-making, into forms that are comprehensible and practical, without over-simplifying essential detail. Elegance is valued in scholarly work because it enhances the accessibility and utility of ideas and concepts, making them more readily understood and adopted by both researchers and practitioners.

Insight denotes the ability of a conceptual contribution to reorganize existing knowledge in ways that reveal new patterns, relationships, or interpretations. In paramedicine, insight may be achieved by integrating disparate strands of evidence, reframing entrenched assumptions, or offering a synthesis that clarifies connections between clinical practice, operational processes, and system outcomes. Insightful contributions move beyond simple descriptions to provide new frameworks that alter how the field conceptualizes and addresses challenges.

Generativity refers to the ability of a conceptual paper to stimulate subsequent inquiry, innovation, and application. A generative idea is not an endpoint but rather a catalyst, sparking new research questions, theoretical refinements, and practice innovations. In paramedicine, generativity may inform future clinical trials, policy development, or inspire novel educational strategies. The hallmark of generativity is that the contribution continues to influence scholarly and practical advancements beyond the original work.

High-quality Concept Papers articulate a central idea and engage thoughtfully with the questions that emerge from it. Authors should define key constructs and assumptions explicitly, present arguments coherently, and ensure that each component of the manuscript builds systematically toward a unified whole. Conceptual rigor is achieved through the application of multiple modes of reasoning: envisioning (identifying and reframing issues), explicating (delineating and clarifying assumptions and frameworks), relating (integrating and differentiating concepts across domains), and debating (presenting competing perspectives and advancing reasoned arguments) (MacInnis, 2011).

Concept Papers should enrich the paramedicine literature by advancing theory, informing practice, and guiding future inquiry. By fostering new ways of thinking, such contributions serve as a catalyst for innovation and improvement in our discipline.

PEER-REVIEW CRITERIA

IJOP reviewers utilize several types of peer-review forms to guide and score various aspects of their reviews. The information from these forms is aggregated from all reviewers and then sent to the authors along with the editorial decision to accept, request revisions, or reject the submission.

The review forms are based on the applicable international consensus guidelines published by the EQUATOR Network (Enhancing the QUAlity and Transparency Of Health Research; https://www.equator-network.org). In the case of Concept Papers, there isn't

an applicable EQUATOR guideline, so the criteria for peer-review and the associated form have been developed by *IJOP* staff.

Several sections of our peer-review forms apply to most all types of manuscripts, such as the quality of the title, abstract, writing, length, and references. Most sections of the review form include a 1 to 5 Likert scale rating with labels relevant to the section. They also have a space for the reviewer to provide a succinct explanation of the reasoning for the section score and to provide constructive feedback and suggestions to the authors.

Specific to Concept Papers, the review form asks reviewers to evaluate the following:

- Does the paper provide a novel idea or concept that is distinct from what has been previously described in the literature or is currently in use?
- Does the paper adequately describe relevant prior research, ideas or concepts?
- Is the idea or concept relevant, useful, and impactful to paramedicine?
- Do the authors indicate what is inside and what is outside the scope of the idea or concept?
- Is the idea or concept likely to stimulate subsequent research, improvement projects, innovations, or direct applications?

The *IJOP* editorial team looks forward to receiving and publishing more Concept Papers in the future.

REFERENCES

MacInnis, D. J. (2011). A framework for conceptual contributions in marketing. *Journal of Marketing*, *75*(4), 136–154. https://doi.org/10.1509/jmkg.75.4.136

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International Journal of Paramedicine

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RESEARCH REPORTS

A SURVEY REVIEW OF MENTAL HEALTH TRAINING IN PARAMEDIC PREPARATION EDUCATION PROGRAMS

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ABSTRACT

Background: Due to increased behavioral health emergency calls, paramedic training must be enhanced to effectively meet the increasing demand for skilled behavioral health crisis response. This investigation aimed to identify current training among paramedic education programs for responding to behavioral health crisis calls. This study is the first known to document gaps in paramedic education regarding patients experiencing behavioral health crises.

Methods: This study utilized a descriptive cross-sectional mixed methods survey distributed to directors of Committee on Accreditation for the Emergency Medical Services Professions (CoAEMSP)-accredited programs. Data were collected on current training methods among paramedic education programs. Bivariate analyses with Chi-square or Fisher's exact test examined variations in perceived training effectiveness and demographic traits. We performed thematic analyses to examine the open-ended question responses and hypothesized the participants would rate their mental health training as insufficient for their needs.

Results: Of the 140 respondents (out of 628 solicited programs), program directors considered behavioral health the least useful training areas, with a 3.38 mean score (out of 5). Notably, 83 participants (59.3%) reported that behavioral health and psychiatric disorders had increased. Further, of the 140 respondents, 64 participants (45.7%) said mental health training hours should increase. Participants emphasized the need for awareness of behavioral health crisis calls for safety, stating that de-escalation training might improve paramedic safety. The participants perceived the most effective strategies for training in behavioral health crisis to include fostering an expectation of compassion, being empathetic, advocating for patients, developing a style for working with patients, recognizing collaboration, using training that involve educating, applying, and evaluating, and intentionally engaging in thoughtful debriefing following real patients.

Conclusions: The findings from this study underscore the urgency for initial paramedic education programs to bolster behavioral health crisis-related training. Participants reported awareness of mental health crises and de-escalation training is crucial in ensuring paramedic safety.

INTRODUCTION

Mental, psychiatric, and behavioral health emergencies are common calls that medical first responders encounter during their careers (Panchal et al., 2021). Mental health emergencies involve

an individual experiencing an acute situation related to mental health issues (National Alliance of Mental Illness, 2024). Whereas "psychiatric emergencies are acute disturbances in thought, behavior, mood, or social relationship that require immediate intervention as defined by the patient, family, or social unit to save the patient and/or others from imminent danger" (Wheat et al., 2016, p, 341). Behavioral health can be defined as a state of mental, emotional, and social well-being or behaviors and actions that affect wellness" (U.S. Centers for Disease Control and Prevention, 2024, para. 2), and behavioral health emergencies serves as an umbrella term for mental health conditions, suicidal ideation and attempts, and substance use concerns. Additionally, some make a distinction between a crisis which may not be an immediately life-threatening situation but involves severe distress, while emergencies are classified as life threatening situations where the individual is a danger to themselves or others (PsychCentral, 2022). An analysis using the National Emergency Medical Services Information System (NEMSIS) data helps highlight trends in psychiatric and mental health-related emergency calls. In 2016, psychiatric problems were the fourth most prevalent documented impression among adult patients, accounting for slightly more than 10.5% of calls (Panchal et al., 2021). By 2022, this figure had decreased to 3.8%, indicating a notable decline in the proportion of calls attributed to psychiatric issues (NEMSIS, 2023).

Data from 2024 further supports this trend, with only 3.09% of all emergency calls being related to psychiatric problems, abnormal behavior, or suicide attempts (NEMSIS, 2025). This suggests a continuing decrease in the percentage of such calls over the years. However, pediatric data tells a different story. Over 15% of emergency calls for pediatric patients involved psychiatric issues, making it the second most common clinical presenting issue in this age group (Panchal et al., 2021).

These findings indicate that while the overall proportion of psychiatric-related calls has decreased for adults, pediatric cases remain significantly high, illustrating the importance of specialized response strategies for different age groups. First responders continue to devote significant resources to addressing mental, psychiatric, and behavioral health emergencies, underscoring the need for targeted interventions and support (Langton et al., 2021). It is worth noting that many prehospital care charting systems restrict providers by offering a narrow and overly generalized array of Primary Impression options, which can inadvertently narrow the scope of their assessments. While first responder encounters with patients experiencing a mental health crisis can end in very tragic ways (Chung, 2023; Schmelzer, 2021); thankfully, these tragic outcomes are an extremely small percentage of behavioral health emergency calls as evidenced by only 1.5% or less of all 9-1-1 encounters ending with an on-scene patient death, which includes calls for medical reasons such as cardiovascular disease (Breyre et al., 2023). Yet, when reviewing the current textbooks commonly used in initial paramedic training, little content is found to equip paramedics for encounters with patients experiencing a mental health crisis (Pollak, 2018; Bledsoe et al., 2023). A recent qualitative analysis of EMS education surveyed subject matter experts about the gaps, opportunities, and challenges in EMS education (Lancaster et al., 2023). Behavioral health concerns ranked number 7 in the top 10 list of areas needing improvement.

Standardization of the initial education of paramedics is an amalgam of guidelines from the Commission on Accreditation of Allied Health Education Programs (CAAHEP), the Committee on Accreditation of Educational Programs for the Emergency Medical Ser-

vices Professions (CoAEMSP), and the National Highway Traffic and Safety Administration (NHTSA). Although the NHTSA (2021) standards were "revised to include more information regarding acute behavioral crisis and mental health disorders" (p. 23) as well as placed s a greater emphasis on mental health, (CAAHEP, 2024; CoAEMSP, 2020; National Highway Traffic Safety Administration, 2021), the hours spent on these topics in practice paramedics education programs is unknown. While the educational standards are designed to be a minimum, the NHTSA guidelines focus on general study areas listing if paramedics should know these areas on a simple, foundational, or complex level without dictating the learning structure. CAAHEP and CoAEMSP require reporting of methods and hours spent on didactics, simulation-based training, and clinical rotations. Time allotments are at the discretion of each EMS educational program. The amount of time allotted behavioral health emergencies taught in paramedic initial education classrooms is unknown. This study is the first known to document gaps in paramedic education regarding patients experiencing a behavioral health crisis and emergencies.

This mixed methods study identified the current training that paramedic preparation education programs employ to prepare their students to respond to behavioral health emergency calls. By reviewing the training paramedics receive regarding effectively diagnosing, treating, and interacting with persons experiencing behavioral health crisis and emergency calls, we can identify reported training strengths and deficiencies. Specifically, this study aims to identify the existing training provided in paramedic education programs to equip paramedics for responding to calls related to behavioral health crises and emergencies. The authors hypothesized that the paramedic education program participants would perceive their mental health training as needing additional time in the area of behavioral health disorders.

METHODS

Study Design and Population

This study utilized a cross-sectional mixed methods survey of program directors of CoAEMSP paramedic education programs across the country. The research team developed the self-designed 30-item survey to examine the following areas: participant demographics, program demographics, program training, program attributes, and trainee qualities. Regarding the specific type of questions, the questions varied from checkboxes to fill-in short or long text boxes, as well as included numerical values of the total number of hours spent in various training areas, and a Likert-type scale reviewing attitudes and beliefs of various training modalities. The survey questions regarding specific paramedic training topics consisted of the following sections: the number of training hours, didactic versus experiential training, scenario-based training, usefulness of training topics, and evolution of training. The survey also included questions regarding specific mental health-related subjects based on the Diagnostic and Statistical Manual of Mental Health Disorders (American Psychiatric Association, 2022), broad disorder criteria (Figure 1), professional disposition evaluation of students, which can be defined as a formal assessment process to evaluate students' inherent qualities and personality fit to determine their suitability to become a paramedic, and the importance of paramedic qualities.

The survey concluded with open-ended questions about the perceptions of paramedic preparation in responding to emergency mental health crisis-related calls. Participants

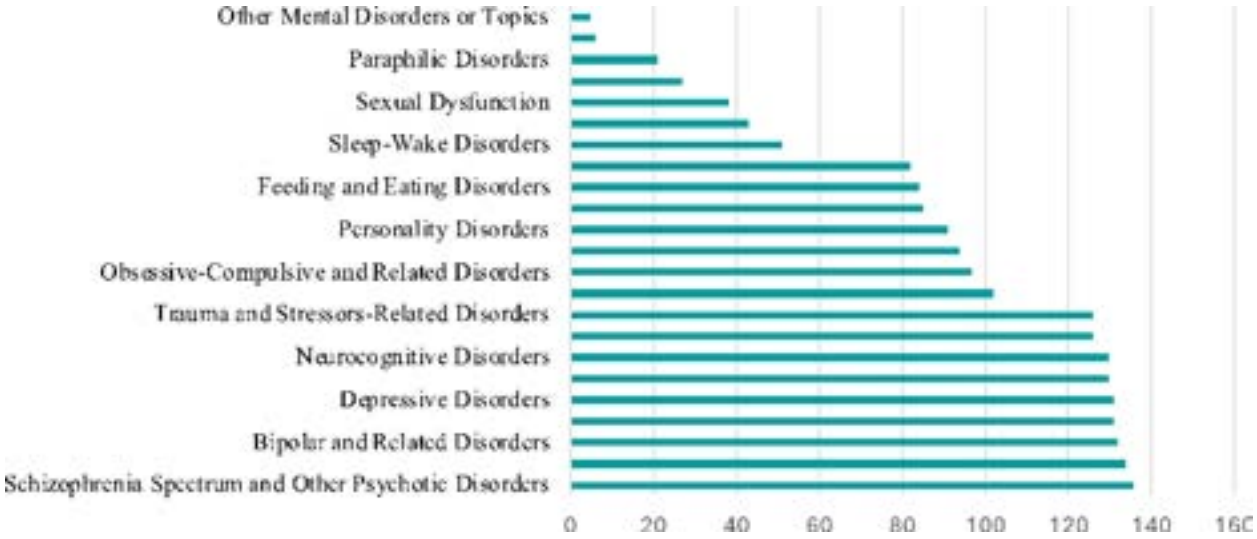

Figure 1. Mental health disorders and topics covered within current training.

were able to provide qualitative responses regarding the training their programs offered in behavioral health emergency calls through open-ended questions such as "What do you believe are the most effective strategies and/or teaching materials, methods, and content for paramedics to better identify and respond to emergency psychiatric/mental health crisis-related calls?" The study was approved by the Institutional Review Board at the researcher's university.

Survey Content and Administration

In Spring 2023, data collection occurred through distributing the online survey developed using the Qualtrics system to all known CoAEMSP accredited programs across the country, which was 628 programs at the time of the study. The recruitment email was distributed three times two weeks apart, from April 10, 2023, to May 8, 2023. As many paramedic programs test their students in May through knowledge-based assessments, the timing of the survey administration may have influenced response rates, which may have caused program faculty to be less available to participate in the study. The solicitation cycle allowed participants to voluntarily opt-in and checked a box indicating they consented to participate using an anonymous data collection method. This resulted in 140 participants from CoAEMSP-accredited programs completing the study (a 22.3% participation rate). Survey utilization data indicated that 140 prospective participants clicked on the link to the survey, and the participants took an average of 41 minutes to complete the surveys. So, we considered 140 participants as our final sample size.

Data Analysis

We utilized STATA statistical software, version 17.0 (StataCorp LLC, College Station, TX), for all quantitative data management and statistical analyses. Missing data were handled through applied listwise deletion. For individual characteristics and descriptive statistics, we computed frequencies and percentages. We conducted bivariate analyses using Chi-square or Fisher's exact test to explore differences in perceived training usefulness and demographic characteristics. The Bonferroni adjustment was employed in this study to control the Type I error rate during multiple comparisons. When conducting numerous statistical tests on a dataset, the probability of obtaining at least one significant result

due to chance alone increases, inflating the Type I error rate (false positives). We applied the Bonferroni adjustment by revising each test's significance level (alpha) to mitigate potential false positives. Instead of using the conventional alpha value (e.g., 0.05) for each test, the adjusted alpha was determined by dividing the desired overall alpha level by the total number of tests conducted. This adjustment rendered each test more conservative, thus diminishing the likelihood of a Type I error.

Qualitative data were analyzed using Thematic Analysis (TA, Braun & Clarke, 2006). The TA process followed included 1) becoming familiar with the quantitative and qualitative data, 2) generating initial codes, 3) searching for themes, 4) reviewing themes, 5) labeling and defining themes, and 6) writing the report of the themes. An author (4th), who is familiar with the data analysis approach, conducted TA with additional confirmations from other authors (1st and 6th) by comparing the raw data against the themes generated until unanimous agreement occurred and through member checking of the data and themes potential bias was addressed and mitigated.

RESULTS

The results are based on a total of 140 directors or faculty members of paramedic education programs accredited by CoAEMSP or CAAHEP who agreed to participate in the study and complete the survey. Table 1 reports the study population characteristics. Notably, the majority of respondents were male (59.3%) and identified their ethnicity as White/Caucasian (88.9%). Further, as paramedics, 75% have more than 16 years of field experience.

Figure 2 presents the average number of reported hours spent providing training, indicating the subjects with the least training hours by area with 7.16 average hours for seizure, 7.55 average hours for abdominal pain, and 8.02 hours for behavioral health and psychiatric disorders.

Table 2 depicts the comparison of the perceived usefulness of training on a 4-point Likert scale of not useful, somewhat useful, useful, and very useful indicates that behavioral health and psychiatric disorders were among the least perceived useful training areas with a 3.38 mean score, which while not significantly lower than the other training areas, indicates a small difference in perceived usefulness.

Further, regarding the perceived usefulness of behavioral health and psychiatric disorders, Table 3 presents the bivariate analyses comparing the perceived usefulness of training in behavioral health and psychiatric disorders to demographic variables of gender and age.

While the sample was not large enough to achieve statistical significance, Table 3 highlights an important trend: 80% of the 15 respondents who reported that behavioral health and psychiatric training was not useful or only somewhat useful were over the age of 50 years old. This trend suggests a potential generational or experiential difference in perceptions of training benefits which warrant further exploration. Regarding recent changes in the number of training area hours, Figure 3 compares the changes in subject area hours and the perceived subject areas that should be adjusted. Notably, 83 participants (59.3%) reported that behavioral health and psychiatric disorders had increased, and 64 participants (45.7%) said the hours should increase.

	Frequency (n)	Percentages (%)
Paramedic education program accredited by CoAEMSP or CAAHEP		
Yes	140	100.0
Gender		
Male	83	59.3
Female	54	38.6
Prefer not to say	3	2.1
Ethnicity		
White/Caucasian	128	88.9
Asian-Eastern	1	0.7
Hispanic	4	2.7
Native-American	3	2.1
Mixed race	2	1.4
Prefer not to say	6	4.2
States represented by NASEMSO regions		
East	22	15.7
Great Lakes	34	24.3
South	51	36.4
Western Plains	15	10.7
West	18	12.9
Highest education level		
Doctoral degree	11	7.9
Master's degree	68	48.6
4-year degree	59	42.1
2-year degree	1	0.7
Prefer not to say	1	0.7
Field experience as a paramedic		
3-4 years	1	0.7
5-6 years	4	2.9
7-8 years	2	1.4
9-10 years	5	3.6
10-15 years	23	16.4
16+ years	105	75.0
Educators practicing paramedics active with patient care outside of an educator's role		
None	5	3.6
Some	66	47.1
All	60	42.9
Other	9	6.4
Affiliation with paramedic training program		
Consortium	13	9.3
2-year college or technical school	106	75.7
4-year university	7	5.0
Other	14	10.0
Graduates serve in community sizes		
Rural (< 50k)	52	29.6
Urban (50k-100k)	77	43.8
Metro (> 100k)	45	25.6
Other	2	1.1

Table 1. Characteristics of participants.

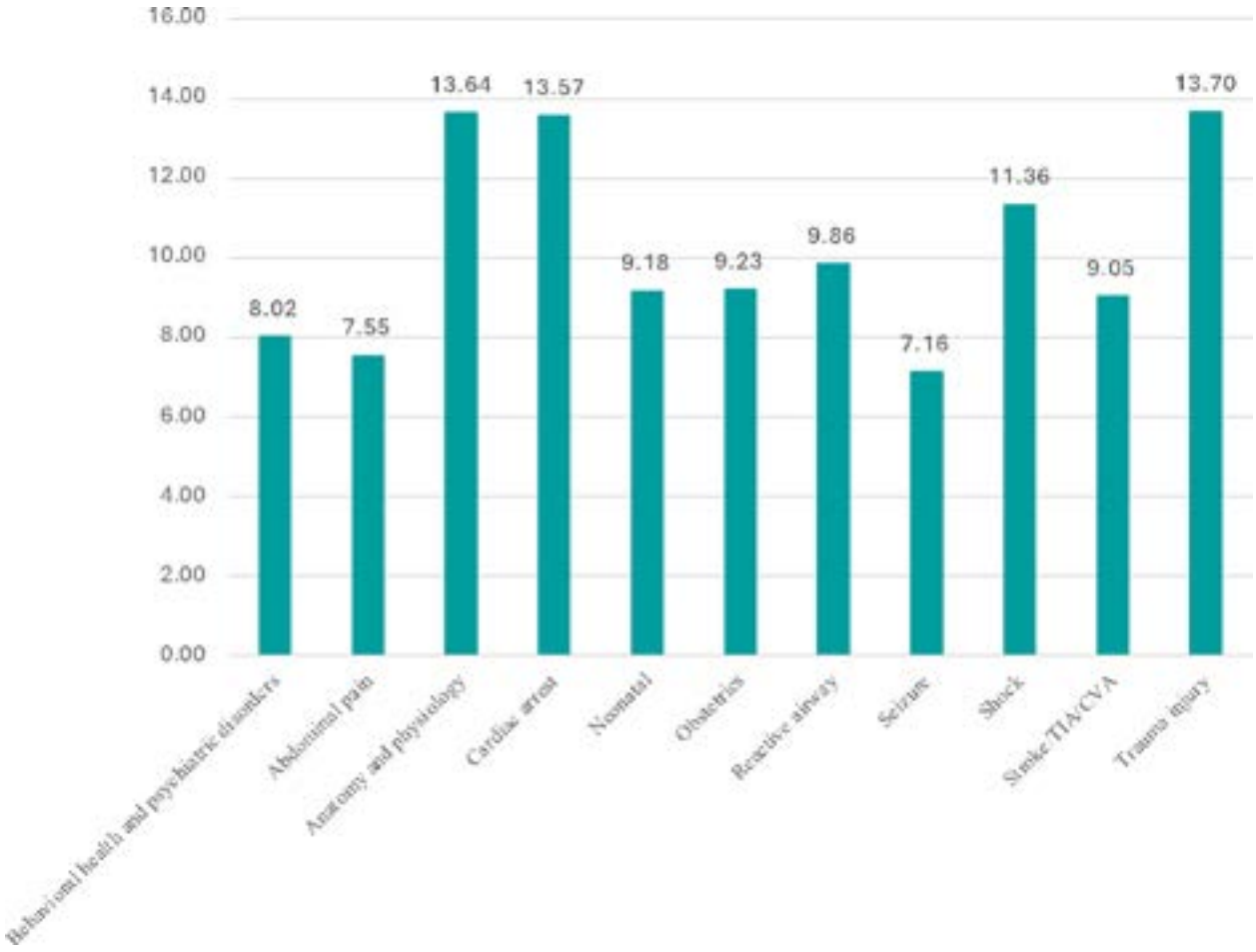

Figure 2. Participants' average number of reported hours spent providing training (N=140).
**Averaged survey responses calculated based on the following recategorizations: No hours spent=0, Less than 1 hour=.5, 1 to 4 hours=2.5, 5 to 9 hours= 7.5, 10 to 14 hours= 12.5, 15 or more hours=15*

Program Training on Mental Health Crisis

The Thematic Analysis (TA) yielded results that indicate a recognition of the need to expand the training on mental health crises and add mental health crisis topics to the curriculum. The subtheme of the high volume of mental health crisis calls emphasizes the

	N=140		
Type of Training	Mean	Std Deviation	Variance
Behavioral health and psychiatric	3.38	0.69	0.48
Abdominal pain	3.41	0.57	0.33
Anatomy and physiology	3.56	0.56	0.32
Cardiac arrest	3.79	0.41	0.17
Neonatal	3.46	0.6	0.36
Obstetrics	3.5	0.57	0.32
Reactive airway	3.66	0.52	0.27
Seizure	3.57	0.52	0.27
Shock	3.71	0.47	0.22
Stroke/TIA/CVA	3.68	0.5	0.25
Trauma injury	3.71	0.46	0.21

Table 2. Sample means and standard deviations for all usefulness scores by training area.

Demographic	Frequency (Percentage)			
	Full sample (N = 140)	Not useful – Somewhat useful (N = 15)	Useful – Very useful (N = 125)	*p*-value
Gender				
Male	83 (59.3)	9 (60.0)	74 (59.2)	1.000
Female	54 (38.6)	6 (40.0)	48 (38.4)	
Prefer not to say	3 (2.1)	0 (0.0)	3 (2.4)	
Age				
20-29	2 (1.4)	0 (0.0)	2 (1.6)	0.308
30-39	15 (10.8)	2 (13.3)	13 (10.4)	
40-49	30 (21.4)	1 (6.7)	29 (23.2)	
50-59	56 (40.0)	5 (33.3)	51 (40.8)	
60-69	31 (22.1)	7 (46.7)	24 (19.2)	
70+	2 (1.4)	0 (0.0)	2 (1.6)	
Prefer not to say	4 (2.9)	0 (0.0)	4 (3.2)	

Table 3. Association between the perceived usefulness of training in behavioral health and psychiatric disorders to demographic variables.

need for additional training. Participants described creating special programs to address mental health crisis calls and incorporating specific topics into the curriculum, including psychopharmacology and medical emergencies. The special programs included a course on conflict resolution and crisis management. Another reason noted for additional training during mental health crises was safety considerations. Specifically, participants reported a need for awareness of mental health crisis calls for their own safety and stat-

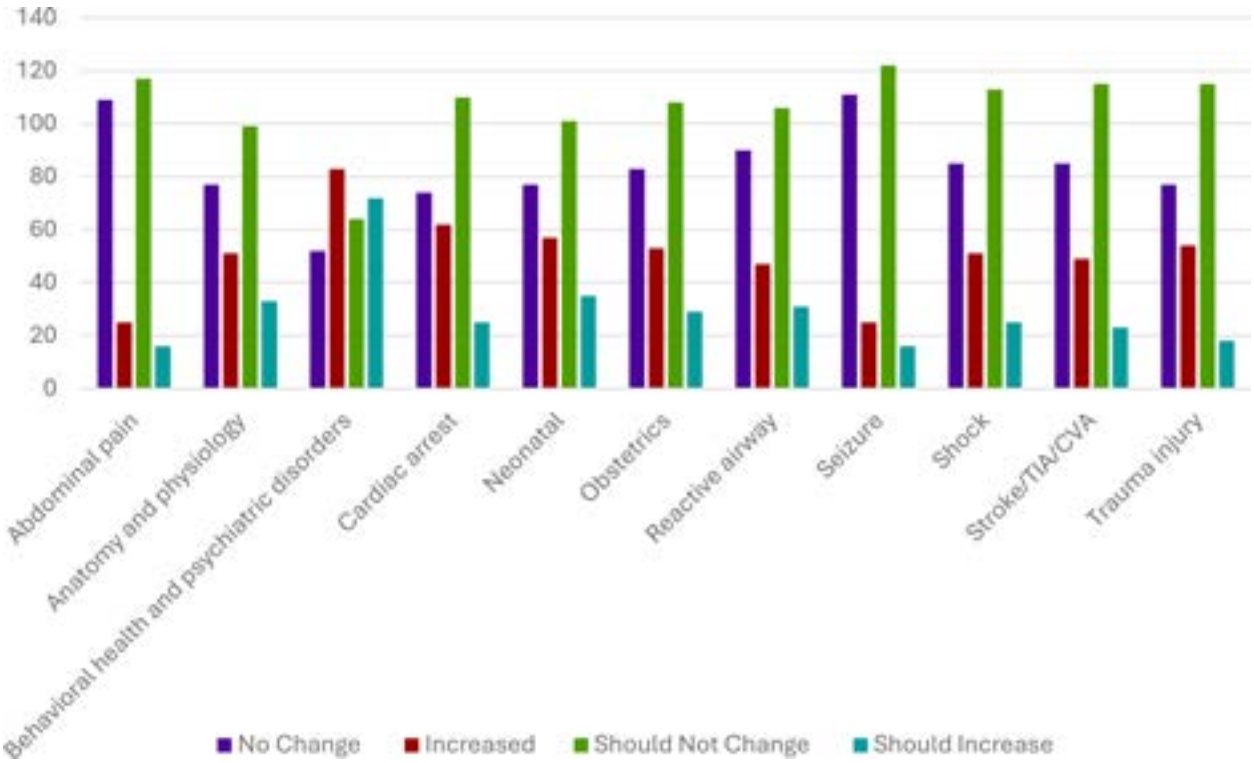

Figure 3. Association between the training hours adjusted and the perceived training hours that should be adjusted in all training areas (N = 140).

ed that de-escalation training might improve paramedic safety. However, participants conveyed that it may be difficult to prepare enough for dangerous situations.

The participants perceived scenario-based learning as the best method to teach topics and, more importantly, real-life experiences with actual patients as the most beneficial activity to increase readiness to address mental health crisis calls; therefore, some programs required students to complete clinical hours observing patients experiencing psychological or behavioral disorders. Additionally, participants elaborated on the training types by enlisting student assignments and presentations on mental health topics to enhance student learning on the subject.

While participants reported a need for additional training on mental health concerns, they also indicated several challenges associated with addressing these concerns, including difficulty getting buy-in regarding the importance of the topic, questions regarding if mental health crisis work should be a duty of paramedics' jobs, and numerous curriculum related concerns. Table 4 shows the complete list of curriculum-related challenges identified in our study. Participants described the need for collaboration across fields to mitigate these challenges and best address mental health crisis calls.

These collaborative efforts included the program faculty receiving training on the topic, soliciting experts to serve as guest lecturers in their courses, and collaborating with others on mental health crisis calls. However, a challenge with collaboration is that subject matter experts well-versed in acute mental health emergency crisis calls may be difficult for each program to identify and consult. Finally, some participants described additional mental health emergency training resources utilized by their programs. Table 5 provides the complete list of mental health crisis training resources obtained in the survey.

Preparation of Graduates for Mental Health Related Calls

Participants classified their graduates' preparation for responding to emergency psychiatric/mental health crisis-related calls as appropriately prepared and not fully prepared. For the programs that indicated their students received adequate training, they stated that their programs covered all mental health topics required to meet the minimum state and local regulations. Other programs acknowledged that while graduates are appropriately prepared, they perceive their program as needing improvement to keep up with the increasing mental health demands on the job. For programs that reported their graduates were not fully prepared for mental health crisis work, they described the challenge of students having limited exposure to actual patients and it being difficult to have accurate scenarios with role-plays and actors like the real experience would provide.

Challenge	Frequency (%) *N*=57
Limited time and more pressing issues to teach	9
Need to focus on life threatening concerns	1
Outdated content of curriculum	15
Difficulty finding opportunities for exposure	26
See patients after they received their medication but not before	1
Certification testing does not emphasize mental health crisis	1
Briefest course despite largest volume of future calls	4

Table 4. Curriculum-related challenges associated with paramedic behavioral health crisis training.

Training Resources	Frequency (%) *N*=61
Compassionomics and Streetsense as well	3
EMH First Aid course	2
Formal CISM	2
Mental Health First Aid for 1st Responders ourse	2
Laws	1
Hotlines	1
Paperwork required	1
Information about local resources and agencies that assist with mental health concerns	49

Table 5. Additional resources for paramedic behavioral health crisis training.

According to participants, preparation for responding to emergency mental health calls included the students needing to possess the appropriate disposition for the profession. Participants reported that student characteristics influence graduates' level of preparation for the field. Therefore, higher standards for admission to the field would serve as a more vigorous gatekeeping practice for the profession and eliminate individuals who do not possess the appropriate professional dispositions. Finally, a student characteristic that was viewed as highly important to be effective in the field and prevent burnout included the individual having strong and healthy coping strategies, self-care, resilience, and a positive perspective. Specifically, the participants discussed instruction on how to manage emotional and mental well-being, refraining from the internalization of mental health interactions, and using actors to simulate verbal abuse scenarios to help students understand the real-life situations they may face.

Most Effective Current Strategies to Train in Mental Health Crisis

The participants reported that they perceived the most effective strategies and/or teaching materials, methods, and content for paramedics to better identify and respond to behavioral health emergency calls as the following: 1) fostering an expectation of compassion, empathy, and patient advocacy, 2) developing their style for working with patients, 3) recognizing the need for collaboration with others to address the topic, 4) using training types that involve educating, applying, and evaluating, and 5) intentionally engaging in thoughtful exposure following actual patients that includes reflection and debriefing.

DISCUSSION

In querying paramedic educators, we recognized a disconnect between their student's behavioral health knowledge and the current realities of paramedicine in the field. The emphasis on life-saving treatment modalities in these educators' curricula is not unexpected; it also reflects the national standards (National Highway Traffic Safety Administration, 2021). Additionally, the NHTSA (2021) standards require addressing the following behavioral health topics (the letters by the areas indicates the level of breath and depth respectively, S for simple, F for foundational and fundamental, and C for comprehensive and complex: "Basic principles of the mental health system (S,S), Patterns of violence, abuse and neglect (C,C), Suicide ideation (C,C), Excited delirium (C,C), Anxiety (C,C), Depression (C,C), Medical fear (F,F), Substance use disorder/ addictive behavior (C,C), PTSD (C,C), Acute psychosis (C,C), Cognitive disorders (F,F), Thought disorders (F,F), Mood disorders (F,F), Neurotic disorders (F,F), Somatoform disorders (F,F), Facti-

tious disorders (F,F), Personality disorders (F,F), Other psychiatric/behavior disorders to be determined locally (S,S)" (p. 43). Further, these standards require that all levels of EMS clinicians have basic mental health knowledge and receive suicide prevention training (NHTSA, 2021). Similarly evident is the relegation of behavioral health emergencies to basic life support treatments and a concomitant minimization of training time.

Regarding substance use emergencies, approximately one-third of patients who accidentally overdosed on opioids utilized EMS services within the year before their death, which illustrates the need for EMS encounters to identify individuals who are at-risk of an opioid overdose (Barefoot et al., 2022). Although EMS providers roles in behavioral health emergencies have traditionally been to provide acute stabilization and transportation of patients to hospitals, Ding and colleagues (2023) recommend EMS are uniquely positioned to provide directed care for individuals experiencing these concerns and should engage in interagency collaborations to augment existing models of behavioral health emergencies and provide person-centered care. Regarding current EMS interventions used to address behavioral health emergencies, Cheetham and colleagues (2024) reported that pediatric patients experiencing a behavioral health emergency who required Emergency Detention (ED) and were transported by EMS or police to a hospital were significantly more likely to receive restraints (pharmacologic, physical, or mechanical) compared to self-transported patients. Emergency detention is a legal action where law enforcement detains an individual for their safety so they can be assessed for medical or mental health treatment.

Though most surveyed paramedic educators recognized behavioral health training deficiencies in their programs, a majority had not significantly altered the balance of time spent on subjects. These participants may have preferred improving the quality of instruction on behavioral health emergencies rather than increasing the number of instructional hours on the subject, which aligned with some of the feedback in the qualitative portion of the survey. The respondents were challenged to extend behavioral health training without sacrificing advanced life support instruction, accreditation standards, or community needs. The three least addressed areas based on time spent were seizures, abdominal pain, and behavioral health. Historically, these patient types have been thought to require minimal prehospital treatment and, therefore limited training. It was not until the mid-1990s that pain management for abdominal pain patients began to gain traction (LoVecchio, 1997), and today, it is sometimes the only treatment administered by paramedics. Also, seizures have typically ceased prior to the EMS provider's arrival at the patient's side, sometimes requiring no intervention (Meritam Larsen et al., 2023). While minimalist care for seizures and abdominal pain is often appropriate, behavioral health emergencies often require a higher level of intervention from EMS providers. Specifically, Ding et al. (2023) recommend collaboration and an interdisciplinary approach across multiple disciplines to deliver specialized care to improve patient outcomes and future management of their behavioral health concerns. Many EMS crews respond to a significant number of calls with primary or secondary impressions of behavioral health-related issues (Boland et al., 2023). Furthermore, behavioral health emergencies are increasing year over year for many EMS services, with a still stronger upward trend seen amongst pediatric patients (Knowlton et al., 2016).

It is acknowledged that while program perception of educational needs provides valuable insights, it represents only one facet of the overall picture. To comprehensively ad-

dress the gaps in paramedic education, particularly concerning training for responding to behavioral health crisis calls, it is crucial to also consider the experiences and feedback of learners themselves.

Incorporating the learner perspective would enrich our understanding by highlighting specific challenges and areas where current training may fall short from those who directly engage with the curriculum. By doing so, we can better tailor educational strategies to meet both the theoretical and practical needs of future paramedics. This holistic approach not only strengthens the educational framework but also enhances the readiness and competence of paramedics in managing behavioral health crises effectively. Future studies may wish to explore learners' perspectives to provide additional insight into the area of preparedness for learners.

RECOMMENDATIONS

We recommend national and local standards and policies that align with paramedic educators' recognition of the need for innovation in behavioral health training. To support these changes, efforts to advocate for expanded behavioral health training should focus on securing lobbying support from national EMS regulatory, planning, certifying, and accrediting bodies such as CoAEMSP, NHTSA, and the National Registry of Emergency Medical Technicians, as well as consider adjusting the future vision of the EMS Agenda 2050 (NEMSIS, 2023). Adjustments such as these would align with the National EMS Education Standards (2021) emphasis on mental health, the Substance Mental Health Services Administrations (SAMSHSA)'s National Guidelines for Behavioral Health Crisis Care (2020) which recommend collaboration among emergency response organizations, the National Association of Emergency Medical Technicians' (2017) priority to focus on EMS practitioners mental and physical health. Therefore, expanded initial paramedic education, continuing education, and the suggested use of Mental Health First Aid as a card course should be nationally supported goals as research supports the efficacy of this program (Forthal et al., 2021). Producing paramedic textbook sections covering behavioral health should include collaborative efforts between educators from EMS and clinical mental health fields.

We are presenting recommendations geared toward aligning training with the needs of behavioral health calls. We would argue that the most valued aspect of restructured training is the provision of tools that keep behavioral health emergencies in the realm of basic life support treatment when appropriate; however, there are instances when ALS assessment and skills are needed to treat behavioral health emergencies such as substance use disorder treatment. For example, improved de-escalation techniques could reduce instances of chemical and physical restraint. It has been recognized that EMS protocols for behavioral health emergencies should focus on the management of agitation (Cheung et al., 2024), supporting de-escalation techniques. Ideally, this would lower risks for the patient cohort and paramedics alike. Additionally, to maintain competence and provide psychological support for advanced practice in ambulance services, mentorship is considered essential (Hodge et al., 2018). A strong mentorship program can guide paramedics through real-world experiences and foster continuous learning, and debriefing after complex situations, ensuring paramedics feel supported and confident in managing behavioral health emergencies. However, unsuccessful mentoring relationships among paramedics have been characterized by a lack of psychosocial support to the

challenging, stressful, and exposure to varying levels of psychological trauma (Furness & Pascal, 2013).

Paramedic programs could also consider collaborating with their community's behavioral health services providers to enhance local training programs and engage in the co-responder model (Police Executive Research Forum, 2023). This model involves a trained behavioral health crisis worker accompanying paramedics on calls. Additionally, programs that have not yet begun to do so may wish to implement a 911 diversion to 988, directing individuals experiencing behavioral health crises away from emergency services and toward an appropriate crisis hotline and local crisis resources. Partnerships could include local mental health authorities, collegiate counseling centers, child advocacy centers, and mental health program professors. If these resources are limited locally, paramedic educators should consider remote options with appropriate partners including SAMSHA which is a federal resource. Affiliation strategies could be used to provide clinical experience opportunities, in-service training like Mental Health First Aid, and a comprehensive picture of community needs. Building these connections could also assist in addressing the educator's admissions of their own needs for more education. Finally, scenario-based training, a cornerstone of paramedic initial and ongoing education (Myers et al., 2021; National Highway Traffic Safety Administration, 2021), is supported by paramedic preceptors, who enhance paramedic student's educational experience through providing work-based learning opportunities during their clinical experiences. These experiences help prepare students to transition into the workforce upon matriculation (MacQueen & Aiken, 2019). However, in the qualitative responses, respondents repeatedly indicated that some behavioral health scenario examples lacked substantive benefit due to the complex nature of depicting behavioral health concerns accurately and preferred trainees receive more real-life scenarios. To allow for these real-life scenarios in a safe environment, training might consist of guest lectures from individuals who have experienced behavioral health concerns. We recommend using the newfound partnerships to develop accurate and impactful scenarios for training, grounded in research to ensure efficacy.

FUTURE RESEARCH

Lastly, implementing improved training should be accompanied by research, as the literature regarding paramedic behavioral health training methods and outcomes is sparse. Prospective and retrospective research assessing paramedic student competency should accompany new training modalities before broader support for implementation. Research of EMS behavioral health patient populations may benefit from greater granularity. In paramedic training for medical emergencies, pediatric patients are recognized as having distinct needs that set them apart from adults. Similarly, when it comes to behavioral health patients, it is essential to acknowledge their unique requirements, which may deviate from those of more typical patients. Substance-induced behavioral health patients contribute significantly to overall volume for paramedic care. Specific research should be applied to this area to validate training practices aimed at reducing the potential for violence and the need for chemical and/or physical restraint. Additionally, research into treatment protocols, such as the administration of Buprenorphine post-overdose for patients with opioid use disorder, presents an opportunity to enhance paramedic care. Future research may wish to explore these interventions. Because this study solely considered identifying existing training, which is currently being provided

to paramedic programs, future research should investigate the effectiveness of behavioral health training interventions to better prepare paramedics for these challenges. Additionally, the escalating number of behavioral health calls impacts numerous stakeholders including educational accrediting bodies, EMS organizations, behavioral health professionals, healthcare systems, public safety and law enforcement, government agencies, and patients and families; thus, future research should explore behavioral health emergency calls from these varied perspectives. As a result of this extensive list of organizations involved in best addressing behavioral health emergency management, future research should examine strategies for effective collaboration among these stakeholders. Specifically, to address the rise in behavioral health emergencies, standardized protocols for dispatch inquiries and strategies for identifying and strengthening networks with regional mental healthcare providers should be investigated. Finally, research should study any problems unique to various cultural backgrounds to ensure best practices across cultural contexts.

LIMITATIONS

While this study offers implications for paramedic preparation education programs, there are limitations to these findings. A limitation of the study is the relatively low response rate (22.3%), with a sample size of 140, which limited statistical power (66.63%). As a result, findings from this study should be interpreted cautiously and considered suggestive rather than conclusive. Additionally, this study only surveys paramedic education programs therefore it may not be applicable to other EMS clinicians. The bivariate analyses can be more prone to oversimplified relationships and may fail to consider confounding variables. Chi-square and Fisher's exact test cannot provide information regarding the strength and direction of relationships. While the Bonferroni adjustment diminishes the probability of a Type 1 error, it does not eliminate the risk of this error and increases the likelihood of a Type II error or false negative. Another limitation of this study was the lack of operational definitions for key terms, such as "actively involved." This left room for variability in respondents' interpretations, potentially affecting the uniformity of responses. Without clear definitions, participants may have applied personal biases or context-specific experiences, which could lead to inconsistencies in how data was reported and interpreted. An additional limitation of this study is the reliance on self-reported data for training hours, which introduces variability and potential inaccuracies. We did not explicitly verify whether the reported hours meet the minimum training standards or if they encompass clinical rotation hours. Consequently, the reported figures may not fully represent the comprehensive training received. Future research should aim to collect more precise and standardized data to enhance the reliability and accuracy of training hour reports. Regarding the qualitative findings, a limitation includes having a singular data source for the survey and being unable to ask follow-up questions or make any observations regarding the responses.

CONCLUSIONS

Behavioral health calls are increasing for EMS crews across the country. This increase highlights the need to improve the training modalities for EMS crews in behavioral health issues. Enhanced training comes with significant barriers, particularly time allotment, limited resources, and cost of resources, educators' knowledge and preparation, and the value placed on such training. The present research depicts the program direc-

tors' perceptions regarding the need to increase training, while sharing strategies participants utilized to address the barriers such an increase would create.

Despite these limitations, the study indicates a need for improved and expanded behavioral health training for EMS providers. The recommendations presented in this study, both national and local, provide a roadmap for addressing the barriers to such training and improving outcomes for patients with behavioral health emergencies. Further, this study did not evaluate training implementation or its effectiveness but rather focused on identifying existing training currently provided to paramedic programs; therefore, continued research in this area is also crucial to validate training practices and improve patient and EMS worker outcomes. Overall, this study underscores the importance of addressing the growing need for behavioral health training in paramedic education programs to provide better patient care and improve the well-being of EMS providers.

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RESEARCH REPORTS

EXPLORING THE EXPERIENCES OF AUSTRALIAN GRADUATE PARAMEDICS: TRANSITIONING BEYOND GOVERNMENT AMBULANCE SERVICES

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ABSTRACT

Introduction: Large student paramedic enrolment numbers in Australasian university paramedicine programs have fuelled perceptions about a supply/demand mismatch in relation to graduate employment. Jurisdictional or state-based ambulance services continue to be the preferred employer for paramedic graduates. Since professional registration commenced with AHPRA in 2018, graduates are seeking alternative options in the burgeoning private sector to maintain recency of practice while also pursuing jurisdictional employment. This study investigates the experiences of graduates who secured employment in the private sector.

Methods: The study gained low-risk ethics approval through the Queensland University of Technology human research ethics committee, and research approval was sought through the Australasian College of Paramedicine. Participants (N=5) undertook semi-structured interviews, which were recorded and transcribed for data analysis purposes. Data was analysed using Braun and Clarke's six phases of thematic analysis.

Results: The analysed findings indicate participants working as new graduates in the private sector perceived a lack of exposure to meaningful clinical cases, a lack of mentoring, and felt unprepared by universities for private sector work. However, there were perceived benefits to working in the private sector such as building situational awareness and gaining experience at mass gathering events.

Conclusion: This study adds to the growing body of knowledge about transition to practice. Existing Australian studies have mainly focused on the transition to working for jurisdictional ambulance services, and not the private sector. Therefore, the results of this research are of significance to university paramedic programs, the private sector and ambulance services employing graduates who have non-jurisdictional clinical experience.

Author Interview:
https://youtu.be/1AwoGRqNoI8

INTRODUCTION

Of the 24,637 Australian practicing registered paramedics in Australia in 2024, just over 70% work for jurisdictional state or territory government and contracted ambulance services. Other work settings included private paramedic roles providing care at sporting events, mining/industrial/offshore roles, hospital,

the defence force or as academics in the tertiary sector. While some paramedics worked for both state and territory ambulance services, as well as private paramedic companies, over 76% received their entire salary from their primary employer. Paramedics in both government and private roles earned on average AU$90,000 well above the national average of AU$65,000 for Australia (Thyer et al., 2024).

Private or non-jurisdictional ambulance service employment options for paramedic graduates in Australia have continued to grow over the past decade (Johnston & Acker, 2022). Traditionally, graduates secured employment with government-funded jurisdictional ambulance services, serving as the primary emergency healthcare responders within the community. However, professional registration through the Australian Health Practitioner Registration Agency (AHPRA), has facilitated the expansion of private paramedic employment opportunities. Graduates now have choices including jurisdictional ambulance services, private sector employment, and international opportunities in the UK, Canada and the U.S. (Ivec et al., 2021). While university graduates transitioning to jurisdictional ambulance services have been researched (Betson et al., 2022; Bigham et al., 2013; Devenish et al., 2015; O'Brien et al., 2014; Reid et al., 2019), as well as the intent of graduates to work for overseas ambulance services (Devenish et al., 2020) there is a dearth of literature on the experiences of graduates working in the Australian private paramedic sector. Therefore, the aim of this study is to explore the experiences of graduates who transitioned to private sector employment in Australia as paramedics after finishing their university course. It seeks to provide universities with a better understanding of how to prepare university paramedic students for practice in the private sector, as well as highlighting areas for professional development for paramedics working for private companies. This qualitative study also provides insight to jurisdictional ambulance services that may employ paramedics who start in the private sector after graduating and then obtain work with an Australian state-based jurisdictional ambulance services.

BACKGROUND

Compared to similar health disciplines such as nursing, research about paramedic transition to practice is limited. A small amount of research exists examining the transition of university students to becoming practicing paramedics working for government funded jurisdictional ambulance services in Australia and the United Kingdom NHS Ambulance Trusts (Devenish et al., 2016; Devenish et al., 2015). The work role transition of emergency paramedics to other roles such as community paramedicine (Long, 2017), clinical management (Stewart et al., 2021) and academia has also been examined (Munro et al., 2016; Munro et al., 2019; Stewart, 2022). What is missing from the literature is the experiences of paramedic graduates transitioning to working outside the traditional jurisdictional service and in the private sector. Unlike other countries such as the USA, where privately owned emergency medical service (EMS) providers is common, in Australia, state jurisdictional ambulance services have monopolistically overseen the provision of emergency out-of-hospital care. Whereas graduates working in the paramedicine private sector primarily focus on delivering medium to low-acuity primary care at sporting events, festivals, and other community gatherings, ensuring timely medical support with a limited scope of practice. Furthermore, in Australia, many private sector employers preferring to recruit paramedics with frontline experience with jurisdictional ambulance services for roles involving great clinical acuity and decision making, especially in austere environments. Therefore, new graduates often employed directly into the private

sector with little experience after finishing their university qualification are designated roles involving lower clinical risk, such as paramedicine at sporting events, in clinics and patient transport roles (Smith, 2024).

METHODS

This study explored the experiences of paramedic graduates (N=5) who had transitioned directly to working in the private sector gender and concise age data were not collected, however, all participants were between 21 and 35 years.

The study used semi-structured interviews and Braun and Clarke's six phases of reflexive thematic analysis to collect and analyse the data (Braun & Clarke, 2022). Ethics approval was applied for and sought through the Queensland University of Technology human research ethics committee (approval number 1800001034). Research approval was gained from the Australasian College of Paramedicine. Semi-structured interviews were conducted face-to-face in a mutual location during the participants' own time. A signed consent form was required before participating in the research study. Data were analysed using six stages outlined in Figure 1. File notes and memos were developed from participant interviews, which also informed the constant comparison data analysis process.

RESULTS

Three main themes were found in the analysed data (see Figure 2). These were perceived deficit of clinical exposure, reality/perception discordance, and benefits to practicing in the Australian private paramedic sector.

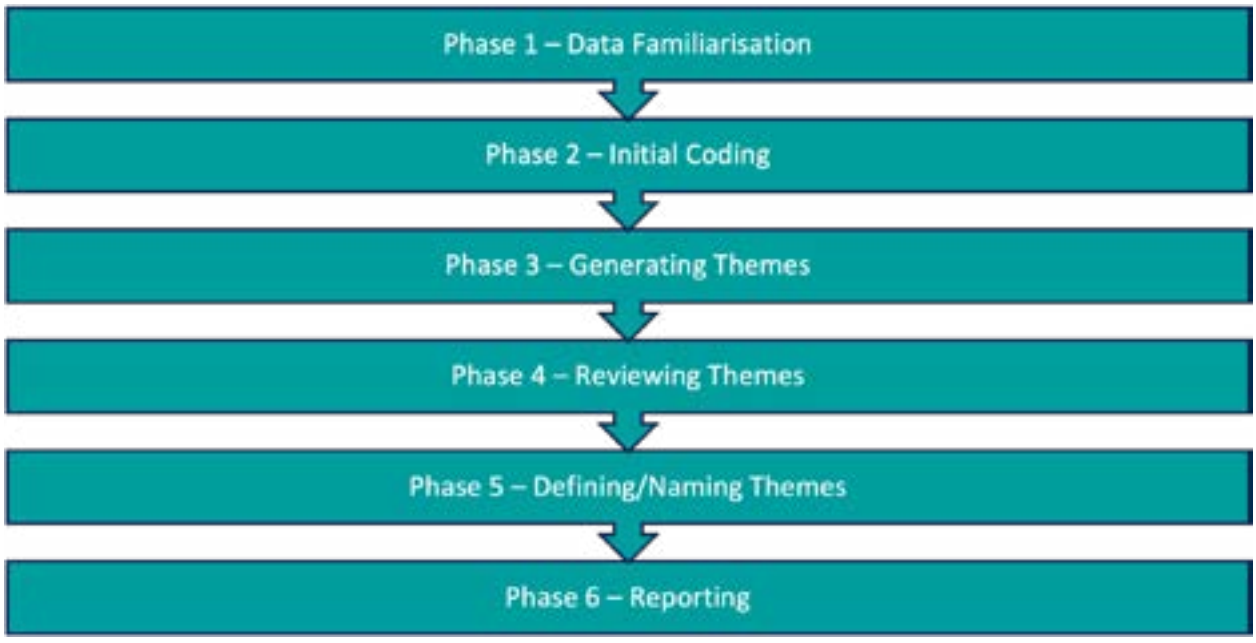

Figure 1. Braun and Clarke's Six Phases on Thematic Analysis (Braun & Clarke, 2022).

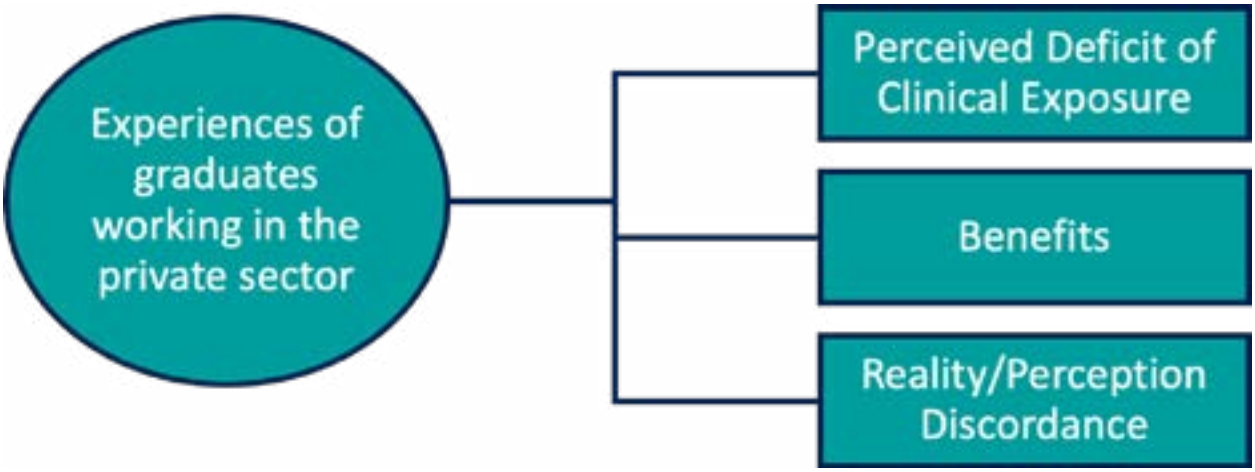

Figure 2. Main themes from the data analysis.

Perceived Deficit of Clinical Exposure

The first category explored the graduates' perception of inadequate clinical exposure whilst employed in the private sector. The caseload was perceived to be of a lower volume and severity when compared to an Australian jurisdictional ambulance service, and often viewed as merely first aid procedures:

> *"There's not a lot of actual cases or anything. Like, you'll go to an event, say like a concert, and you'll get five people coming up asking for a band-aid because they've got a blister."*

Participants described a lack of exposure to a diverse range of specific patient groups negatively impacted their ability to consolidate knowledge into practice. It was not only the acuity of the caseload but also the frequency of patient encounters that contributed to perceptions of insufficient clinical experience.

> *"[We're] not getting the exposure to specific patient groups or specific case types over time and as a consequence, the development of understanding and skills is challenged by a lack of exposure and the environment [in which we work]"*

Another factor impacting on the frequency of case load was the COVID-19 pandemic. Participants working for companies supporting mass gathering events, spoke of shifts being cancelled due to health restrictions, such as at sporting and concert events.

Preceptorship was highlighted as an area of concern. During university clinical placements, students assessed patients and implement clinical management under direct clinical supervision of an experienced paramedic. However, after graduating, they reported a lack of clinical confidence exacerbated by having to work without direct supervision in the private sector, and little clinical experience to fall back on.

> *"I don't feel confident you know, practicing on my own, with no one else there to help."*

Furthermore, participants did not feel prepared for private paramedic practice as their university programs focused more on jurisdictional ambulance service clinical practice guidelines rather than health screening or working in clinics.

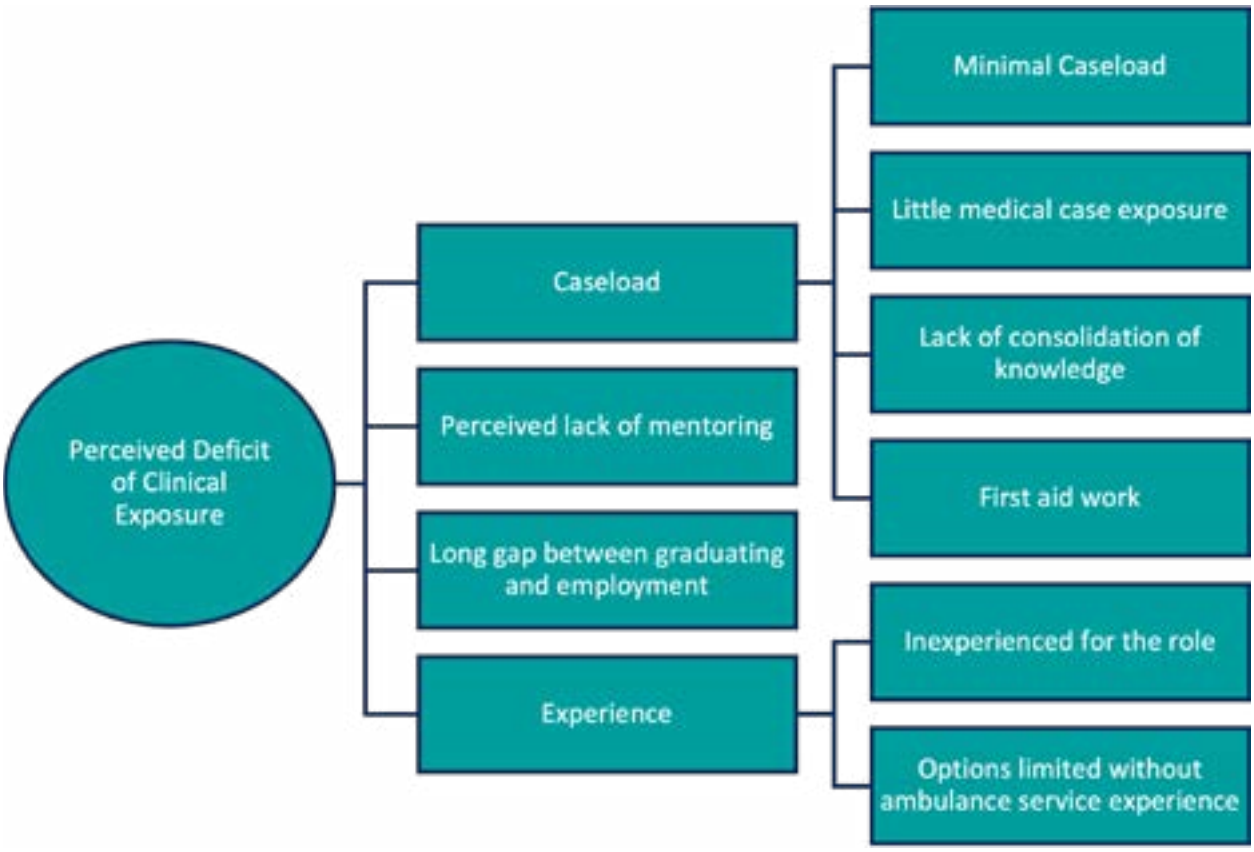

Figure 3. Summarised findings - perceived lack of exposure to diverse clinical work category.

A key reason cited by respondents for pursing jobs in the private sector was a fear of skill degradation due to a potentially long duration between graduating and securing employment with a jurisdictional state ambulance service. The university-employment gap may have been exacerbated by a supply and demand mismatch between graduate numbers and available jobs. Some private sector employers which do offer more diverse or acute clinical work required several years of paramedic experience as an essential criterion, limiting development options for new graduate paramedics. The findings from the perceived deficit of clinical exposure theme are summarised in Figure 3.

Reality/Perception Discordance

The second category highlighted a gap between graduate perceptions versus reality regarding working in the private sector. Despite being employed as a registered paramedic, participants didn't necessarily feel it counted as paramedic work. For example, the following participant was using private employment as a stopgap between graduating and obtaining a job with a jurisdictional state ambulance service:

> *"[You're] not putting into practice anything you've learned … I'm trying to get myself ready and … do something between graduating and becoming a paramedic and I feel like it's not quite enough sometimes."*

Of interest is the view that a 'real' paramedic works for an ambulance service, and not in the private sector. Furthermore, a focus on jurisdictional state ambulance service practice

and neglecting the private sector was identified as a gap in the university curriculum and associated clinical placements.

> *"Paramedic graduates working in private industries, like the mining sector, or other areas need different tweaks to their education that universities don't currently provide. The university system prepares paramedic graduates for ambulance services. Universities need to produce people who have the ability to think and act within a range of environments rather than building robots for ambulance services."*

Participants spoke of the value of including more non-traditional paramedic practice case scenarios and information about transitioning to practice in the private sector. More clinical placements options in the private sector could also be beneficial. The observation that universities produce 'robots' rather than critical thinkers is also concerning.

Although paramedics in the private sector practice across many different practice environments this work was reported by participants to be sporadic and patchy, lacking diversity of experience due to minimal caseload. A lack of exposure to patient groups and high acuity work was possibly because that did not have the experience of working for a state ambulance service prior to working in the private sector (Smith, 2024). Participants perceived further work is required by ambulance services when employing paramedics who have worked in the private sector to address possible gaps. The findings from the reality/perception discordance theme are summarised in Figure 4.

Benefits to Private Sector Work

While participants spoke about feeling unprepared for working in the private sector, several benefits were highlighted. An improvement of 'adulting' work skills and respon-

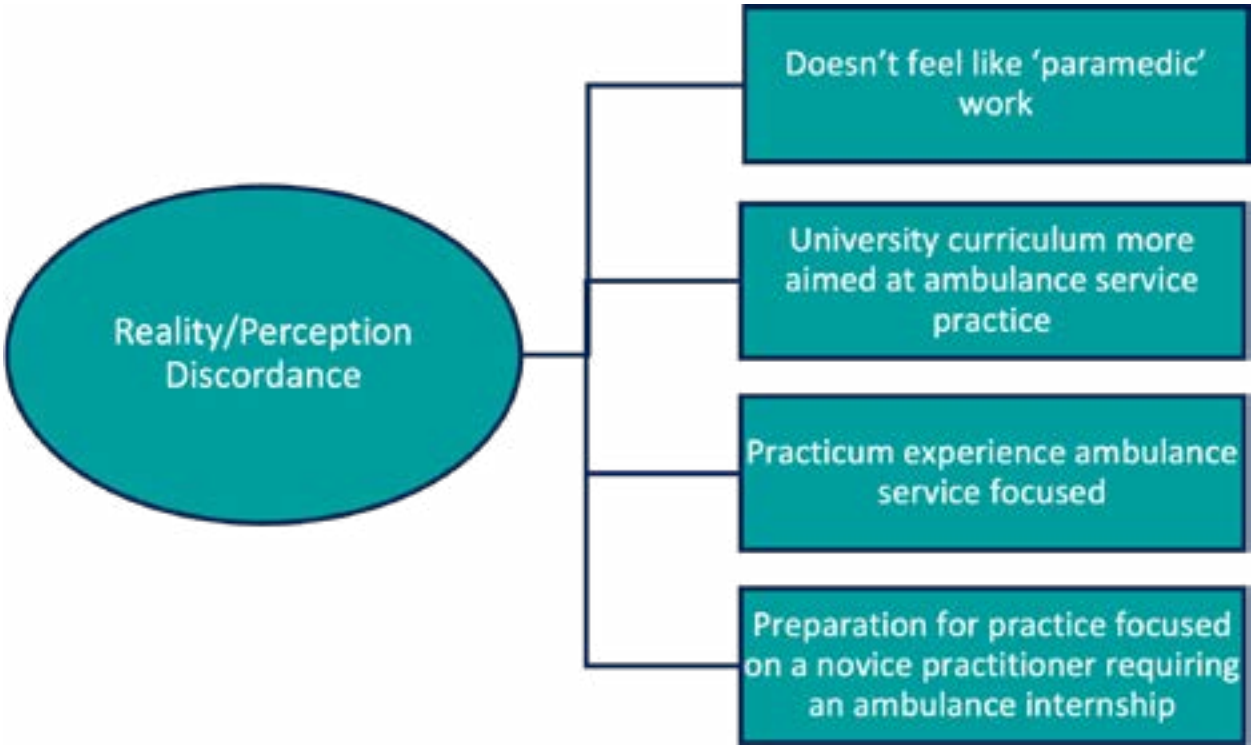

Figure 4. Summarised findings - reality/perception discordance category.

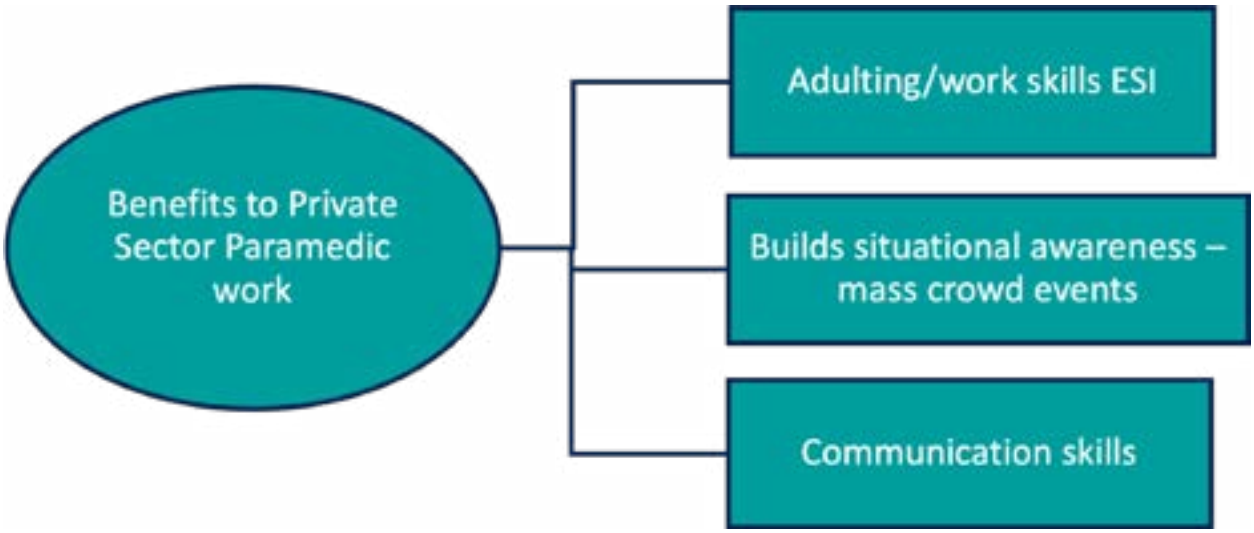

Figure 5. Summarised findings - benefits to working in the private sector category.

sibility associated with emotional and social intelligence were reported. Furthermore, participants viewed communication skills development was another benefit to working in the paramedic private sector. Of particular note, working in the private sector possibly provided new graduates with greater development of situational awareness at mass crowd events than a traditional jurisdictional state ambulance service:

> *"It's all about situational awareness … to always to be aware of … what you're doing … cautious of what someone else is going to do. You never know what the behaviour is like … being in a situation and understanding that you know it's okay right now, but it can change. It's like you need to be able to … read people a little bit".*

The findings from the benefits to working in the private sector theme are summarised in Figure 5.

DISCUSSION

The study explored the experiences of new graduate paramedics who transitioned to work in the private sector. All participants in this study described pursuing private sector work as a stop-gap measure while waiting to secure or start employment with a jurisdictional state-based ambulance service. This result confirms similar findings in the literature which highlight ambulance services are the preferred employer for Australian paramedic graduates (Devenish et al., 2020). The reasons for this preference require further research but the literature highlights financial renumeration, stability, status, and reduced scope of practice appear to be major drivers (Australian Federal Government, 2021; Devenish et al., 2020). The findings also highlight a disparity between high student numbers and available jurisdictional ambulance service vacancies was a driver for choosing private sector work as a mechanism to maintain recency of practice for registration until a state ambulance service job could be secured (Devenish et al., 2020). The oversupply of graduates for Australian ambulance service roles highlights challenges in policies and practices about controlling student enrolment numbers and a possible disconnect between paramedic tertiary programs and university decision makers. Of note, paramedic programs appear to be bucking the downward trend in sector-wide enrolment patterns,

evidence of the popularity of bachelor of paramedicine programs and the profession in general (Universities Australia, 2022).

While other options are becoming available to maintain recency of practice and gain experience and a wide variety of caseloads, such as international paramedic employment, not all graduates can move to a different continent to obtain employment, especially for those who have secured a job offer in Australia but need to fill in several months while waiting for their start date. Literature has examined the intention of Australian paramedic graduates to work in the United Kingdom (Devenish et al., 2020), whether these reasons extend to graduates pursuing paramedic employment in other countries such as the United States and Canada remains unclear and warrants further investigation.

Another important finding was university curricula possibly did not prepare graduates for working in the private sector. Instead, universities appeared to better prepare graduates to work for jurisdictional state-based ambulance services. External accreditation is moving programs to prepare graduates for non-traditional paramedic roles, accompanied by changes in government legislation around more autonomous practice for advanced practice paramedics and a national scope of practice review (Australian Government: Department of Health and Aged Care, 2024; Weber et al., 2024a, 2024b)

Many universities appear to favour placement with state-based ambulance services. Accreditation standards expect programs to provide clinical placements in a wide range of environments. Exploring alternative work integrated learning environments and working in multi-disciplinary teams may better prepare graduates for the transition to private sector work (Devenish et al., 2019; Johnston & Bilton, 2020). With many current ambulance placement providers reaching capacity due to large enrolment numbers, and ambulance clinical placement fees being introduced, non-traditional placement opportunities are being explored by programs, further rounding of graduate experiences.

Most government or contracted state or territory ambulance services have a structured internship process, where new graduates are expected to be novice practitioners and a supported into clinical practice (Reid et al., 2019). The Australian preemployment model of paramedic education provides exposure to real-world environments with opportunities to explore practice under direct supervision, this is not structured as an internship. There is little to no consistency in internship programs across the country. Furthermore, there is no consistent preceptorship programs offered by private paramedic employers, which is an area key advocacy bodies such as the Australasian College of Paramedicine could look to address. Additional research is needed to explore paramedic preceptorship models in the private sector.

The suggestion universities may not produce graduates with critical thinking ability is concerning. Critical thinking is one of the professional capabilities for registered paramedics (Paramedicine Board of Australia, 2021) and a commonly stated university graduate attribute although the ability to teach this is debated (Huber & Kuncel, 2016; Prikshat et al., 2019).

The perception that private sector employment was not 'real' paramedic work may have been due to an emphasis on high acuity work at university through a hidden curriculum (Johnston & Bilton, 2020; Weber et al., 2021) and limited exposure to the reality of practice or a wide variety of clinical settings on work integrated learning placements (Devenish

et al., 2016; Wongtongkam & Brewster, 2017). It may also have resulted from an unrealistic view of the paramedic role developed through anticipatory socialisation from television shows, the media and observing ambulances at road traffic collisions (Devenish, 2014; Devenish et al., 2016; Weber et al., 2021). A reason for the perceived disadvantages to working in the private sector may be a result of participants' expectations that jurisdictional ambulance work was more desirable and working for a private company was less attractive financially. These findings concur with other research (Gosling et al., 2022; Ross et al., 2018) suggesting universities need to pursue greater collaboration with the private sector and pursue alterative work integrated learning activities to better prepare graduates for the transition to the wider Paramedicine profession and not focus solely on jurisdictional ambulance service practice.

The view that a lack of adequate caseload leads to knowledge and skill degradation is not new. The perception of knowledge and skill degradation reported in the private sector due to case-mix is not too different to the experiences of new graduates working for jurisdictional state-based ambulance services, where the type of work undertaken on a routine basis is not necessarily high acuity (Hill et al., 2024; Hobbs et al., 2015; Hobbs et al., 2021). While there were perceived disadvantages to working in the private sector compared with expectations around working for jurisdictional state-based ambulance services, there were reported benefits. Unique findings from this study associate the development of situation awareness skills at mass crowd events with private sector work. The finding that participants developed 'adulting' skills, social and emotional intelligence and communication skills are not unique to private sector and are important transferable skills for entering the workforce. These critical skills may not be adequately developed in all paramedic graduates so additional opportunities are beneficial (Mangan et al., 2022; Sellakumar, 2017).

SIGNIFICANCE AND LIMITATIONS

The findings of this research are of significance to universities, the private sector, professional associations providing ongoing development training, and jurisdictional ambulance services. It provides advice to universities about developing curricula to prepare graduates to work in the private sector. Professional associations represent and advocate on behalf of the Paramedicine profession. Professional associations have a role to play in advocating for structured internship and mentoring programs in the private sector in addition to providing a framework around recording and tracking mandatory professional development required for registration. The findings of this research indicate many graduates pursue work in the private sector as a stopgap measure while waiting to obtain employment with a jurisdictional state ambulance service. Thus, ambulance services may need to adjust internship programs for paramedics who have undertaken private sector work prior to pursing a qualified paramedic entrance pathway to employment. Private sector employment may not provide the caseload and experience with patient groups to the same extent as state-based ambulance service work.

A limitation of this study is that it only represents the experiences of graduates entering the private sector directly after finishing their university course. Private paramedic employers may prefer paramedics with jurisdictional ambulance service experience, and as such have a greater capacity to work unsupervised, with higher acuity cases in an environment with greater clinical risk. The use of qualitative research methods may be

seen as a limitation. The study does not profess to represent the experiences of the profession or the private sector as a whole. It explores in depth the experiences of the participants only and is not generalisable to the wider private sector. Participant numbers (N = 5) may be viewed as a limitation. Participant numbers in this study are comparable to similar qualitative studies. Qualitative research may be viewed by some to be subjective. Study rigor was maintained by using well know qualitative methods to guide the data collection and analysis. Findings were also valid and transferable according to the extant literature.

SUMMARY

The experiences of Australian paramedic graduates who transitioned to working in the private sector after finishing university were explored in this study. The study's findings highlight graduates pursed work in the private sector while waiting to obtain employment with jurisdictional ambulance services. Graduates did not necessarily feel prepared by universities to work in the private sector. Furthermore, the limited acuity, frequency, and diversity of the caseload were viewed as challenges. There was also a perceived lack of preceptorship or a structured internship programs compared to jurisdictional state ambulance services. Reported benefits of private sector work included communication skills, the development of emotional and social intelligence and situational awareness at mass crowd events. The study highlighted views that private sector work was not perceived to be real paramedic work. Further work needs to be done by universities and professional bodies to represent the private sector as an alternative career pathway to state-based ambulance services, to address the perception versus reality mismatch reported in this study, which the literature show is not limited to private sector work.

CONTRIBUTION

LS designed the study, obtained ethical approval, and collected the data. LS, SS, and SD analysed the data, revising it critically for important intellectual content, analysis, and interpretation, and wrote the article.

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RESEARCH REPORTS

IS RURALITY ASSOCIATED WITH HIGHER PROBABILITY OF CONVEYANCE TO HOSPITAL FOLLOWING DIABETES-RELATED AMBULANCE CALLOUTS? A RETROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Objectives: Understanding the factors that influence avoidable and unavoidable hospital conveyance, including rurality and distance from hospital, is important and will help to inform guidelines and develop policy for emergency services including paramedic and ambulance staff. This national study compared the impact of degree of rurality, and other factors on conveyance rates across rural and urban areas for diabetes-related metabolic problems.

Methods: Using a national retrospective five-year dataset from a national ambulance service, we conducted a univariate, bivariate, and multivariable analysis of factors influencing conveyance to hospital for people with diabetes-related metabolic complications. The analysis focused on rurality using a standardized classification, initial blood glucose level, type and complexity of treatment at the scene, day of the week or time of day, paramedic attendance, time spent at the scene, and the distance to the nearest hospital as potentially significant factors.

Results: Conveyance rates were highest for those experiencing hyperglycemia (82%), for those under 20 (69%) or over 80 years of age (64%), and for females (58%). Rates were lower for longer time spent at the scene, up to 40mins (p<0.001) and the longer the distance to hospital from the scene, up to 150km (p<0.001). Probability of conveyance was more likely with increasing age (p<0.001), with glucose levels in the normal or higher range (> 4mmol/L p<0.001 and > 11mmol/L, p<0.05), and less likely for males (p<0.05) and if there was a paramedic in attendance (p<0.001). There was no association of degree of rurality with probability of conveyance (p=0.6).

Conclusions: Assessment of database metrics suggests that rurality does not appear to be associated with increased probability of higher conveyance rates. The presence of a paramedic is associated with lower probability of conveyance. Conveyance to hospital following ambulance callouts for diabetes metabolic complications is related to predictable factors.

INTRODUCTION

There are various indications from the literature that rural communities present a number of challenges for pre-hospital care

(Alanazy et al., 2019). In addition, there may be a higher instance of general acute health care needs arising in remote and rural contexts, (World Health Report, 2006). This means that achieving reductions in inappropriate hospitalization in rural communities presents issues and dilemmas that are relevant for health care systems all over the world (van de Mortel et al., 2017; Abel et al., 2018).

Although rurality means reduced accessibility to various healthcare and social services, high levels of community engagement and support can compensate for this in ways that are not yet fully understood. Thus, sensitivity to the types of rurality is vital, and taxonomies like the Scottish Urban Rural Classifications (URC) can be helpful in this regard (Urban rural classification, 2022). At present, whether rurality (if taken as a unified concept) is a significant factor impacting conveyance and hospitalization rates is unclear, although there is evidence indicating that avoidable admission rates are higher in rural settings (Chen et al., 2017; Ridge et al., 2021).

Reducing inappropriate hospitalization for people with diabetes is a policy priority internationally (Seringa et al., 2019), particularly for older adults with diabetes (Fismen et al., 2021). In remote settings, high quality diabetes care is very much dependent on accessibility, connectivity, and community engagement (Longman et al., 2013). However, various barriers to adequate diabetes care in rural communities have been demonstrated (Simmons et al., 2007). Research has found a lower uptake of diabetes self-management education in rural communities (Luo et al., 2022) and higher mortality rates in comparison to more urban areas (Callaghan et al., 2020). A lack of access to integrated care and knowledge of the individual requiring treatment could cause problems in pre-hospital care of patients with diabetes-related metabolic complications (Watson et al., 2021). In addition, the increased risk of leaving someone at home when they have little or no support network in the immediate vicinity, and where they are far from a hospital should an emergency arise, may result in an increased concern on the part of first responders and thus impact on the probability of conveyance (Allan & Sampson, 2013).

In people with type 1 diabetes < 50 years, around 22% of deaths are due to metabolic complications such as diabetic ketoacidosis or coma with around 79% of these deaths occurring out of hospital (O'Reilly et al., 2020). The factors influencing the ability of paramedics and ambulance technicians to treat diabetes-related metabolic complications such as hypoglycemia, hyperglycemia, or ketoacidosis effectively at the scene in rural settings has not been fully investigated but concerns have been raised about the lack of access to blood ketone meters by paramedics (van Woerden et al., 2021).

A study comparing rural and urban ambulance practices for people suffering trauma in the west of Scotland found that prehospital times were significantly longer for rural patients, included more air ambulance transfers, and are characterized by greater paramedic presence (McGuffie et al., 2005). Distinguishing these various push-and-pull factors is vital for a more informed policy response to the complexity of delivering high quality care in rural settings.

We have hypothesized that conveyance, a factor in hospitalization, is more likely in rural versus urban areas because the patient's condition may be more serious due to delay in response times and inaccessible services and also greater risks of leaving patients in isolated locations. We sought to investigate the factors influencing conveyance to hos-

pital by looking at national ambulance service data covering five, pre-pandemic years between 2013 and 2017. We analysed the relationship between conveyance rates, demographic data, initial blood glucose levels and relevant treatment, time at scene, distance from hospital and the degree of rurality based on the Scottish government URC (Urban rural classification, 2020).

METHODS

A national anonymised retrospective dataset from the TerraPACE electronic patient report system was provided by the Scottish ambulance service which collate information taken at eh time of the call in ambulance control centres. This was a subset of data that formed part of a larger project on unscheduled hospital admissions for diabetes. Data were extracted from the electronic patient report form (ePRF). The sample was based on incidents related to emergency callouts, NHS24 (Out of hours service) or community medical staff and in which the ambulance crew used the final code group 'diabetic'. These incidents covered a range of different medical emergencies, but the majority related to cases of hyper or hypoglycemia. Data were supplied for 5 years from 1 January 2013 until 31 December 2017 and covered remote rural areas to densely populated urban centres, country wide. Prior to data cleansing, there were 40,458 observations within the incident data set. From these, 3,525 observations were removed from the dataset - for example we identified 1,634 pairs of observations which had identical incident numbers but different time of arrival and where the first was not conveyed but the latter was. In these cases, we removed the 1,634 earlier observations and retained the later observations. These were labelled as repeat callers 'within 24 hours' which is shorthand for "conveyed not immediately but within 24 hours. A further 948 duplicates and triplicates were manually scrutinised to determine whether they were 'true' duplicates (i.e., all data points were identical) or whether they should be treated as repeat callouts within 24 hours.

Caldicott Guardian approval, which allows for the transfer of data between the national health service and other organizations, and relevant data sharing agreements were granted for this study.

During 2017, the ambulance service moved to a new clinical reporting system but most of the data collected were common across both systems. Blood glucose readings were gathered using the first measurement recorded by the ambulance paramedics and technicians. The range of treatments for hypoglycemia included glucose-rich food, glucose gels, parenteral glucagon, or intravenous glucose. These were coded in relation to the severity of symptoms being treated. Categories 0 to 3 dealt with treatments for hypoglycemia. No treatment was categorized as 0, food was category 1, Oral glucose (e.g., dextrose gel) was category 2 and intramuscular (IM) or intravenous (IV) Glucagon and Glucagen and IV glucose treatments were category 3. Categories 1 and 2 are 'simple' hypoglycemia treatments, and category 3 were considered 'complex' hypoglycemia treatments. Fewer treatment options are available in cases of hyperglycemia, and these are more complex to apply but include intake of fluids or intravenous 0.9% sodium chloride to treat dehydration as well as the provision of oxygen according to Joint Royal Colleges Ambulance Liaison Committee 2019 guidance (Brown et al., 2019). Neither intravenous fluids nor oxygen therapy were included as a category of hyperglycemic treatment as it is ambiguous as to whether they were being used for hyperglycemia or for some other reason. Therefore, in this category, only the relationship between glucose levels and conveyance was

examined and analysis was only conducted on treatment for hypoglycemia. In many cases there were multiple hypoglycemic treatments associated with a particular incident. Where we found multiple treatments for a particular hypoglycemia incident number, we selected the maximum treatment of those given, based on the above scale from 0 to 3.

The category of a conveyance associated with an incident which we labelled 'Conveyed within 24 hours' was identified by looking at duplicate incident numbers where all other data fields were the same, but the "resource arrived at scene time" diverged. In these cases, we assumed that the ambulance when first called out treated the patient at the scene and left but were subsequently called out a second time. Where the individual was then conveyed on the second call out, and that second call out was within 24 hours of the original arrival time, we categorized them as conveyed within 24 hours. The numbers of "within 24 hours" data were low, and we included the "within 24 hours" as "conveyed" and removed the duplicates from the analysis.

We examined primary diagnosis, what treatment was provided, when, where, by whom and whether the person was conveyed to hospital. The variables were chosen on the basis that the data set was restricted to these factors and on expert opinion of what was of interest to the study. All analyses were carried out using R version 4.0.3. We conducted univariate and bivariate analysis prior to multiple stepwise logistic regression analyses to assess risk factors associated with hospital conveyance.

The complexity of treatment for hypoglycemia was categorized in Table 1.

The Scottish URC classification utilized is shown in Table 2 (1 = Large urban area, 8 = remote rural area).

Multiple logistic regression analysis models were used to estimate the relationship between conveyance and rurality, first blood glucose measurement, hypoglycemia treatment category, age, gender, and paramedic attendance. Chi-Square tests were used to determine associations between distance, time at scene, paramedic attendance and conveyance. Differences with $p \leq 0.05$ were considered statistically significant.

Treatment	Complexity Rank
No treatment	0
Food	1
Oral glucose gel	2
IM or IV glucagon / IV glucose solution	3

Table 1. Categorization of complexity of treatment for hypoglycemia at the scene.

RESULTS

The summary in Table 2 is derived from a dataset consisting only those incidents which had information on all the characteristics identified above (36,933 incidents had complete data). Conveyance rates were highest for females, for those under 20 or over 80yrs, and for those experiencing hyperglycemia. Conveyance rates were also higher in these categories for repeat callers conveyed within 24 hours of the original call. Those in large urban areas were most likely to be repeat callers conveyed within 24 hours. Where paramedics were in attendance, there was a lower conveyance rate compared to cases where paramedics did not attend.

Univariate analysis indicated that people experiencing hyperglycemia (BG > 11mmol/L) had a conveyance rate of 82% (n=8,685) straight from the scene and 6% (n=608) conveyed

within 24 hours While 36% of those with hypoglycemia were conveyed following first attendance by an ambulance crew (*n*=6,155) and 4% (*n*=606) were conveyed within 24 hours. A total of 45% of those with glucose in the normal range were conveyed following first attendance (*n*=1,975) and 3% (*n*=136) were conveyed within 24 hours (Table 2).

Of the 36,933 conveyances, the breakdown by rurality as per the URC 2020 can be seen in Table 2. While the percentage of people conveyed was higher than that for those not conveyed in all categories, there was no clearly defined pattern in the data to suggest that in remote rural and very remote rural areas (i.e. categories 7 and 8) there was a higher percentage of conveyance compared to the large urban or other urban areas (categories 1 and 2). Initial analysis indicated that, the probability of conveyance to hospital was not

Characteristics	Participants	Not Conveyed	Conveyed Immediately	Conveyed Within 24 Hours
Gender				
Female	16,350 (44%)	6,052 (37%)	9,507 (58%)	791 (5%)
Male	20,204 (55%)	8,720 (43%)	10,642 (52%)	842 (4%)
NA	379 (1%)	82 (22%)	295 (78%)	2 (0.01%)
Age (years)				
<20	2,100 (6%)	509 (24%)	1,455 (69%)	136 (6%)
(20-40]	7,180 (19%)	2,641 (37%)	4,152 (58%)	387 (5%)
(40-60]	9,976 (27%)	4,592 (46%)	4,970 (50%)	414 (0.04%)
(60-80]	11,132 (30%)	4,425 (40%)	6,261 (56%)	446 (4%)
>80	4,493 (12%)	1,422 (32%)	2,885 (64%)	186 (4%)
NA	2,052 (6%)	1,265 (62%)	721 (35%)	66 (3%)
First Blood Glucose (mmol/L)				
≤ 4	17,190 (47%)	10,405 (60%)	6,155 (36%)	630 (4%)
4-11	4,426 (12%)	2,315 (52%)	1,975 (45%)	136 (3%)
> 11	10,626 (29%)	1,333 (13%)	8,685 (82%)	608 (6%)
NA	4,691 (13%)	801 (17%)	3,629 (77%)	261 (6%)
Treatment Category for Hypoglycemia				
No Treatment (0)	4	4 (100%)	0 (0%)	0 (0%)
Oral Food/Glucose (1 & 2)	6,200 (16%)	3,222 (52%)	2,675 (43%)	303 (5%)
Glucago IM/IV or IV Glucose (3)	7,252 (19%)	4,298 (59%)	2,628 (36%)	326 (5%)
NAP	23,481 (63%)	-	-	-
Rural/Urban Classification				
1 Large Urban Areas	12,822 (35%)	5,366 (42%)	6,679 (52%)	777 (6%)
2 Other Urban Areas	14,511 (39%)	5,572 (38%)	8,300 (57%)	639 (5%)
3 Accessible Small Towns	2,770 (8%)	1,162 (42%)	1,515 (55%)	93 (3%)
4 Remote Small Towns	895 (2%)	384 (43%)	502 (56%)	9 (1%)
5 Very Small Towns	533 (1%)	133 (25%)	400 (75%)	0 (0%)
6 Accessible Rural Areas	2,852 (8%)	1,249 (44%)	1,526 (53%)	77 (3%)
7 Remote Rural Areas	806 (2%)	328 (41%)	467 (58%)	11 (1%)
8 Very Remote Rural Areas	870 (2%)	391 (45%)	475 (54%)	4 (0.5%)
NA	874 (2%)	269 (31%)	580 (66%)	25 (3%)
Paramedic Attendance				
No	4,146 (11%)	1,680 (41%)	2,466 (59%)	-
Yes	26,853 (73%)	13,038 (49%)	13,815 (51%)	-
NA	5,934 (16%)	-	-	-

Table 2. Characteristics in relation to conveyance to hospital.
NA = Not Available; NAP = Not Applicable

significantly higher in rural compared with urban areas, (p=0.07) although there was a decreasing probability of conveyancing as the index increased.

Conveyance to hospital was highest when staff spent beween 10-30 mins at the scene (68-75%) and least likely when staff spent more than 40 minutes at the scene, (29-37%), p<0.0001 (Table 3).

Time	< 10min	10-20min	20-30min	30-40min	40-50min	50-60min	1hr+
Total Number	4,983*	7,726	7,570	6,678	5,705	3,970	0
% Conveyed	45	75	68	51	37	29	-
% Not Conveyed	55	25	32	49	63	71	-

Table 3. Time at scene and percentage of indivdiuals conveyed to hospital.
** Missing data 301*

Data was only available for 40% (n=14,827) of incidents for distance between scene and hospital, with the greatest number of recordings for incidents that were < 20km from hospital. There was an inverse linear relationship between the number of people conveyed and distance form hospital, p< 0.0001 (Table 4).

Distance	< 20km	20-40km	40-60km	60-80km	80-100km	100-150km	150km+
Total Number	10,435	2,904	726	310	98	126	228
% Conveyed	60	44	43	32	29	16	3
% Not Conveyed	40	56	57	68	71	84	97

Table 4. Distance to hospital and percentage of indivdiuals conveyed.

There was no difference in number of callouts with a paramedic in attendance across distance from hospital and difference in conveyance rates when a paramedic was present was not related to distance. p>0.05 (Table 5).

Distance	< 20km	20-40km	40-60km	60-80km	80-100km	100-150km	150km+
Total Number	10,435	2,904	726	310	98	126	228
Paramedic							
% Conveyed	47	34	34	24	18	13	3
% Not Conveyed	33	47	49	58	54	71	84
No Paramedic							
% Conveyed	10	8	7	6	10	2	0
% Not Conveyed	5	7	6	8	15	10	11
Not Recorded							
Not Recorded	5	4	4	4	3	4	2

Table 5. Distance to hospital and conveyance percentage by paramedic attendance.

Multiple regression analysis indicated that probability of conveyance was significantly more likely the higher a person's age p<0.001 and for blood glucose levels > 4mmol/L (p<0.001) or > 11mmol/L, (p<0.05). Conveyance was also less likely if a paramedic was in attendance, p<0.001, the higher the category of hypoglycemic treatment administered,

$p<0.001$ or if the patient was male, $p<0.01$. There was no association of conveyance with URC in the model, $p=0.6$ (Supplementary Table 1).

DISCUSSION

Our analysis has shown that the greatest number of callouts were associated with hypoglycemia although the highest percentage of people conveyed to hospital were those with hyperglycemia. Individuals with non-hypoglycemic blood levels were significantly more likely to be conveyed to hospital. This would include individuals with conditions such as ketoacidosis usually associated with type 1 diabetes and reflected in the high rate of conveyance for individuals < 20 years, although this was not specifically recorded. Conditions such as hyperosmolar hyperglycemia state in older individuals may have accounted for some cases with initial high blood glucose levels but the high rate of conveyance of older individuals, particularly over 80 years suggests the presence of associated medical conditions such as diabetes-related chronic complications or infections as the main reason for conveyance rather than a diabetes-related metabolic problem (Lin et al., 2016). Interestingly, our results suggest that those receiving more complex treatment for hypoglycemia were less likely to be conveyed. It could be speculated that in general, individuals whose episode of hypoglycemia was the sole medical issue were treated successfully at the scene. Although current treatment of diabetes was not recorded, previous research suggests that admission for hypoglycemia is associated with use of oral hypoglycemic agents in type 2 diabetes and with more complex treatment of diabetes (Sinclair et al., 2023), meaning some elderly individuals may have had protracted hypoglycemia associated with medication and thus more likely to require hospital transfer.

While there was a greater number of male participants, reflecting the higher prevalence of diabetes in males, (Kautsky-Willer et al., 2023) females were more likely to be conveyed to hospital in keeping with the more general population age demographic (United Nations, 2022).

Paramedics were present in most callouts, however, the absence of a paramedic in attendance at the scene was associated with an overall higher conveyance rate. There was no effect of distance from hospital on these conveyance rates whether a paramedic was present or not. Previous research suggests that in terms of non-conveyance of elderly people to hospital, role-related factors such as emergency staff educational background may be important, with paramedic staff less frequently conveying patients to hospital (Oosterwold et al., 2018).

We also examined time at scene to assess the relationship with conveyance, and it appeared that transfer to hospital was less likely when staff spent more than 40 mins at the scene. This may reflect implementation of a 'see and 'treat' approach in these instances and/or more time spent on ensuring other forms of support were in place to allow for non-conveyance to hospital (Oosterwold et al., 2018). In addition, although not specifically related to the diabetes context, research has demonstrated that ambulance crews tend to spend more time with frail patients over the age of 50 years and they are also less likely to be conveyed to hospital (Charlton et al., 2022).

It is not known if call backs were secondary to incidents where initial conveyance had been considered unnecessary by ambulance staff, refusal by patients, or if there had been deterioration or recurrence of the original problem. Callbacks within 24 hours were

slightly more common in urban areas as compared to rural areas and compare with callback figures cited in other countries (Ebben et al., 2017). The slight increase in conveyance numbers in more urban areas after repeat calls may be a result of greater accessibility and that ambulance staff are less likely to take the risks of non-conveyance in locations where the distance to hospital is shorter.

Data was not available regarding subsequent hospital admission following conveyance and further research would be useful to understand if rurality impacts this.

We hypothesized that rurality would be associated with greater probability of conveyance to hospital, and while the greater the distance from hospital the less conveyance occurred, it is important to recognise the low numbers of data recordings for distance between scene and hospital and the increasingly lower numbers of callout the greater the distance. Rurality in terms of the URC was not associated with an increased chance of conveyance.

Individuals may be more reluctant to travel to hospital in more rural areas for several reasons meaning that everything possible is done to stabilize them at the scene (van Vuuren et al., 2021). However, it is possible we were not observing statistical significance due to the lower number of incidents occurring in the more rural categories with consequent reduced statistical power. This points to a question of whether the uneven distribution of data amongst the different rurality categories warrants a different classification such as an aggregation of the current classes. There is almost an inherent barrier in studying rurality because rural areas are invariably less populated so gathering enough data to conduct robust statistical analysis comparing rural and urban settings is difficult (McGrail et al., 2005). Of course, the small effect size may also indicate that rurality is not a significant causative factor and is merely incidental to other factors such as deprivation associated with more urban areas (Nishino et al., 2015). In addition, the complexity of the concept of rurality and the multitude of sub-factors that constitute it make it a contradictory and difficult parameter to measure in terms of its impact on the quality of health care (Hart et al., 2005). In future studies it may be more productive to split rurality into more granular factors such as distance to hospital, accessibility of primary/social care, community support, and population density.

Although rurality does not appear to have a relationship with conveyance rates, there is evidence in the literature that context specific initiatives to reduce unscheduled care admissions might be very effective in rural areas (Spleen et al., 2014). For example, although not specifically to do with conveyance, the Community Paramedicine program, posting trained paramedics in rural communities to serve patients who frequently use the emergency department, was shown to reduce Emergency Department and inpatient stays, it resulted in less intensive care utilization, improved health outcomes, and reduced healthcare expenditure (Bennett et al., 2018). Because rurality contains various push and pull factors in terms of likelihood of conveyance, it seems likely that whatever the location or nature of the callout, paramedic attendance could reduce conveyance to hospital as sufficient and effective treatment can be provided at the scene. This indicates that if we want to safely impact the conveyance rate in rural ambulance call outs, ambulance services could assign more experienced paramedics to these cases if possible. How paramedics are assigned and whether they are more likely to attend more rural callouts is not something we can establish in the data but would be an interesting question for further study.

In some rural locations, those who call an ambulance may be collected using an air ambulance helicopter resulting in different practices and approaches to treatment and conveyance decisions at the scene (Neagle et al., 2019). Greater resources dedicated to patients in extremely rural areas may mitigate some of the factors that contribute to worse outcomes.

Future studies are necessary and should address rurality assessment and definition as well as transport times for emergency services in this context. Furthermore, the development or adaption of an existing emergency service decision-making framework with ongoing evaluation could help with understanding and analysis of the more nuanced environmental and contextual factors that contribute to conveyance and hospitalization in general (Lauder & Penney, 2023) and would provide important insights into avoidable or unavoidable hospital conveyance in rural areas.

LIMITATIONS

The research outcomes in this study that relate to conveyance are based on analysis of metrics within a database and it is likely that other contextual and social factors influence conveyance in individual circumstances. Further exploration of these factors would help to explain the contribution of the variables we have identified to be associated with conveyance and rurality. While conveyance is linked to hospitalization, our dataset did not include information on subsequent hospital admission following conveyance. Also, the results within this study are specific to the definition of rurality and context of emergency medical services in Scotland and may not be directly comparable with rurality contexts, service provision, and related metrics of other nations.

CONCLUSIONS

Conveyance to hospital for metabolic-related diabetes complications is associated with predictable factors such as youth and older age, hyperglycemia more than hypoglycemia, and lack of attendance of a paramedic. Based on this dataset analysis of linear elements, it appears that degree of rurality does not appear to be associated with higher rates of conveyance compared with urban areas. More prospective research deploying a pragmatic mix of methodologies is required to elucidate the way rurality (and its various constituent factors) and more complex real-time circumstantial or contextual decision-making related to patients and paramedic staff might be associated with or impact operational and administrative decision-making and pre-hospital service provision and patient outcomes in rural communities.

Coefficient	Estimate	Std. Error	z-value	p
(Intercept)	-0.6043201	0.1097609	-5.506	< 0.001
Urban Rural Classificaition	-0.0052800	0.0101586	-0.520	0.6
Age Yrs.	0.0151089	0.0009555	15.812	<0.001
Gender Male	-0.1031095	0.0371677	-2.774	<0.01
BG 4-11mmol/L	0.4277217	0.0745370	5.738	<0.001
BG > 11mmol/L	0.5851149	0.2495422	2.345	<0.05
Category Hypoglycemia Treatment	-0.1076280	0.0221097	-4.868	<0.001
Paramedic Present	-0.1771318	0.0518364	-3.417	<0.001

Supplementary Table 1. Multiple regression analysis of factors associated with probability of conveyance.

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RESEARCH REPORTS

CONSTRUCTION EMPLOYEE'S EXPERIENCES OF BEING INVOLVED AS A LAYPERSON FIRST-AID PROVIDER IN A SERIOUS WORKPLACE INJURY EVENT: A QUALITATIVE STUDY

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ABSTRACT

Background: Workplace-related serious injury events are a recognized problem in Europe, with construction sites bearing a higher risk compared to other workplaces. Sweden reports approximately 1,000 serious injury per year. Layperson involvement in workplace injury events can be stressful and may impact their ability to respond effectively. There is a knowledge gap concerning how workers in this context perceived their role.

Aim: To describe Swedish construction employees' experiences of being involved as a layperson first aid provider in a serious workplace injury event.

Method: A total of nine construction employees were interviewed. Their ages ranged from 22 to 66 years, and varying experience in the construction industry, from 5 to 41 years. Eight had completed a first aid course at their workplace within the last three years. None of the participants had a background in areas such as rescue services, police, healthcare, or military. None of the construction sites had trained EMTs or company medical personnel on site. The transcribed text from the interviews was analyzed using qualitative content analysis.

Results: The study showed that construction employees experiences of being involved as a layperson first aid provider was linked to one main category: to try to reduce the consequences of limited knowledge through mutual understanding and support. There were three additional categories for reported experiences: suddenly trying to save lives after realizing the unexpected, the importance of collaboration in a chaotic situation, and the need for social support and following improvements with subcategories.

Conclusion: The results showed that with injury events in a complex environment, such as construction sites, there is a need for mutual understanding between dispatcher, ambulance services, rescue service, and laypersons. A level of understanding from professional organizations is required to support the layperson to be a valuable resource to the emergency personnel in serious workplace injury events.

INTRODUCTION

Workplace-related serious injury events are a well-recognized problem in Europe, with construction sites bearing a higher risk of such events compared to other workplaces (Berglund et al., 2021; Perlman et al., 2014). One explanation for this heightened risk is that construction sites often operate under exposed conditions with varying safety margins and significant time pressure (Hansen et al., 2022). To put this in our study context, Sweden reports approximately 1,000 serious injury events each year (medical leave of absence for thirty days or longer), including some fatalities (Berglund et al., 2021). Serious injury events occur suddenly, involving a substantial release of energy on the human body. This high-energy impact leads to a primary injury where there can also be secondary injuries for the person including, for example, inadequate breathing or circulation after the primary injury (Winge., 2019).

When serious injuries occur on construction sites, it is necessary to gain a comprehensive understanding of the specific situation and the mechanisms underlying the injury (Lennquist, 2017). Time is an important factor, and swift implementation of life-saving actions is essential as these actions can potentially influence the injury's outcome (Pham et al., 2017). Early assessments and interventions by laypersons, or persons without advanced emergency care training are important, especially in situations like cardiac arrest but also in injury events (Linderoth et al., 2021; Ter Avest et al., 2019). Laypersons can perform life-saving actions before the arrival of an ambulance. In a study by Bakke et al. (2015) where 330 prehospital trauma alerts and interventions were observed, it was noted that 35% of laypersons had received first aid training. Those with first aid training tended to perform more accurate and effective actions compared to those without such training. It is also worth noting that first aid administered by laypersons can sometimes be executed incorrectly (Tannvik et al., 2012).

Being involved in a workplace injury event as a layperson can be a stressful experience and can affect their ability to act effectively. Three basic conditions usually should be met for a layperson to act in the event of an injury: (a) the person must have personally witnessed the injury event, (b) the person must perceive the situation as an emergency, and (c) the person must decide to assist the injured individual by acting (Sepahvand et al., 2020, 2023). Acting as a layperson in the event of an injury requires courage, knowledge, and swift action (Duut et al., 2022). Presently, there is limited knowledge of how employees in the construction industry react and act when they find themselves in the role of saving a colleague's life during a serious injury event. Knowledge from this study can increase the understanding of how dispatchers and rescue personnel (emergency medical services) could interact and cooperate with laypersons in event of serious injuries at a construction site to improve responses. Furthermore, this knowledge can also deepen understanding of the support that construction employees acting as layperson first responders may require to mitigate potential negative consequences in the case of serious workplace injury events.

Aim

This study aims to describe the experiences of layperson, construction employees who have been involved as first aid providers in a serious workplace injury event.

METHODS

Study Design

This qualitative study was conducted with semi-structured individual interviews and reported following the Consolidated Criteria for Reporting Qualitative Research (COREQ) (Tong et al., 2007).

Participants

The data collection took place in Sweden in 2022, and a convenience sampling was used with participants recruited from various construction companies in Sweden. To be included, it was required that, for the event involved, the emergency number 112 had been dialed, that an ambulance arrived at the scene, and that the injured person needed ambulance transportation into hospital. Ten individuals agreed to participate in the study, and then one opted out before the interview. A total of nine were interviewed, eight of whom were men and one was a woman. Their ages ranged from 22 to 66 years, and they had worked in the construction industry for varying lengths of time, from 5 to 41 years. Eight of these had completed a first aid course at their workplace within the last three years. None of the participants had a background in areas such as rescue services, police, healthcare, or military. None of the construction sites had trained EMTs or company medical personnel on site.

Data Collection

An interview guide was created by the authors and was based on the context to be studied: i) when the injury event occurred, ii) management of the injury event, and iii) after the injury event. The interviews began with an open question, "Can you tell me about when you performed first aid for one or several colleagues? Report freely about what you experienced from the time of discovery of the injured, the emergency call to 112, and to transport by ambulance. Try to describe what you thought, felt and what you did." Follow up-questions, if these details were not included in the account, included for example, "What did you think when you saw that your colleague was injured?," "What did you do?," "How did you take care of the injured person?," and "How did it feel to give your colleague first aid?" Six participants were interviewed live on a digital video platform (TEAMS®), and three participants interviewed at their workplace in a private room without any distractions. All interviews lasted between 35 to 50 minutes and were recorded and then transcribed verbatim.

Analysis

Interviews were analyzed using a qualitative content analysis method as described by Granheim and Lundman (Graneheim et al., 2004, 2017). The analysis process initially sorted all the text into a common analysis database (Word-ds). Common words and sentences were identified and grouped into meaningful units. Subsequently, a condensation of the texts was performed to reduce the volume without losing the essence of the participants' descriptions. The condensed text was further abstracted and compared against the original meaningful units. Afterward, the common text fragments from all transcripts were coded and grouped into subcategories, which were then organized into categories and main category describing the findings at a descriptive level.

Ethics

The study has been approved by the Swedish Ethical Review Authority (document number 2021-05774-01). All participants provided informed consent before entering the study. All methods were carried out in accordance with relevant guidelines and regulations.

RESULTS

One main category and three additional categories with nine subcategories were identified which illustrated construction employee experiences of being involved as a layperson first aid provider in a serious workplace injury event. These are exemplified with citations (Table 1).

Main category	Categories	Subcategories
To try to reduce the consequences of limited knowledge through mutual understanding and support.	Suddenly trying to save lives after realizing the unexpected	Understanding that a serious injury has occurred
		Initiating an own response
		First aid activities for individuals and teams
		Inexperience, fear of doing wrong
	The importance of collaboration in a chaotic situation	Acting with support from dispatcher
		Support from ambulance and rescue service
	The need for social support and following improvements	Stated desire for early support and later follow-up
		Long-term psychology experience
		Trying to learn from injury event experience

Table 1. Main category, categories and subcategories illustrated construction employee's experiences of being involved as a layperson first-aid provider in a serious workplace injury event.

Suddenly Trying to Save Lives After Realizing the Unexpected

Four subcategories were highlighted: Understanding that a serious injury has occurred, initiating an own response, first aid activities own and team, and inexperience, fear of doing wrong affected the initiation of starting some kind of rescue effort.

Understand that a Serious Injury has Occurred

Attempting to understand what had happened was described as important in the role of laypersons. Participants highlighted that when a risk escalated into a serious injury event, they described a profound change in their awareness. It became surreal and challenging to grasp the reality of a serious injury event. To comprehend reality, participants described that they relied on their sensory experiences to understand and create awareness of what had occurred.

As one participant expressed:

> *"I initially thought it wasn't him who had fallen down; I was convinced that it was some construction material. It felt surreal."*

Initiating an Own Response

The participants described how the event created immediate stress with a strong sense of discomfort. The initial thought was an immediate reaction of just wanting to walk away from there, to move away from the scene of the injury event. This thought then transitioned into a desire to help and take responsibility. They described that many col-

leagues were standing and watching in what they described as a chaotic environment. Taking action involved the ability to maintain composure, not hesitate, as the participants described it, to take initiative, organize, and support by thinking steps ahead.

> *"The feeling was to simply try to assess the situation while also supporting the colleagues who couldn't immediately handle the situation."*

First Aid Activities for Individuals and Teams

The participants described first aid activities as despite their sense of stress they still worked together within their team. Medical actions were initiated and carried out, such as supporting the injured person's breathing, applying initial dressings, and warming the injured person.

The participants further described that their teamwork in mutual assistance, collectively devising innovative solutions such as constructing a stretcher or moving equipment that was in way, ensuring an adequate number of colleagues were present, and providing support to each other in the chaotic situation. This teamwork was described as a way to maintain calm within the group, a calmness that was conveyed to the injured person.

> *"There were perhaps about 10 colleagues around when this happened, everyone behaved, it was professional considering how people tend to react. It felt really good and safe."*

Inexperience, Fear of Doing Wrong

The participants experienced the events as unexpected, something they hadn't mentally prepared for or, as they described, trained in advance. They described how they lacked experience in assessing and managing these severe conditions, with severe bleeding being particularly challenging. Additionally, they encountered difficulties in understanding how medical materials worked, from opening packages to knowing how to correctly apply pressure dressings for severe bleeding. The condition of the injured person created fear among the first aid responders, which the participants described as a fear of making mistakes and worsening the injury. This fear, as described by the participants, primarily occurred when the injured person was unconscious and when the participants assessed that the airway was blocked and needed to be addressed physically at the scene of the injury. Fear was also described during the encounter and conversation with the injured person, and the fear was related to not wanting to provide incorrect information, something that the participants described as particularly pronounced when they themselves did not know the extent of the person's injuries.

> *"I hold him so he gets air, I've pulled him out so he can breathe. Then I don't want to do much more because he was pretty bad, I didn't want to move his neck so much."*

The Importance of Collaboration in Chaotic Situation

The category delineated the participants' experiences of collaboration, both between emergency call dispatchers and the personnel in the ambulance or rescue services. These experiences were divided into two subcategories: Acting with support from a dispatcher and Support from ambulance and rescue services.

Acting with Support from Dispatcher

The collaboration with society's emergency responders began even before the ambulance and rescue service arrived at the scene of the injury event. Participants described this collaboration as commencing when they dialed the emergency number 112 and talked to the dispatcher. The initial feeling that arose during the conversation with the dispatcher was described as a sense of calm among the participants, a feeling of security simply by knowing that an ambulance was on the way. Furthermore, the participants described a mutual collaboration, where they needed to receive advice and support from the dispatcher, while the dispatcher needed a clear description of the event's situation and guidance to accurately describe the address and approach route for the ambulance and rescue service personnel. Participants highlighted important factors in collaboration with the dispatcher, such as ensuring that mobile coverage was available and, in cases where a fixed address was not available for a construction site, clear coordinates were provided.

The initial sense of calm among the participants quickly turned into a feeling of discomfort on occasions when they had to wait for an extended period for the ambulance to arrive at the scene. Participants described this waiting as compelling, compelling them to continue assisting the injured person during the ongoing emergency call, but now with support and collaboration with the dispatcher while awaiting the ambulance.

> *"The conversation with the dispatcher was calm and instructive, they are trained for this. They ask where you are, where you work, where you are located. What does the place look like? So, they keep talking to you and providing support. It was very reassuring because you get scared yourself. You want the ambulance to be here now."*

Support from Ambulance and Rescue Service

When the ambulance arrived at the scene, the participants described it as an overall calmness prevailed. Through this feeling, the participants fully relinquished their responsibility to the ambulance personnel, and a strong desire arose to leave the injury site. The participants understood that their effort was not over even though the ambulance was on the scene. The work had to continue, but now in collaboration with the ambulance and rescue service personnel. This awareness was described as arising through the ambulance personnel's ability to convey calmness. Collaboration with the ambulance personnel was based on communication among each other. The participants described that the calmness and clarity of the ambulance personnel helped them understand what they needed to assist with, and through their guidance, they executed tasks together.

> *"He wanted my help, so I buttoned up the collar. I had no idea how tight to fasten it; we did it together. He was good, calm, and easygoing."*

The Need for Social Support and Following Improvements

The participants described how the event affected them even afterward once the injured person was transported to the hospital. The participants described a stated desire for early support and later follow-up, long-term psychology experience, and trying to learn from injury event experience.

A Stated Desire for Early Support and Later Follow-Up

After the injury event, there was a strong desire among participants to come together, to gather and discuss the experience. They referred to this gathering as a check-in, where their primary concern was to assess the well-being of all involved and determine if anyone needed immediate support or assistance. When the crisis management team was in place and began functioning, participants described it as a positive experience, having the opportunity to share their stories or feel acknowledged. However, during the initial period following the injury, participants noted that they had to rely on each other for support. From this phase of taking care of each other, participants described the need for external support from the company's management organization. They described this external support as a crisis team responsible for monitoring all involved individuals, providing updates on the injured person's condition, and offering information to family members. When this support was lacking, disappointment arose, including disappointment over the time it took to receive assistance.

> *"We were disappointed with how we had been handled, that is, from the top, by our management. Yes, it took some time before any support was provided."*

Long-Term Psychology Experience

The participants described experiences of the injury events as affecting them both in the short and long term. Returning to their workplace initially felt good, but at the same time, they described that the feeling of the injury event still lingered. Participants explained that those particularly vulnerable were the persons who were close to the injured person, those who tried to save lives during the injury event.

> *"The ones who suffered the most were those who tried to save him, yes, to do something. Yes, it's a trauma that never leaves you, or a memory that never leaves you."*

Trying to Learn from Injury Event Experience

The injury event led to insights that participants described, and participants provided suggestions for new approaches to organizational procedures and training methods. Considering the need to guide individuals (ambulance) on a construction site without an address, it immediately became challenging, and the participants emphasized the importance of this in training, that appointing someone to lead the way could prove advantageous. Furthermore, the on-site response equipment could undergo further development to better handle severe traumatic injuries, replacing outdated equipment. The primary aspect highlighted by the participants was the experience of being present during an injury event.

> *"To analyze the worst-case scenario, if I put it that way, how do we handle it, who does what, and that's something I take with me, that we need to plan before the worst can happen."*

DISCUSSION

This study aimed to describe the experiences of construction employees who have been involved as layperson first aid providers in a serious workplace injury event.

The participants encountered uncertainty and challenges when attempting to recognize, comprehend, interpret, and raise awareness of the injury event. The realization of such

an event led to a major shift in their consciousness, and they relied on their sensory perceptions to comprehend the situation and take appropriate actions. According to Perlman et al. (2014), these challenges in recognition and understanding can be attributed to the work environment, where sound and other distractions can impede sensory perception and affect their ability to interpret and understand.

The attempt to act and take responsibility emerged as a significant issue in our results and is in accordance with to Sepahvand et al. (2020, 2023) that argue that bystanders observe each other on the scene, and if they do not interpret the situation as an emergency, they do not act either. Initially, the study participants experienced discomfort and a fight-or-flight reaction, but they eventually transitioned into a desire to provide assistance and take responsibility. It was noted that individuals reacted differently to the situation. Some participants proactively initiated life-saving actions, while others initially observed the event without acting. We interpret this variation in responses as possible forms of the bystander effect. According to the bystander effect, the presence of others leads to the diffusion of responsibility, meaning that each of the individuals present does not act because they believe someone else will offer help (Fischer et al., 2011). Our results demonstrate that some participants can take responsibility for the situation and thus act. We infer that when other bystanders realize that someone is taking the lead, they also take responsibility and act, which contradicts hesitation related to the bystander effect. This can be attributed to the close relationships that existed between the participants and the injured individual, a conclusion also highlighted by Hal et al. (2013).

Insecurity and doubt were common feelings among the participants when caring for a seriously injured individual with life-threatening injuries, as Hal et al. (2013) also highlighted in their study. One possible explanation for this uncertainty, in our view, could be a sense of lacking the right first aid knowledge. In our study, participants provided insights that align with this explanation of inadequate knowledge. They expressed uncertainty about necessary actions in critical life-saving situations, such as handling severe bleeding or an unconscious person. Our results emphasize the idea that knowledge and experience can alleviate laypeople's fears, increase the likelihood of them taking action, and initiating life-saving actions while waiting for an ambulance. This concept is also supported by Kulnik et al. (2019).

Collaboration with rescue personnel began as soon as the participants dialed the emergency number 112. They felt a sense of relief knowing that help was on the way. However, their insecurity grew as they had to wait for the ambulance for an extended period. We interpret that the wait for the ambulance encouraged the participants to cooperate with and engage in the advice and support of the dispatcher. The participants described this collaboration as mutual, where they could also support the dispatcher by describing the incident and explaining the location of the injury site to facilitate the arrival of the ambulance.

When the ambulance arrived, the participants experienced an overall sense of calm, and they willingly handed over their responsibilities to the ambulance personnel. The participants shared their experiences of completely trusting the ambulance and rescue services and physically leaving the scene. The participants mentioned that the professionalism and calm demeanor of the ambulance and rescue service personnel encouraged them to stay and assist in ongoing rescue efforts. We posit that this collaboration requires mu-

tual understanding from all organizations, including construction workers, dispatcher, ambulance, and rescue services. It is especially important for professional organizations, including ambulance services, to recognize that involved laypersons are vulnerable and may require support.

After the injury event, participants experienced a strong desire to inquire about each other's well-being and seek external support from the company's management team. Some participants also began reflecting on their actions and questioning whether they had done enough or potentially worsened the injury. We believe that this self-doubt can be the onset of inner stress, a common feeling reported in previous studies (Brinkrolf et al., 2021; Kulnik et al., 2019). The effects of these reactions extended beyond the initial days following the injury event. Several participants shared that the event continued to occupy their thoughts and affect them in the long term. This phenomenon is described by Torun-Mathiesen et al. (2016) who highlight how individuals involved in critical situations outside a hospital setting can experience lasting emotional effects and may struggle to adapt to life after the event.

Reflection over the injury event subsequently led to suggestions for new ways to organize and educate employees, as well as improve equipment to better handle traumatic injuries, and to prepare the organization for worst-case scenarios. Through this result, we believe that the organization can prepare for the worst by, as step 1, linking risk to an action plan. Step 2 involves adapting training based on the organization's expected needs and challenges, as highlighted in previous research (Lingard et al., 2001; Reason., 1998; Salas et al., 2005). Our findings also support the need to prepare the organization for what needs to be done after the injury event. Without psychosocial support, the risk of long-term negative consequences for the personnel who acted as first responders in a serious injury event increases our findings respond to several research reports (Goralnick et al., 2018; Landgraf et al., 2019; Linderoth et al., 2021; Møller et al., 2014). Through our result, we have been able to describe a group of personnel who were strongly affected by having to participate in the rescue of colleagues who were injured in a serious injury event. We believe that, through this impact, the participants have learned and gained new experiences that we hope have strengthened their ability to have the courage to act if they find themselves in a situation where they need to save lives.

Methodological Considerations

In qualitative research and analysis, various methods are employed to gain knowledge. The initial steps in analyzing the collected data are similar regardless of the qualitative method used, involving processes of sorting, and categorizing the information (Graneheim et al., 2004, 2017).

An important concept in qualitative study findings is trustworthiness, which is a summary of various aspects of credibility, reliability, and transferability (Graneheim et al., 2017). The trustworthiness of this study was strengthened by active participation of multiple researchers in the interview process and continuous presence throughout the entire analysis phase.

LIMITATIONS

Regarding the transferability of the results, it is notable that the participant sample size was small despite attempts to recruit more. According to Polit & Beck (2017), participants in studies who choose to express and reflect on their experiences can create data saturation with a relatively small sample. After seven interviews we did not encounter any new variation in the narrative themes. Additionally, two further interviews were conducted, both of which yielded no new variation. It is worth noting that discussion of, or revisiting their experiences, was expected to be sensitive for some participants, especially regarding uncertainty surrounding rightness or wrongness of actions in the described events. This also implies a potential risk that participants may not have fully shared their innermost experiences and reactions to the events, which could impact on the credibility and reliability of the findings here.

CONCLUSION

The results show the challenges for a layperson to switch from being an employee on a construction site trying to understand when a serious injury event has occurred and then change roles to trying to save lives. Their intervention can potentially affect the individual both in the short and long term after the injury event. To prevent short-term and long-term negative stress reactions, some preparation should provide benefit, for example in terms of job-based education or training in first aid. We believe that in complex environments and responses, such as at construction sites, there is a need for mutual understanding between dispatcher, ambulance services, rescue services, and laypersons to support the layperson in becoming a valuable resource to the emergency personnel in serious workplace injury events.

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RESEARCH REPORTS

POTENTIAL BIAS IN USE OF "SMELL OF ALCOHOL" AND OTHER SUBSTANCE USE DESCRIPTORS AS DIAGNOSTIC CRITERIA IN PREHOSPITAL CARE

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ABSTRACT

"Smell of alcohol" (SoA) is widely used as a diagnostic tool. However, assigning SoA to a patient is entirely provider dependent and may be associated with negative social connotations.

This paper aims to identify differences in the diagnostic application of SoA among patients in the prehospital setting. We further investigate whether SoA impacts patient care by evaluating transport times. To accomplish these aims, we performed a cross-sectional study of the National Emergency Medical Services Information Service (NEMSIS) databases for 2017-2023. SoA was established using NEMSIS's standardized substance use evaluation metric.

In part one of our study, we analyzed the use of SoA across multiple demographic factors including race and ethnicity, age, and gender. We found statistically significant differences in the application of the SoA metric to non-White patients (*OR* 1.056, 95% CI 1.052-1.060 to 1.266, 95% CI 1.248-1.283). Similar patterns were observed in the application of 'Other Substance Use Suspected' to Black or African American (*OR* 1.217, 95% CI 1.213-1.221) and female (*OR* 1.133, 95% CI 1.130-1.136) patients.

In part two of our study, we observed increased transport times for patients with a confirmed alcohol level. No increase was observed in patients with a positive SoA. These results suggest that SoA is applied in a biased manner across demographics, but its application does not influence patient transportation time in the prehospital setting.

INTRODUCTION

The smell of alcohol (SoA) is an unique odor that humans are able to distinguish (Commetto-Muniz & Abraham, 2008), and the presence of alcohol and its metabolites is detectable on the breath and body in 66-86% of cases of alcohol consumption (Moskowitz, Burns, & Furguson 1999; Malhotra et al. 2013). This distinctive odor is also widely accepted as a diagnostic tool in hospital medicine (Walsh & Macleod, 1983; Moskowitz, Burns, & Ferguson 1999; Shibayama & Ino, 2012; Liberatti et al, 2003), prehospital medicine (Maine Prehospital Care Protocols, 2024), policing (van Boekel et al, 2013), and other public service work.

However, the sense of smell and one's ability to distinguish odors is not routinely standardized or assessed, leaving room for error and inconsistency (Moskowitz, Burns, & Ferguson 1999; Shibayama & Ino, 2012). Furthermore, previous studies found SoA may cause implicit bias (Delker, Brown, & Hasin, 2016). This bias in turn may result in negative patient outcomes.

It is important that we analyze and discuss implicit bias in healthcare as it may impact patient care and outcomes. Implicit bias is often a result of fast, unconscious heuristic-based evaluations (Gopal et al. 2021; Marcelin et al. 2019). These evaluations in turn are shaped by external factors, including learned experiences (Gopal et al. 2021). However, the sum of these evaluations create preferential action, which when unconsciously applied, creates implicit bias. When the perceptions of the provider are negative toward the patient, this implicit bias can manifest in disparate patient care decisions and quality (Marcelin et al. 2019). Mitigating implicit bias requires intent and a multi-modal approach, but the first step is uncovering and identifying unconscious biases (Marcelin et al. 2019). This paper aims to establish whether implicit bias exists in the EMS community through examining the application of SoA to patients, where biased application could lead to differences in treatment (e.g. delaying or omitting a stroke assessment on a patient suspected of alcohol intoxication).

This study first evaluated patterns in the application of SoA across various demographic factors, including race, age, and gender. Differences observed across patient subpopulations represent underlying biases in the use of SoA. This study then investigated if SoA or other indications of alcohol use may impact patient care, utilizing transportation time as a proxy for patient management.

METHODS

Our study used the National EMS Database (NEMSIS) with data element definitions and collection standards as established by the National Highway Traffic Safety Administration (NEMSIS v3.4, 2024). Data collected included the years 2017-2023 as these years are in concordance with Version 3 of the National Emergency Medical Services Information System (NEMSIS) Database with improved data metrics and quality standards. Packages and functions used for data extraction and analysis are included in the supplemental section of this report (see Appendix A).

Our team designed this study to answer two research questions: (1) Is SoA applied equitably across different patient demographics? and (2) Does SoA or other alcohol or drug use indicators impact patient management? Our team accessed the National EMS Information System (NEMSIS) to study these questions. Each variable of the NEMSIS 3.4.0. Data Dictionary was reviewed. The following variables were selected: ePatient.13 [patient gender], ePatient.14 [patient race], ePatient.15 & ePatient.16 [patient age], eDisposition.20 [reason for choosing destination], and eHistory.17 [alcohol/drug use indicators]. All fields are required for EMS clinicians to complete, and they involve either a text-box answer (patient age) or checking a box related to the descriptors (patient gender, race, age, reason for choosing a destination, and alcohol/drug use indicators) as expressed by the patient and/or as determined by the clinician. A glossary of terms as well as definitions for select terms may be found in Appendix B.

NEMSIS data files were extracted to produce .sas7bdat files, which were read using the R software system (R Core Team, 2024). The relevant variables were extracted and matched according to the deidentified patient identification number (PcrKey). We then categorized our data to facilitate our model development as follows.

Race and ethnicity groups created include: (1) White; (2) Asian; (3) Black or African American; (4) Hispanic or Latino; or (5) American Indian, Alaska Native, Native Hawaiian, or other Pacific Islander. Patient gender, as reported by EMS providers, was recorded as (1) female, (2) male, or (3) unknown. Patient age was categorized by this study as: 0-20, 21-44, 45-54, 55-64, 65-74, 75-84, and 85+ years old in accordance with age categories established by the Centers for Medicare and Medicaid Services (White, 2020), with a slight modification account for the legal age of alcohol consumption in the United States of 21 years old. Disposition reason and EMS transport time (minutes) were extracted directly from NEMSIS.

Two subsets of data were extracted. To address our first research question regarding the use of the SoA metric across various demographics, data subset one - the Demographics Subset - was created including patients with a confirmed alcohol or drug use indicator. This indicator was recorded in standardized NEMSIS data element eHistory.17 [Alcohol/Drug Use Indicator].

Our second data subset - designated Altered Mental Status Subset - was designed to address our next research question: does a patient's response to element eHistory.17 impact their care? Because patient emergency department records were not linked in the NEMSIS database, our selection of patient outcomes was significantly limited. Our team identified patient transportation time as an outcome variable that could strongly reflect a responder's feelings towards the patient (e.g. for patients with life-threatening status, transport times were assumed to be shorter). To account for variation in transportation time across potential chief complaints (i.e. penetrating trauma vs. generalized weakness), our team also selected a common chief complaint of ICD-10 code R41.82 or "Change in Mental Status, NOS [Not Otherwise Specified]". Both emergent and non-emergent call types were included in the analysis because the emergent vs non-emergent return decision is based on the clinician impression of the patient: that is, whether the patient meets criteria for an emergent return based on clinical factors including SoA. It is for this reason that both 911 responses and interfacility transport calls were included in the analysis as well.

Please refer to Figure 1 for a visual representation of this data extraction process. An ANOVA analysis was performed for the final stage of our data extraction process to identify underlying differences in each data subset, (1) completed records with alcohol/drug use indicator and (2) completed records with altered mental status, relative to the overall NEMSIS dataset with completed records.

We then conducted a statistical analysis. For the Demographics Subset, we implemented a multinomial logistic regression model to determine if any patient demographics (age, race, or gender) were correlated with use of eHistory.17 [Alcohol or Drug Use Indicators]. Any statistically significant differences in utilization patterns could suggest bias in provider usage. For the Altered Mental Status Subset, we implemented a generalized linear model to identify statistically significant differences in patient transportation time

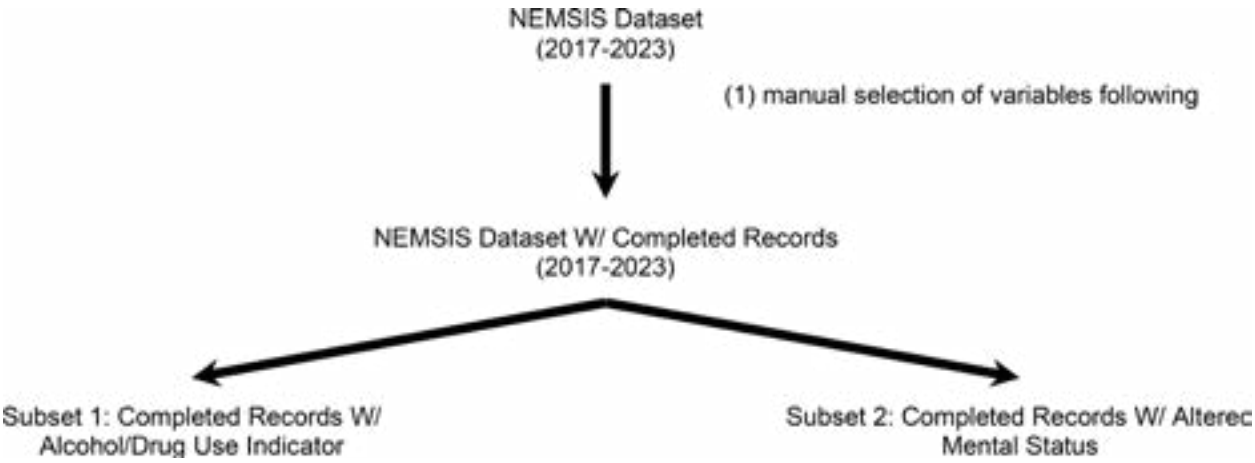

Figure 1. Visual representation of the data selection process.

across alcohol or drug use indicators when controlling for patient age, race or ethnicity, and gender. We chose to use a generalized linear model with a Quasipoisson family and a log link given that the distribution of EMS transportation times was a continuous numeric outcome with a strong rightward skew (shorter transportation times were more common than longer transportation times). Variations in these patterns by demographic or alcohol use indicator could reflect bias on the part of the responder.

This project met the local policy requirements for ethical review by meeting exemption criteria: NEMSIS data are de-identified to be HIPAA-compliant, and the dataset is publicly available. EMS providers are assumed to have entered the data factually in accordance with their respective documentation procedures for the purposes of providing care to their patients. The authors declare no conflicts of interest or disclosures.

RESULTS

General

262,685,635 unique EMS reports were filed with NEMSIS over the period of 2017-2023. Application of our inclusion and exclusion criteria significantly reduced the eligible population for our study. For example, in 2017, approximately 3.9 million unique calls were completed. Of these, nearly 50% were excluded on the grounds of incompletion.

Demographics Subset

For the Demographics Subset, approximately 11 million unique patient encounters with an alcohol or drug use indicator were recorded from 2017-2023. An ANOVA analysis and distribution plot was generated for each year (see Appendix C for results from 2017 analysis). A multinomial logistic regression model was then implemented, with results summarized in Figure 2 and in Appendix D and Appendix E. Each odds ratio compares demographic categories relative to our established reference group of white males aged 21-44 years who disclose using alcohol ("alcohol use disclosed by patient"). This reference group was chosen as it is the most populous patient group studied in terms of alcohol use descriptors. As such, other groups are considered "minority groups".

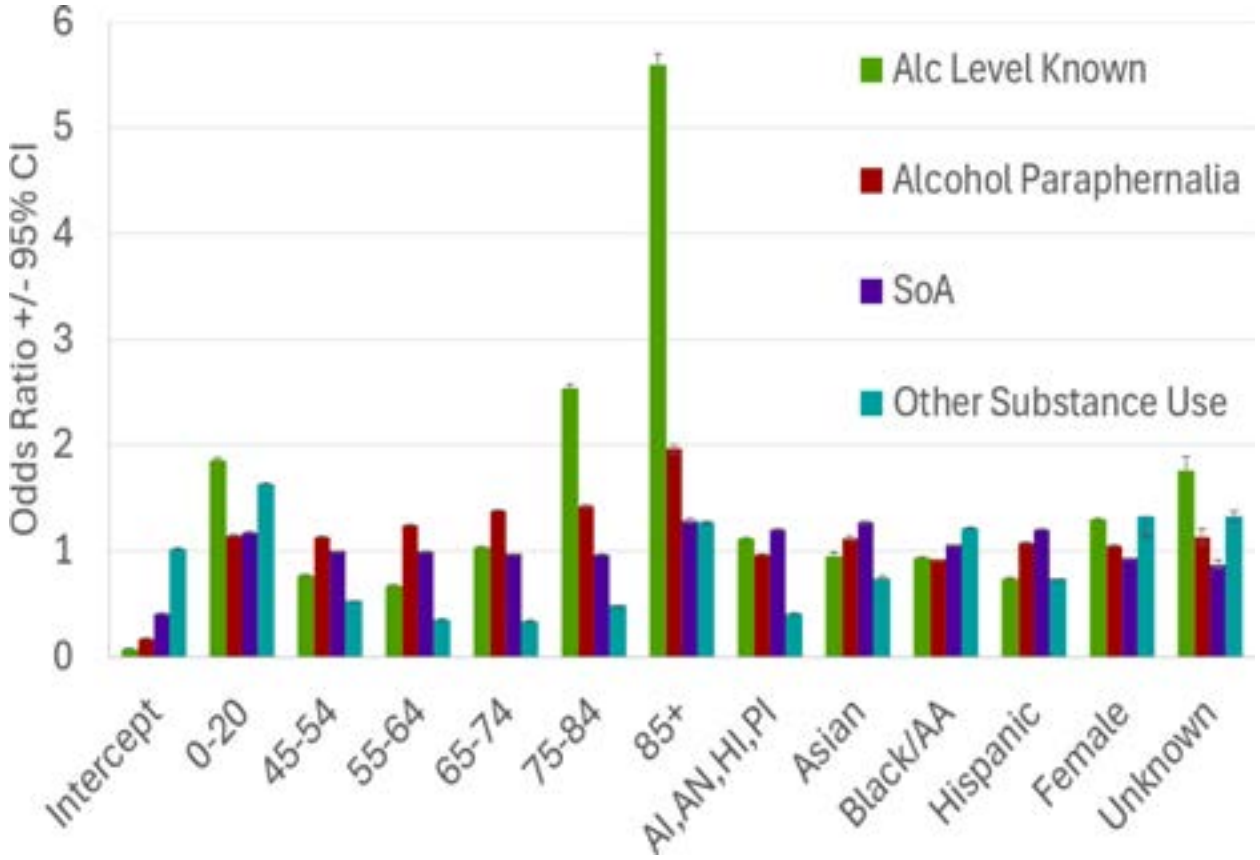

Figure 2: Logistic regression model data for NEMSIS 2017-2023.

Notable results include the fact that non-White patients had statistically significantly higher odds of being reported with SoA (*OR* 1.056±0.004 to 1.266±0.018, all 95% CI and $p<0.0001$). Additionally, the 'Other Substance Use' indicator was applied more frequently to Black or African American patients (*OR* 1.217±0.004 95%CI, $p<0.0001$) and female patients (*OR* 1.133±0.003 95%CI, $p<0.0001$).

Altered Mental Status Subset

For the Altered Mental Status Subset, approximately 7 million unique patient encounters were recorded from 2017-2023. A summary of the characteristics for each subset population are summarized in Appendix D. We then applied a generalized logistic regression model to predict EMS transportation times, controlling for patient demographic factors including age, race, and gender. Results can be found in Appendix F (below). Odds ratios reported estimate relative differences in EMS transportation time amongst altered mental status patients on the basis of alcohol or drug use when controlling for demographic factors, with higher odds ratios denote relatively longer EMS transportation times. Results indicate that, when compared to the control group of 21-44 year old males with reported alcohol usage, transport times were not statistically longer for minority groups.

DISCUSSION

ANOVA Analysis

Our team found statistically significant differences across key demographics, including patient age, race or ethnicity, and gender for each data subset. When considering these results in clinical context, however, such findings are expected.

Considering the Demographics Subset, age-related differences may be attributed to alcohol consumption patterns in the US population, with younger patients ages 21-44 more likely to engage with binge drinking or other high-risk consumption practices. Heterogeneity also exists between races/ethnicities, with higher rates of alcohol consumption among Hispanic patients. Existing literature has identified Hispanic White males are most likely to develop liver cirrhosis and to be involved in motor vehicle collisions associated with alcohol, two conditions which may lead to altered mental status (Delker, Brown, & Hasin, 2016; White, 2020; Rahimi, Elliott, & Rockey, 2013). Finally, with regard to variation by gender, existing literature has demonstrated that on average females consume approximately one third of the alcohol that men consume in a year (White, 2020). Therefore, the presence of a difference in gender between our study population and the general population was expected.

Considering the Altered Mental Status Subset, age differences may be attributable to increased susceptibility for sepsis or dementia in older populations. With regards to heterogeneity between races and ethnicities, lower rates of altered mental status were seen amongst Asian, American Indian, Alaskan Native, Hawaiian, and Pacific Islander populations relative to the general population. This may be a result of cultural differences in family and children involvement in elderly care. Finally, when considering gender, higher rates of altered mental status were noted among males. This may be a result of increased comorbidities and higher incidence of cerebrovascular accidents amongst males relative to females.

These differences may affect the validity or generalizability of our study's outcomes. However, they reflect reasonable and expected patterns of substance use and altered mental status in the United States.

Demographics Subset - The Logistic Regression Model

The results generated by the Logistic Regression Model for NEMSIS data 2017-2023 demonstrate that there are disparities between different demographics when it comes to the application of alcohol use modifiers compared to a control group of 21-44 year old white males who self-reported alcohol use.

Alcohol Level Known: All age groups 0-20, 65-74, 75-84 and 85+ years old have a higher likelihood of alcohol level known than 21-44 year old patients ($p<0.0001$). The age groups 45-54 and 55-64 years old show a lower likelihood of having a known alcohol level than that anticipated for the control group. This is logical from the perspective that alcohol use by anyone in the age group 0-20 is considered illegal in the United States, and the presence of police with the ability to test for alcohol level in the field is more likely for these patients (Goldenberg, 2016). Additionally, alcohol intoxication is a differential diag-

nosis for patients with stroke, which is more likely in the 65+ year old age range. These patients may have undergone a toxicology screen prior to interfacility transport.

For race and ethnicity, AI, AN, HI, PI ($p<0.0001$) are more likely than the control group to have an alcohol level known, whereas Asian ($p<0.01$), Hispanic ($p<0.0001$), and Black/African American ($p<0.0001$) patients have a lower likelihood for having a known alcohol level than white patients. This is consistent with the literature in that people of AI, AN, HI, PI racial and ethnic background have a higher incidence of violent crime and motor vehicle collision associated with alcohol use than other races/ethnicities (Delker, Brown, & Hasin, 2016). Given that this population has an alcohol poisoning rate eight times that of White controls and that it also has the highest rate of alcohol use disorder of any of the subpopulations studied (Kerr et al 2022), it is more likely that drivers of the AI, AN, HI, PI racial and ethnic background involved in a motor vehicle accident or violent crime would display probable cause for a preliminary breathalyzer analysis to establish a known alcohol level (NHTSA 2025).

For gender, females ($p<0.0001$) and unknown gendered individuals ($p<0.0001$) are more likely to have an alcohol level known than males. This is contrary to the literature, which states that females have a lower overall use rate and binge rate that might lead to a police encounter than males (White, 2010). Further investigation of this phenomenon is not possible given lack of case-specific information within the NEMSIS database.

Alcohol Paraphernalia on Scene: All age groups ($p<0.0001$) have a higher likelihood of alcohol paraphernalia on scene than the control group. The increased presence of alcohol paraphernalia with increasing age, as seen in the odds ratio, is contrary to alcohol use patterns for age, which have been shown to decrease with age (Delker, Brown, & Hasin, 2016). A possible explanation for this is that alcohol clearance decreases with age, increasing its toxicity. (Vestal et al, 1977). This might result in higher incidence of medical emergencies during which paramedics would encounter the alcohol paraphernalia.

For race and ethnicity, Asian and Hispanic patients ($p<0.0001$) are statistically more likely to have alcohol paraphernalia on scene than White patients, and AI, AN, HI and PI ($p<0.0001$) and Black or African American ($p<0.0001$) patients are less likely. This is not explained by the literature, and further investigation is not possible given NEMSIS database lack of case-specific information.

For gender, females ($p<0.0001$) and unknown gendered patients ($p<0.0001$) are more likely to have alcohol paraphernalia on scene than males. As above, this is contrary to the literature (Delker, Brown, & Hasin, 2016) and further investigation is limited due to NEMSIS case-specific de-identification within the dataset.

Smell of Alcohol: All groups except for 0-20 ($p<0.0001$) and 85+ ($p<0.0001$) year olds have an equal or lower likelihood of SoA than the control group. This is expected as overall alcohol use and frequency declines with age. The group 0-20 years old have a higher likelihood of smelling like alcohol, which is supported through higher incidence of binge drinking and overall alcohol use among college-aged individuals (Delker, Brown, & Hasin, 2016). The spike for 85+ year old individuals is unexplained and requires additional research.

Racial and ethnic patterns identified by our analysis are not supported by the literature. While weekly drinking is reported to be highest among Hispanic patients, White patients are more likely to binge drink than individuals from other ethnicities (Delker, Brown, & Hasin, 2016). Our study found that all non-white race/ethnicity patients (all $p<0.0001$) have higher odds of being applied the Smell of Alcohol descriptor than white patients, which does not align with recorded alcohol use patterns (Delker, Brown, & Hasin, 2016) and is not explained otherwise. Therefore, it is likely that these discrepancies are due to provider bias.

Finally, female and unknown gendered patients are less likely to smell like alcohol as male patients. This matches the trends highlighted in the literature.

Other Substance Use Suspected: All age groups except for 0-20 year olds ($p<0.0001$) have a decreasing likelihood of suspicion of other substance use with age, and the 0-20 year old group has a higher likelihood of suspicion. This fits with published literature, which states that younger populations under age 26 have a higher likelihood of developing substance use disorder compared to older populations (Lu, Lopez-Castro, & Vu, 2023), which are reported to be at or below the same likelihood for the control group. Again, 85+ year old patients also show a higher likelihood ($p<0.0001$) than the control 21-44 year old demographic, which cannot be accounted for in the literature. Further research is warranted

What is not corroborated by the literature is the higher likelihood of Black or African American patients ($p<0.0001$) to be assigned the descriptor "Other Substance Use Suspected"; Black or African American patients have lower substance use disorders than White patients (Lu, Lopez-Castro, & Vu, 2023). This would presumably result in fewer emergency calls related to substance use requiring an ambulance for these populations. This finding may represent a provider bias.

Another potential bias may be found in the unequal assignment of "Other Substance Use Suspected" to female patients and unknown gendered patients, who per our results are more likely to incur this designation ($p<0.0001$). Females are less likely to develop substance use disorders than males, making this discrepancy likely due to provider judgment.

Altered Mental Status Subset - The Generalized Linear Model

Intercept: Perhaps the most interesting finding is that 21-44 year old white male patients who self-disclose alcohol use have a 10-times longer transport time than other demographics (*OR* 11.386, 95% CI 11.347-11.425, $p < 0.05$). It is possible that this metric is largely influenced by patient self-disclosure of alcohol use, as this implies a patient is (1) protecting their airway, (2) breathing spontaneously, (3) speaking coherently, and (4) oriented to the situation. However, a limitation of our study is that we do not have case-by-case data to understand why such delays occurred.

Age demographic: It is surprising that transport times are higher in other age groups except the 85+ demographic when compared to the 21-44 year old group. Elderly patients tend to be less healthy than patients in the age range 21-44 years, which means that there could be a higher number of true medical emergencies in this group when compared to the control (Vestal et al, 1977). Additionally, pediatric patients in the age group 0-20 may

require transportation to a dedicated pediatrics emergency room, which may prolong transportation times. Further investigation is required.

Race and ethnicity demographic: A similar effect may also be the cause for prolonged transport times for AN, AI, HI, PI population members, many of whom live in rural areas without immediate access to a hospital (American Indians, 2014). Statistically shortened transport times for other races and ethnicities may be a function of increased urban safety-net hospital usage amongst these groups (Yearby, Clark, and Figueroa, 2022).

Gender demographic: With regards to the gender demographics, increased transport time for female and unknown gender patients is unexpected and not easily explained; men have a higher morbidity and mortality associated with injuries and accidents related to alcohol consumption (Delker, Brown, & Hasin, 2016). Further research is required.

Disposition reason: Disposition reason was included in our model to adjust for alternative causes of transportation delays among patients. Intuitively, any disposition reason other than "closest facility" would inherently have a longer expected transportation time. Interestingly, destinations "Regional Specialty Center" and "Physician Choice" were approximately 30% higher than other destination selections. This may be attributed to the fact that many municipalities do not possess tertiary and quaternary services. Further research incorporating patient zip code data is needed.

Alcohol use descriptors: Controlling for all patient demographics and disposition reasons, SoA did not seem to affect transport times with any statistical significance. The

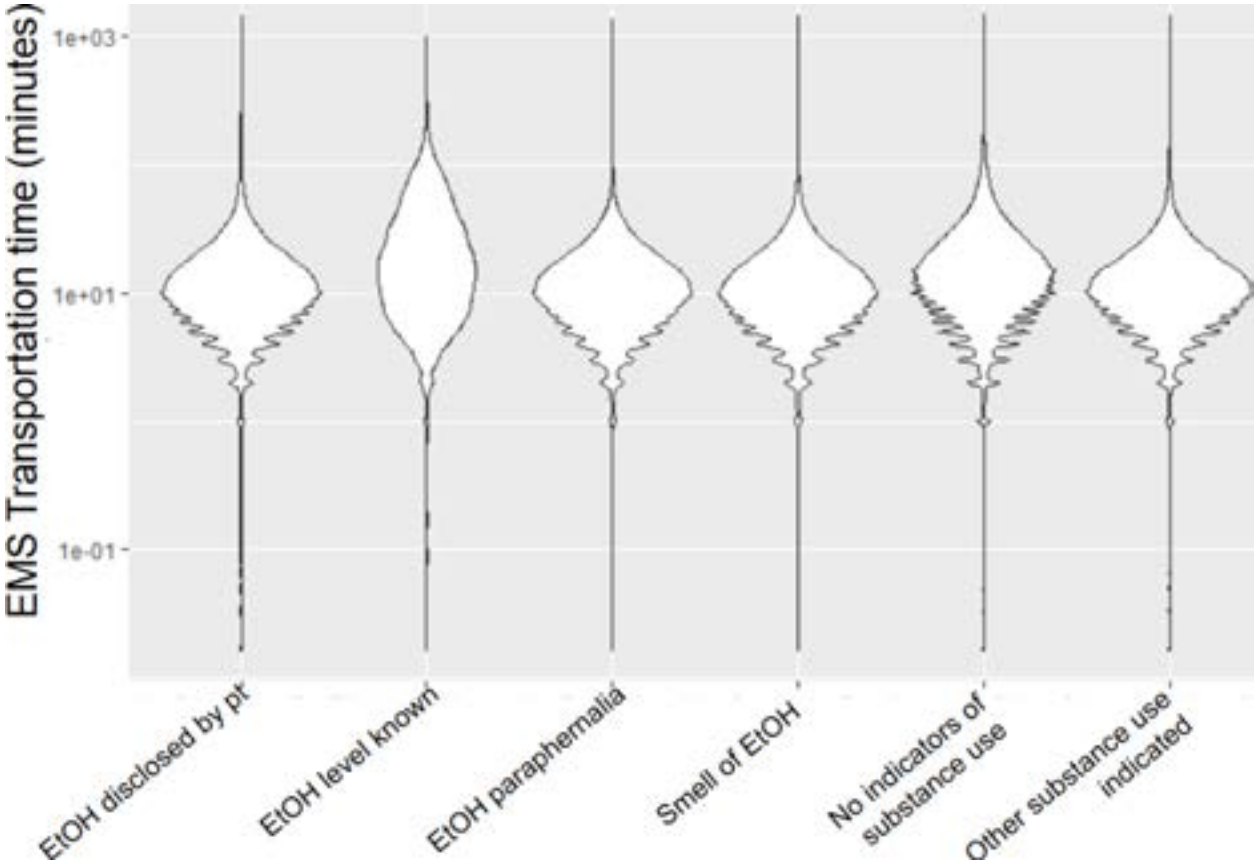

Figure 3. Violin plot of EMS transport time (minutes) vs. alcohol use indicators.

"alcohol level known" indicator had statistically longer transport times. This is to be expected as patients must be protecting their airway and breathing adequately to complete a portable breathalyzer test or be transported from one hospital to another, which would indicate lack of medical emergency. Interestingly, altered mental status patients without any indications of alcohol or drug use had increased transportation times. However, the transport times for all alcohol use descriptors were similar, as shown in Figure 3.

CONCLUSION

General Interpretation Summary

Our results serve to establish that provider assignment of subjective substance use descriptors to patients may be influenced by bias. While there was a statistically significant increase in the use of the SoA indicator among non-white patients relative to white patients, the clinical significance of this is unclear given the small magnitude of the absolute difference. Additional analysis of the clinical impact of these findings, as measured by patient transportation time, demonstrated such potential bias did not affect patient care.

Applicability to Existing Literature

Our results indicating a potential assessment bias aligns with existing literature. Indeed, numerous sources report that people of color were less likely to experience pain assessment or be treated with pain medications for traumatic injuries when compared to white patients (Brunsen et al, 2023; Kennel et al, 2019; Crowe et al, 2023). Also, Hanchate et al. (2016) and Pack et al. (2023) found that people of color were more likely to be transported to a safety net hospital vs white patients who were living in the same zip code. Respectively, Brunson et al. (2023) reinforce a well-documented bias that is widespread in medicine, namely that people of color are under-assessed and undertreated for pain in all environments, not just in the prehospital sphere. (Brunsen et al, 2023; Dickason et al, 2015).

Our results indicating an assessment bias on the part of prehospital providers regarding SoA and patient age add new perspective regarding prehospital provider bias, which is less well-studied. Our findings support the idea that bias regarding SoA and patient age does not impact patient outcomes, as measured by patient transportation time.

Our results indicating a treatment bias regarding patient gender add to existing studies examining this phenomenon. Rothrock et al (2001) describe gender disparities in the assessment and treatment of patients with chest pain, stating that elderly women are statistically less likely to receive aspirin or a 12-lead EKG in the field vs male controls. Additionally, when comparing female patients to males, EMS clinicians are less likely to correctly diagnose stroke, give epinephrine for anaphylaxis, or transport fall patients to trauma centers (Farcas et al., 2023). Therefore, our identification of potential gender bias in the prehospital setting adds to the greater conversation regarding gender-related bias in provider heuristics and patient care.

Limitations

This study has several limitations. First, a large number of patients were excluded from our study. Approximately 50% of patients had incomplete demographic variables record-

ed. These patients were excluded as incomplete demographic variables likely indicate incomplete or erroneous patient records. However, such incomplete data could be due to inconsistent coding or inaccurate charting. Exclusion of these patients may also introduce selection bias. Despite this limitation, millions of patients met our inclusion criteria for altered mental status and alcohol/drug use. We felt this sample size was sufficient for the purposes of our analysis.

A second limitation of our study is that some patient encounters could have resulted in multiple resource activation, such as in regions where fire and ambulance resources are dispatched simultaneously. This would lead to duplication in reporting patient status if both agencies are recorded by NEMSIS. Our analysis did not include specifying for the transporting agency as this data element was not available for all years of the 2017-2023 time period. However, in applicable systems, duplicate calls are a result of dispatch protocols and would likely be duplicated equally across all patients.

A third limitation of this study is that patient race and ethnicity are recorded based on provider judgment rather than patient's self-reported identity. NEMSIS could consider adding a data element regarding if patient race/ethnicity is self-reported or reported by EMS provider.

A fourth limitation is the fact that the equation of transport time to patient management has no precedent in the literature. Indeed, Elkbuli et al (2021) contend that longer transport times with aerial EMS had better outcomes for trauma patients when compared to ground EMS, and McCoy et al (2012) showed that transport times were not associated with increased mortality odds with penetrating traumas in ground EMS. We further acknowledge that there are numerous confounding factors that could influence transport time. Some confounding factors we consider include ZIP code, time of day, and other response data. However, these are omitted from the NEMSIS database to maintain patient confidentiality. Additionally, traditional outcomes such as patient morbidity or mortality measures were not available as patient outcomes after ED visit or hospital admission are not currently included in the NEMSIS database. Despite these limitations, NEMSIS database remains the best source of large-scale EMS data necessary for this caliber of analysis. Therefore, we feel that using transport time as a proxy for patient management quality is appropriate for the purposes of this study, but that this outcome variable may have significant limitations.

Our study focuses on the perceived feelings of the clinician towards the patient - clinical or otherwise per Hanchate et al (2016) - which results in a transport decision. We are aware that this decision may be influenced by numerous factors, including the patient's wishes, system status, hospital capability, etc, but ultimately the transport decision rests with the clinician. We account for some of this variability by including the transportation disposition reason. As such, looking at transport time is indicative of how the clinician perceives the patient, which affects patient management. We can speculate as to how management is affected, but ultimately we set out to investigate whether the feelings of the clinician as influenced by their record of substance use modifiers caused differences in transport times. We do not believe that the confounding factors listed influence our results to a great extent: the sheer number of calls that we analyze negates these confounders as we establish a value for response time (see Figure 3) that corresponds to the average for the US that is reported in the literature (Mell et al, 2017). Therefore, we

assert that proxy association between transport time and patient management is appropriate for the purposes of this study.

A final limitation of this study is the cross-sectional, ecological nature of its design, which does not have patient-specific or quality control metrics in place. Therefore, it is not possible to ensure the data we include in our models is 100% accurate. We recognize steps NEMSIS has taken to review and standardize data and appreciate the data standards implemented by this national organization. In addition, our study lacks case-specific data, preventing our team from using conclusions of this study to guide patient care. However, our team believes this is a reasonable weakness that commonly impacts studies of this cross-sectional design.

Future Recommendations

Building on the foundation established by this study, we find it would be of interest to investigate if variation in use of alcohol or drug use indicators also exist in the prehospital settings of other countries. Additionally, more detailed EMS datasets should be created to allow for case-by-case analysis of patient care, allowing us to further analyze unusual patterns in patient care discussed in this paper.

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APPENDIX A. PACKAGES AND FUNCTIONS USED FOR DATA EXTRACTION AND ANALYSIS

Data processing:

1) Individual race variable

```
# Importing dataset from NEMSIS
Race <- read_sas("C:/Users/PC/Documents/DataScience/2023/pcrpatientracegroup.sas7bdat")
head(Race)
# Recoding variable by race/ethnicity categories
# provided by NEMSIS
Race$Race_Recoded <- "None"
Race$Race_Recoded <- if_else(Race$ePatient_14 == "2514001",
    "AI_AN_HI_or_PI", Race$Race_Recoded)
Race$Race_Recoded <- if_else(Race$ePatient_14 == "2514003",
    "Asian", Race$Race_Recoded)
Race$Race_Recoded <- if_else(Race$ePatient_14 == "2514005",
    "Black", Race$Race_Recoded)
Race$Race_Recoded <- if_else(Race$ePatient_14 == "2514007",
    "Hispanic", Race$Race_Recoded)
Race$Race_Recoded <- if_else(Race$ePatient_14 == "2514009",
    "AI_AN_HI_or_PI", Race$Race_Recoded)
Race$Race_Recoded <- if_else(Race$ePatient_14 == "2514011",
    "White", Race$Race_Recoded)
# Plotting recoded variable distribution
# ggplot(Race,aes(x=Race_Recoded))+ geom_bar()
# Clean up race dataset
Race_Final <- Race[, c("PcrKey", "Race_Recoded")]
Race_Final <- Race_Final %>%
    filter(Race_Recoded != "None")
rm(Race)
```

2) Individual age variable

```
Demographics <- read_sas("C:/Users/PC/Documents/DataScience/2023/pub_pcrevents.sas7bdat",
    col_select = c(PcrKey, ePatient_13, ePatient_15,
        ePatient_16))
# Utilizing health care age categories as
# established by Medicare/Medicaid, adjusted for
# minimum legal drinking age in the US (age 21):
# 0-20, 21-44, 45-54, 55-64, 65-74, 75-84, and
# 85+
head(Demographics)
Demographics$Age_Cat <- "None"
Demographics$Age_Cat <- if_else(Demographics$ePatient_16 ==
```

```
    "2516001", "0-20", Demographics$Age_Cat)
Demographics$Age_Cat <- if_else(Demographics$ePatient_16 ==
    "2516003", "0-20", Demographics$Age_Cat)
Demographics$Age_Cat <- if_else(Demographics$ePatient_16 ==
    "2516005", "0-20", Demographics$Age_Cat)
Demographics$Age_Cat <- if_else(Demographics$ePatient_16 ==
    "2516007", "0-20", Demographics$Age_Cat)
Demographics$Age_Cat <- if_else(Demographics$ePatient_16 ==
    "2516009" & Demographics$ePatient_15 < 21, "0-20",
    Demographics$Age_Cat)
Demographics$Age_Cat <- if_else(Demographics$ePatient_16 ==
    "2516009" & Demographics$ePatient_15 >= 21 & Demographics$ePatient_15 <
    45, "21-44", Demographics$Age_Cat)
Demographics$Age_Cat <- if_else(Demographics$ePatient_16 ==
    "2516009" & Demographics$ePatient_15 >= 45 & Demographics$ePatient_15 <
    55, "45-54", Demographics$Age_Cat)
Demographics$Age_Cat <- if_else(Demographics$ePatient_16 ==
    "2516009" & Demographics$ePatient_15 >= 55 & Demographics$ePatient_15 <
    65, "55-64", Demographics$Age_Cat)
Demographics$Age_Cat <- if_else(Demographics$ePatient_16 ==
    "2516009" & Demographics$ePatient_15 >= 65 & Demographics$ePatient_15 <
    75, "65-74", Demographics$Age_Cat)
Demographics$Age_Cat <- if_else(Demographics$ePatient_16 ==
    "2516009" & Demographics$ePatient_15 >= 75 & Demographics$ePatient_15 <
    85, "75-84", Demographics$Age_Cat)
Demographics$Age_Cat <- if_else(Demographics$ePatient_16 ==
    "2516009" & Demographics$ePatient_15 >= 85, "85+",
    Demographics$Age_Cat)

# Plot Age category
# ggplot(Demographics,aes(x=Age_Cat))+ geom_bar()

# Clean up Age dataset
Age_Final <- Demographics[, c("PcrKey", "Age_Cat")]
Age_Final <- Age_Final %>%
    filter(Age_Cat != "None")
```

3) Individual gender

```
head(Demographics)
Demographics$Gender_Cat <- "None"
Demographics$Gender_Cat <- if_else(Demographics$ePatient_13 ==
    "9906001", "Female", Demographics$Gender_Cat)

Demographics$Gender_Cat <- if_else(Demographics$ePatient_13 ==
    "9906003", "Male", Demographics$Gender_Cat)

Demographics$Gender_Cat <- if_else(Demographics$ePatient_13 ==
    "9906005", "Unknown", Demographics$Gender_Cat)

# Plot Gender category
# ggplot(Demographics,aes(x=Gender_Cat))+
# geom_bar()
```

```
# Clean up Gender Data
Gender_Final <- Demographics[, c("PcrKey", "Gender_Cat")]
Gender_Final <- Gender_Final %>%
    filter(Gender_Cat != "None")
rm(Demographics)
```

4) Disposition reason

```
Dispo_Reason <- read_sas("C:/Users/PC/Documents/DataScience/2023/factpcrdestinationreason.sas7bdat")

Dispo_Reason$Dispo_Reason_Recoded <- "None"
Dispo_Reason$Dispo_Reason_Recoded <- if_else(Dispo_Reason$eDisposition_20 ==
    "4220001", "Closest Facility", Dispo_Reason$Dispo_Reason_Recoded)
Dispo_Reason$Dispo_Reason_Recoded <- if_else(Dispo_Reason$eDisposition_20 ==
    "4220003", "Diversion", Dispo_Reason$Dispo_Reason_Recoded)
Dispo_Reason$Dispo_Reason_Recoded <- if_else(Dispo_Reason$eDisposition_20 ==
    "4220005", "Family Choice", Dispo_Reason$Dispo_Reason_Recoded)
Dispo_Reason$Dispo_Reason_Recoded <- if_else(Dispo_Reason$eDisposition_20 ==
    "4220007", "Insurance", Dispo_Reason$Dispo_Reason_Recoded)
Dispo_Reason$Dispo_Reason_Recoded <- if_else(Dispo_Reason$eDisposition_20 ==
    "4220009", "Law Enforcement", Dispo_Reason$Dispo_Reason_Recoded)
Dispo_Reason$Dispo_Reason_Recoded <- if_else(Dispo_Reason$eDisposition_20 ==
    "4220011", "Medical Direction", Dispo_Reason$Dispo_Reason_Recoded)
Dispo_Reason$Dispo_Reason_Recoded <- if_else(Dispo_Reason$eDisposition_20 ==
    "4220013", "Other", Dispo_Reason$Dispo_Reason_Recoded)
Dispo_Reason$Dispo_Reason_Recoded <- if_else(Dispo_Reason$eDisposition_20 ==
    "4220015", "Patient choice", Dispo_Reason$Dispo_Reason_Recoded)
Dispo_Reason$Dispo_Reason_Recoded <- if_else(Dispo_Reason$eDisposition_20 ==
    "4220017", "Physician choice", Dispo_Reason$Dispo_Reason_Recoded)
Dispo_Reason$Dispo_Reason_Recoded <- if_else(Dispo_Reason$eDisposition_20 ==
    "4220019", "Protocol", Dispo_Reason$Dispo_Reason_Recoded)
Dispo_Reason$Dispo_Reason_Recoded <- if_else(Dispo_Reason$eDisposition_20 ==
    "4220021", "Regional Specialty Center", Dispo_Reason$Dispo_Reason_Recoded)

# Plot Dispo Reason category
# ggplot(Dispo_Reason,aes(x=Dispo_Reason_Recoded))+
# geom_bar()+ theme(axis.text.x =
# element_text(angle = 90, vjust = 0.5, hjust =
# 1))

# Clean Up Dispo Reason
Dispo_Final <- Dispo_Reason[, c("PcrKey", "Dispo_Reason_Recoded")]
Dispo_Final <- Dispo_Final %>%
    filter(Dispo_Reason_Recoded != "None")
rm(Dispo_Reason)
```

5) Alcohol use indicator

```
EtOH_Indicator <- read_sas("C:/Users/PC/Documents/DataScience/2023/factpcralcoholdruguseindicator.sas7b
EtOH_Indicator$Alcohol_Cat <- "None"
EtOH_Indicator$Alcohol_Cat <- if_else(EtOH_Indicator$eHistory_17 ==
    "3117001", "Alc_Paraphernalia", EtOH_Indicator$Alcohol_Cat)
```

```
EtOH_Indicator$Alcohol_Cat <- if_else(EtOH_Indicator$eHistory_17 ==
    "3117005", "Alc_Disclosed_By_Pt", EtOH_Indicator$Alcohol_Cat)
EtOH_Indicator$Alcohol_Cat <- if_else(EtOH_Indicator$eHistory_17 ==
    "3117009", "Alc_Level_Known", EtOH_Indicator$Alcohol_Cat)
EtOH_Indicator$Alcohol_Cat <- if_else(EtOH_Indicator$eHistory_17 ==
    "3117011", "Alc_Smell_on_Breath", EtOH_Indicator$Alcohol_Cat)
EtOH_Indicator$Alcohol_Cat <- if_else(EtOH_Indicator$eHistory_17 ==
    "3117003", "Other_Substance_Use_Suspected", EtOH_Indicator$Alcohol_Cat)
EtOH_Indicator$Alcohol_Cat <- if_else(EtOH_Indicator$eHistory_17 ==
    "3117007", "Other_Substance_Use_Suspected", EtOH_Indicator$Alcohol_Cat)

# Plot Alcohol Use Indicator
# ggplot(EtOH_Indicator,aes(x=Alcohol_Cat))+
# geom_bar()+ theme(axis.text.x =
# element_text(angle = 90, vjust = 0.5, hjust =
# 1))

# Clean up Alcohol Use Indicator
EtOH_Indicator_Final = EtOH_Indicator[, c("PcrKey",
    "Alcohol_Cat")]
# EtOH_Indicator_Final=
# EtOH_Indicator_Final%>%filter(Alcohol_Cat!='None')
rm(EtOH_Indicator)
```

6) Alcohol and altered mental status primary symptom code

```
Primary_Symptoms <- read_sas("C:/Users/PC/Documents/DataScience/2023/factpcrprimarysymptom.sas7bdat")
Primary_Symptoms$Diagnosis_Cat <- "Other/None"
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.1", "Alc_Abuse_not_intox", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.10", "Alc_Abuse_not_intox", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.12", "Alc_Abuse_with_intox", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.120", "Alc_Abuse_with_intox", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.129", "Alc_Abuse_with_intox", Primary_Symptoms$Diagnosis_Cat)

Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.229", "Alc_Dep_with_intox", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.23", "Alc_Dep_with_withdrawal", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.230", "Alc_Dep_with_withdrawal", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.231", "Alc_Dep_with_withdrawal", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.239", "Alc_Dep_with_withdrawal", Primary_Symptoms$Diagnosis_Cat)

Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.9", "Alc_Use", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
```

```
    "F10.92", "Alc_Use_with_intox", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.920", "Alc_Use_with_intox", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.929", "Alc_Use_with_intox", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "F10.92", "Alc_Use", Primary_Symptoms$Diagnosis_Cat)
Primary_Symptoms$Diagnosis_Cat <- if_else(Primary_Symptoms$eSituation_09 ==
    "R41.82", "AltMentalStatus", Primary_Symptoms$Diagnosis_Cat)

# Plot Primary Symptoms
# ggplot(Primary_Symptoms,aes(x=Diagnosis_Cat))+
# geom_bar()

# Clean Up Primary Symptoms
Primary_Sx_Final <- Primary_Symptoms[, c("PcrKey",
    "Diagnosis_Cat")]
rm(Primary_Symptoms)
```

7) Secondary symptoms

```
Secondary_Symptoms <- read_sas("C:/Users/PC/Documents/DataScience/2023/factpcradditionalsymptom.sas7bda
Secondary_Symptoms$Diagnosis_Cat <- "Other/None"
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.1", "Alc_Abuse_not_intox", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.10", "Alc_Abuse_not_intox", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.12", "Alc_Abuse_with_intox", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.120", "Alc_Abuse_with_intox", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.129", "Alc_Abuse_with_intox", Secondary_Symptoms$Diagnosis_Cat)

Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.229", "Alc_Dep_with_intox", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.23", "Alc_Dep_with_withdrawal", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.230", "Alc_Dep_with_withdrawal", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.231", "Alc_Dep_with_withdrawal", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.239", "Alc_Dep_with_withdrawal", Secondary_Symptoms$Diagnosis_Cat)

Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.9", "Alc_Use", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.92", "Alc_Use_with_intox", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.920", "Alc_Use_with_intox", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.929", "Alc_Use_with_intox", Secondary_Symptoms$Diagnosis_Cat)
```

```
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "F10.92", "Alc_Use", Secondary_Symptoms$Diagnosis_Cat)
Secondary_Symptoms$Diagnosis_Cat <- if_else(Secondary_Symptoms$eSituation_10 ==
    "R41.82", "AltMentalStatus", Secondary_Symptoms$Diagnosis_Cat)

# Plot Primary Symptoms
# ggplot(Secondary_Symptoms,aes(x=Diagnosis_Cat))+
# geom_bar()

# Clean Up Primary Symptoms
Secondary_Sx_Final <- Secondary_Symptoms[, c("PcrKey",
    "Diagnosis_Cat")]
rm(Secondary_Symptoms)
```

8) Outcome: transport times

```
Comp_Elements <- read_sas("C:/Users/PC/Documents/DataScience/2023/computedelements.sas7bdat",
    col_select = c(PcrKey, EMSTransportTimeMin))
head(Comp_Elements)
Comp_Elements %>%
    drop_na(EMSTransportTimeMin)

# Plot EMS Transport times
# ggplot(Comp_Elements,aes(x=EMSTransportTimeMin))+
# geom_histogram()

# Clean up Transport times
Trans_Time_Final <- Comp_Elements[, c("PcrKey", "EMSTransportTimeMin")]
rm(Comp_Elements)
```

9) Final dataset merge

```
Final_Dataset <- merge(Age_Final, Race_Final, by = "PcrKey")
Final_Dataset <- merge(Final_Dataset, Gender_Final,
    by = "PcrKey")
Final_Dataset <- merge(Final_Dataset, Dispo_Final,
    by = "PcrKey")
Final_Dataset <- merge(Final_Dataset, EtOH_Indicator_Final,
    by = "PcrKey")
Final_Dataset <- merge(Final_Dataset, Primary_Sx_Final,
    by = "PcrKey")
Final_Dataset <- merge(Final_Dataset, Secondary_Sx_Final,
    by = "PcrKey")
Final_Dataset <- merge(Final_Dataset, Trans_Time_Final,
    by = "PcrKey")

Altered_Mental_Status <- Final_Dataset %>%
    filter(Diagnosis_Cat.x == "AltMentalStatus" | Diagnosis_Cat.y ==
        "AltMentalStatus")

Alcohol_Status <- Final_Dataset %>%
    filter(Alcohol_Cat != "None")
```

```
# ggplot(Altered_Mental_Status,aes(x=Diagnosis_Cat.x,
# fill=Alcohol_Cat))+ geom_bar(stat='count',
# position=position_dodge())+ theme(axis.text.x =
# element_text(angle = 90, vjust = 0.5, hjust=1))

# Anova analysis to see if there is any
# difference in patient demographics among all
# NEMSIS patients who 1) have altered mental
# status as a chief complaint or 2) have a
# different chief complaint (not AMS).
Final_Dataset$Altered_Mental_Status_binary <- if_else(Final_Dataset$Diagnosis_Cat.x ==
    "AltMentalStatus", 1, 0)
Final_Dataset$Altered_Mental_Status_binary <- if_else(Final_Dataset$Diagnosis_Cat.y ==
    "AltMentalStatus", 1, Final_Dataset$Altered_Mental_Status_binary)
one_way_AOV_AMS_age <- aov(Altered_Mental_Status_binary ~
    Age_Cat, data = Final_Dataset)
summary(one_way_AOV_AMS_age)
one_way_AOV_AMS_race <- aov(Altered_Mental_Status_binary ~
    Race_Recoded, data = Final_Dataset)
summary(one_way_AOV_AMS_race)
one_way_AOV_AMS_gender <- aov(Altered_Mental_Status_binary ~
    Gender_Cat, data = Final_Dataset)
summary(one_way_AOV_AMS_gender)

# Anova analysis to see if there is any
# difference in patient demographics among
# altered mental status patients who 1) have an
# alcohol or drug use indicator and 2) have no
# alcohol or drug use indicator.
Final_Dataset$Alcohol_Cat_binary <- if_else(Final_Dataset$Alcohol_Cat ==
    "None", 0, 1)
one_way_Alc_age <- aov(Alcohol_Cat_binary ~ Age_Cat,
    data = Final_Dataset)
summary(one_way_Alc_age)
one_way_Alc_race <- aov(Alcohol_Cat_binary ~ Race_Recoded,
    data = Final_Dataset)
summary(one_way_Alc_race)
one_way_Alc_gender <- aov(Alcohol_Cat_binary ~ Gender_Cat,
    data = Final_Dataset)
summary(one_way_Alc_gender)

# Sanity test
Final_Dataset$Alcohol_Cat_binary <- Final_Dataset$Alcohol_Cat_binary ==
    1
ggplot(Final_Dataset, aes(Age_Cat)) + geom_bar(aes(fill = Alcohol_Cat_binary))
ggplot(Final_Dataset, aes(Race_Recoded)) + geom_bar(aes(fill = Alcohol_Cat_binary))
ggplot(Final_Dataset, aes(Gender_Cat)) + geom_bar(aes(fill = Alcohol_Cat_binary))
# The p-value shows how likely it is that the F
# value calculated from the test would have
# occurred if the null hypothesis of no
# difference among group means were true. A low
# p-value therefore indicates that there is a
# statistically significant difference between
```

```
# the two populations on the basis of the
# alcohol/drug use indicator variables.

# File rewritten for each year of data
write_csv(Final_Dataset, "2023_General.csv")
write_csv(Altered_Mental_Status, "2023_AMSSubset.csv")
write_csv(Alcohol_Status, "2023_AlcSubset.csv")

# Load in cleaned datasets:
data_2017_Alc <- read_csv("2017_AlcSubset.csv", col_names = TRUE)
data_2017_AMS <- read_csv("2017_AMSSubset.csv", col_names = TRUE)
data_2017_Alc$year <- "2017"
data_2017_AMS$year <- "2017"
data_2018_Alc <- read_csv("2018_AlcSubset.csv", col_names = TRUE)
data_2018_AMS <- read_csv("2018_AMSSubset.csv", col_names = TRUE)
data_2018_Alc$year <- "2018"
data_2018_AMS$year <- "2018"
data_2019_Alc <- read_csv("2019_AlcSubset.csv", col_names = TRUE)
data_2019_AMS <- read_csv("2019_AMSSubset.csv", col_names = TRUE)
data_2019_Alc$year <- "2019"
data_2019_AMS$year <- "2019"
data_2020_Alc <- read_csv("2020_AlcSubset.csv", col_names = TRUE)
data_2020_AMS <- read_csv("2020_AMSSubset.csv", col_names = TRUE)
data_2020_Alc$year <- "2020"
data_2020_AMS$year <- "2020"
data_2021_Alc <- read_csv("2021_AlcSubset.csv", col_names = TRUE)
data_2021_AMS <- read_csv("2021_AMSSubset.csv", col_names = TRUE)
data_2021_Alc$year <- "2021"
data_2021_AMS$year <- "2021"
data_2022_Alc <- read_csv("2022_AlcSubset.csv", col_names = TRUE)
data_2022_AMS <- read_csv("2022_AMSSubset.csv", col_names = TRUE)
data_2022_Alc$year <- "2022"
data_2022_AMS$year <- "2022"
data_2023_Alc <- read_csv("2023_AlcSubset.csv", col_names = TRUE)
data_2023_AMS <- read_csv("2023_AMSSubset.csv", col_names = TRUE)
data_2023_Alc$year <- "2023"
data_2023_AMS$year <- "2023"

data_combined_Alc <- rbind(data_2017_Alc, data_2018_Alc,
    data_2019_Alc, data_2020_Alc, data_2021_Alc, data_2022_Alc,
    data_2023_Alc)
write_csv(data_combined_Alc, "2017_to_2023_Combined_Alc.csv")
data_combined_AMS <- rbind(data_2017_AMS, data_2018_AMS,
    data_2019_AMS, data_2020_AMS, data_2021_AMS, data_2022_AMS,
    data_2023_AMS)
write_csv(data_combined_AMS, "2017_to_2023_Combined_AMS.csv")

# Models for the year Combined Alcohol data
# subset Data Setup with reference ranges
data_combined_Alc <- read.csv("2017_to_2023_Combined_Alc.csv")
data_combined_AMS <- read.csv("2017_to_2023_Combined_AMS.csv")
```

```
names <- c("Age_Cat","Race_Recoded","Gender_Cat","Dispo_Reason_Recoded","Alcohol_Cat")
data_combined_Alc[,names] <- lapply(data_combined_Alc[,names] , factor)
data_combined_Alc$Age_Cat<- relevel(data_combined_Alc$Age_Cat, ref= "21-44")
data_combined_Alc$Race_Recoded<-al relevel(data_combined_Alc$Race_Recoded, ref= "White")
data_combined_Alc$Gender_Cat<- relevel(data_combined_Alc$Gender_Cat, ref= "Male")
data_combined_Alc$Dispo_Reason_Recoded<- relevel(data_combined_Alc$Dispo_Reason_Recoded, ref = "Closest
data_combined_Alc$Alcohol_Cat<- relevel(data_combined_Alc$Alcohol_Cat, ref="Alc_Disclosed_By_Pt")

##Model 1: are demographics associated with certain alcohol use label
Alcohol_Label_Bias_Model<- multinom(Alcohol_Cat ~ Age_Cat + Race_Recoded + Gender_Cat, data=data_combin
betas.Alcohol<- coef(Alcohol_Label_Bias_Model)
OR.Alcohol<- round(exp(betas.Alcohol),3)
OR.Alcohol
CI.OR.Alcohol<- round(exp(confint(Alcohol_Label_Bias_Model)),3)
CI.OR.Alcohol

#Models for the year 2017 AMS data subset
##Data Setup with reference ranges
data_combined_AMS[,names] <- lapply(data_combined_AMS[,names] , factor)
data_combined_AMS$Age_Cat<- relevel(data_combined_AMS$Age_Cat, ref= "21-44")
data_combined_AMS$Race_Recoded<- relevel(data_combined_AMS$Race_Recoded, ref= "White")
data_combined_AMS$Gender_Cat<- relevel(data_combined_AMS$Gender_Cat, ref= "Male")
data_combined_AMS$Dispo_Reason_Recoded<- relevel(data_combined_AMS$Dispo_Reason_Recoded, ref = "Closest
data_combined_AMS$Alcohol_Cat<- relevel(data_combined_AMS$Alcohol_Cat, ref="Alc_Disclosed_By_Pt")
##Model 2: is alcohol use label associated with different outcome (EMS transport time) controlling for
```

```
Transport_Time_Model <- glm(EMSTransportTimeMin ~ Age_Cat +
    Race_Recoded + Gender_Cat + Dispo_Reason_Recoded +
    Alcohol_Cat, data = data_combined_AMS, family = quasipoisson(link = "log"))
# Poisson family used as transport time is a
# 'count' variable
Betas.Transport <- coef(Transport_Time_Model)
OR.Transport <- round(exp(Betas.Transport), 3)
CI.Transport <- round(exp(confint.default(Transport_Time_Model)),
    3)
Output.Transport <- cbind(OR.Transport, CI.Transport)
Output.Transport

myVars <- c("Age_Cat", "Race_Recoded", "Gender_Cat",
    "Dispo_Reason_Recoded", "EMSTransportTimeMin",
    "Alcohol_Cat")
catVars <- c("Age_Cat", "Race_Recoded", "Gender_Cat",
    "Dispo_Reason_Recoded", "Alcohol_Cat")
```

```
table1.overall <- CreateTableOne(vars = myVars, data = data_combined_Alc,
    factorVars = catVars)
print(table1.overall)

table2.alcohol_strat <- CreateTableOne(vars = myVars,
    strata = "Alcohol_Cat", data = data_combined_Alc,
    factorVars = catVars)
print(table2.alcohol_strat)
```

```
z_Combined <- summary(Alcohol_Label_Bias_Model)$coefficients/summary(Alcohol_Label_Bias_Model)$standard
p_Combined <- (1 - pnorm(abs(z_Combined), 0, 1)) *
    2
p_Combined
```

```
z_Combined <- summary(Transport_Time_Model)$coefficients/summary(Transport_Time_Model)$standard.errors
p_Combined <- (1 - pnorm(abs(z_Combined), 0, 1)) *
    2
p_Combined
```

```
summary(Transport_Time_Model)
```

```
# ggplot for SOA - Age and Gender
data_subset_SOA_AG <- subset(data_combined_Alc, Alcohol_Cat ==
    "Alc_Smell_on_Breath")
data_subset_SOA_AG <- subset(data_subset_SOA_AG, Gender_Cat ==
    "Male" | Gender_Cat == "Female")
p1 <- ggplot(data_subset_SOA_AG, aes(x = as.factor(Age_Cat)),
    fill = as.factor(Age_Cat)) + geom_bar() + facet_wrap(~Gender_Cat) +
    scale_color_brewer(palette = "RdBu") + scale_fill_brewer(palette = "RdBu") +
    theme(legend.position = "none")
p1
```

```
# ggplot for SOA - Gender and Race
data_subset_SOA_GR <- subset(data_combined_Alc, Alcohol_Cat ==
    "Alc_Smell_on_Breath")
data_subset_SOA_GR <- subset(data_subset_SOA_GR, Gender_Cat ==
    "Male" | Gender_Cat == "Female")
p4 <- ggplot(data_subset_SOA_GR, aes(x = as.factor(Race_Recoded)),
p4
    fill = as.factor(Race_Recoded)) + geom_bar() +
    facet_wrap(~Gender_Cat) + scale_color_brewer(palette = "RdBu") +
    scale_fill_brewer(palette = "RdBu") + theme(legend.position = "none")
```

```
# ggplot for OSUS
data_subset_OSUS_AG <- subset(data_combined_Alc, Alcohol_Cat ==
    "Other_Substance_Use_Suspected")
data_subset_OSUS_AG <- subset(data_subset_SOA, Gender_Cat ==
    "Male" | Gender_Cat == "Female")
p3 <- ggplot(data_subset_OSUS_AG, aes(x = as.factor(Age_Cat)),
    fill = as.factor(Age_Cat)) + geom_bar() + facet_wrap(~Gender_Cat) +
    scale_color_brewer(palette = "RdBu") + scale_fill_brewer(palette = "RdBu") +
    theme(legend.position = "none")
p3
```

```
# ggplot for OSUS
data_subset_OSUS_AG <- subset(data_combined_Alc, Alcohol_Cat ==
    "Other_Substance_Use_Suspected")
data_subset_OSUS_AG <- subset(data_subset_SOA, Age_Cat ==
    "0-20" | Age_Cat == "21-44" | Age_Cat == "45-54" |
    Age_Cat == "55-64" | Age_Cat == "65-74" | Age_Cat ==
    "75-84" | Age_Cat == "85+")
```

```
p5 <- ggplot(data_subset_OSUS_AG, aes(x = as.factor(Race_Recoded)),
    fill = as.factor(Race_Recoded)) + geom_bar() +
    facet_wrap(~Age_Cat) + scale_color_brewer(palette = "RdBu") +
    scale_fill_brewer(palette = "RdBu") + theme(legend.position = "none") +
    scale_y_continuous(trans = "log10")
p5
```

```
# ggplot for transport time
p2 <- ggplot(data_combined_AMS, aes(x = Alcohol_Cat,
    y = EMSTransportTimeMin)) + geom_violinplot(outlier.colour = "red") +
    theme(legend.position = "none") + scale_y_continuous(trans = "log10")
p2
```

APPENDIX B. GLOSSARY AND DICTIONARY OF TERMS

Grouping	Descriptor	Definition (Based on Definitions Listed in Extended Data Definitions NEMSIS v3.5.0)
eHistory.17	N/A	Alcohol & Drug Use Indicators
eHistory.17	None Reported	Situations where this option is applicable: The patient (or the EMS crew) identified that the use of drugs or alcohol were unrelated to the patient's condition; There was no apparent alcohol or drug use; or, Patient denied the use/misuse of drugs or alcohol.
eHistory.17	Unable to Complete	Patient was unable to confirm or deny drug or alcohol use for any reason (e.g., unconsciousness, language barrier, or other physical impairment/barrier). This value would also be appropriate if there was not enough patient contact or no other indicators are present to determine.
eHistory.17	Alcohol Containers/Paraphernalia at scene	Refers to any material/object used in the intake of alcohol into the human body.
eHistory.17	Drug Paraphernalia at Scene	Any material/object used in manufacturing, producing, processing, preparing, injecting, ingesting, inhaling, or otherwise introducing into the human body or misuse of a substance.
eHistory.17	Patient Admits to Alcohol Use	By written, verbal, or motor action (e.g., head nod), patient admitted to consuming alcohol or being under the influence of alcohol. Patient does not have to meet any legal standard of intoxication for this purpose.
eHistory.17	Patient Admits to Drug Use	By written, verbal, or motor action (e.g., head nod), patient admitted to injecting, ingesting, inhaling, or being under the influence of drugs. Patient does not have to meet any legal standard of intoxication for this purpose.
eHistory.17	Positive Level Known from Hospital or Law Enforcement	Third-party report of drug or alcohol use based on a diagnostic source (e.g., breathalyzer, blood, urine, field narcotic test, field sobriety test, or other patient record).
eHistory.17	Smell of Alcohol on Breath	EMS clinician observation of an alcohol-like odor coming from the patient
eHistory.17	Other Drug Use Suspected	EMS clinician observation of signs or symptoms of suspected drug use. This value would also be appropriate if the patient's condition improved after administration of an opioid antagonist.
ePatient.13	N/A	Patient Gender
ePatient.13	Female	Patient Gender recorded as female.
ePatient.13	Male	Patient Gender recorded as male.
ePatient.13	Unknown	Patient Gender not identified by EMS clinician
ePatient.14	N/A	Patient Race
ePatient.14	American Indian, Alaska Native, Hawaiian Islander, Pacific Islander (AI, AN, HI, PI)	A person having origins in any of the original peoples of North, Central, and South America and who maintains tribal affiliation or community attachment.
ePatient.14	Asian	A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.
ePatient.14	Black or African American	A person having origins in any of the black racial groups of Africa. Terms such as "Haitian" or "Negro" can be used in addition to "Black or African American."
ePatient.14	Hispanic or Latino	A person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race. The term "Spanish origin" can be used in addition to "Hispanic or Latino."
ePatient.14	White	A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.
ePatient.15	N/A	Patient Age (value)
ePatient.16	N/A	Patient Age (units)

APPENDIX C. 2017 ANOVA SUBSET COMPARISON AND SUMMARY STATISTICS

Variable	*F*-Value	Degrees of Freedom	*p*-value
Subset 1: Alcohol or Drug Use Indicator			
Age	14345	6	<2e-16
Race and ethnicity	1422	4	<2e-16
Gender	11068	2	<2e-16
Subset 2: Altered Mental Status			
Age	246.3	6	<2e-16
Race and ethnicity	161.2	4	<2e-16
Gender	826.9	2	<2e-16

Note: Similar patterns observed for 2018-2023 populations.

APPENDIX D. STUDY POPULATION CHARACTERISTICS (2017-2023)

	Categorical Count	Percentage	Categorical Count	Percentage
	Subset 1: Alcohol or Drug Use Indicator		Subset 2: Altered Mental Status	
Total	14,459,186	100	9,396,991	100
Age (years)				
0-20	797,935	5.5	479,641	5.1
21-44	6,552,786	45.3	1,901,035	20.2
45-54	2,559,280	17.7	911,592	9.7
55-64	2,748,599	19.0	1,399,276	14.9
65-74	1,240,249	8.6	1,682,331	17.9
75-84	396,363	2.7	1,696,399	18.1
85+	163,974	1.1	1,326,717	14.1
Race & Ethnicity				
American Indian, Alaskan Native, Hawaiian, or Pacific Islander	560,083	3.9	214,792	2.3
Asian	152,626	1.1	163,365	1.7
Black or African American	3,035,693	21.0	1,792,571	19.1
Hispanic	1,715,586	11.9	836,517	8.9
White	8,995,198	62.2	6,389,746	68.0
Gender				
Female	4,826,610	33.4	4,996,180	53.2
Male	9,615,847	66.5	4,387,143	46.7
Unknown	16,729	0.1	13,668	0.1
Disposition Reason				
Closest Facility	7,051,664	48.8	4,116,069	53.2
Patient Choice	4,363,249	30.2	1,783,771	19.0
Protocol	1,074,700	7.4	687,042	7.3
Regional Specialty Center	569,640	3.9	590,449	6.3
Family Choice	397,908	2.8	937,792	10.0
Other	154,508	1.1	246,762	2.6
EMS Transport Time in Minutes				
Transport Time in Mins (SD)	14.66	16.06	16.88	19.01
Alcohol Categorization				
Alcohol Disclosed by Patient	5,944,108	41.1	541,437	5.8
Alcohol Level Known	478,465	3.3	66,648	0.7
Alcohol Paraphernalia on Scene	1,168,535	8.1	221,994	2.4
Smell of Alcohol	2,503,663	17.3	385,886	4.1
No Alcohol Disclosed	-	-	7,604,556	80.9
Other substance Use Suspected	4,364,415	30.2	576,470	6.1

Table D-1: Study population characteristics for demographic and altered mental status subsets.

	Alcohol Use Descriptors				
	Alcohol Disclosed by Patient	Alcohol Level Known	Alcohol Paraphernalia On Scene	Smell of Alcohol	Other Substance Use Suspected
Total	5,944,108	478,465	1,168,535	2,503,663	4,364,415
Age (years), *n* (%)					
0-20	226,268 (3.8)	34,355 (7.2)	45,329 (3.9)	112,682 (4.5)	379,301 (8.7)
21-44	2,423,094 (40.8)	194,326 (40.6)	418,850 (35.8)	1,025,944 (41.0)	2,490,572 (57.1)
45-54	1,150,208 (19.4)	70,540 (14.7)	223,082 (19.1)	483,243 (19.3)	632,207 (14.5)
55-64	1,338,139 (22.5)	71,923 (15.0)	284,116 (24.3)	555,805 (22.2)	498,616 (11.4)
65-74	595,634 (10.0)	49,920 (10.4)	141,014 (12.1)	238,535 (9.5)	215,146 (4.9)
75-84	166,844 2.8)	35,888 (7.5)	41,077 (3.5)	64,764 (2.6)	87,790 (2.0)
85+	43,921 (0.7)	21,513 (4.5)	15,067 (1.3)	22,690 (0.9)	60,783 (1.4)
Race & Ethnicity, *n* (%)					
American Indian, Alaskan Native, Hawaiian, or Pacific Islander	267,520 (4.5)	23,743 (5.0)	49,054 (4.2)	129,914 (5.2)	89,852 (2.1)
Asian	61,595 (1.0)	5,269 (1.1)	13,238 (1.1)	31,617 (1.3)	40,907 (0.9)
Black or African American	1,178,008 (19.8)	86,263 (18.0)	212,886 (18.2)	500,724 (20.0)	1,057,812 (24.2)
Hispanic	715,730 (12.0)	43,636 (9.1)	145,073 (12.4)	348,654 (13.9)	462,493 (10.6)
White	3,721,255 (62.6)	319,554 (66.8)	748,284 (64.0)	1,492,754 (59.6)	2,713,351 (62.2)
Gender, *n* (%)					
Female	1,893,710 (31.9)	193,378 (40.4)	383,063 (32.8)	756,042 (30.2)	1,600,417 (36.7)
Male	4,044,416 (68.0)	284,287 (59.4)	784,192 (67.1)	1,745,337 (69.7)	2,757,615 (63.2)
Unknown	5,982 (0.1)	800 (0.2)	1,280 (0.1)	2,284 (0.1)	6,383 (0.1)
Disposition Reason, *n* (%)					
Closest Facility	2,843,450 (47.8)	179,512 (37.5)	612,063 (52.4)	1,250,603 (50.0)	2,166,036 (49.5)
Patient Choice	1,956,101 (32.9)	69,790 (14.6)	322,571 (27.6)	733,540 (29.3)	1,281,257 (29.4)
Protocol	441,115 (7.4)	24,373 (5.1)	87,873 (7.5)	209,286 (8.4)	312,053 (7.1)
Regional Specialty Center	224,294 (3.8)	56,937 (11.9)	38,144 (3.3)	109,999 (4.4)	140,266 (3.2)
Family Choice	132,191 (2.2)	8,703 (1.8)	46,362 (4.0)	68,745 (2.7)	141,907 (3.3)
Other	350,702 (5.9)	139,233 (29.1)	60,764 (5.2)	139,191 (5.2)	327,331 (7.5)
EMS Transportation Time, Mean (*SD*)					
EMS Transportation Time	14.48 (15.51)	28.33 (33.25)	13.16 (12.14)	13.37 (13.25)	14.53 (15.54)

Table D-2. Study population characteristics, stratified by descriptor of alcohol use.

APPENDIX E. LOGISTIC REGRESSION MODEL DATA FOR NEMSIS 2017-2023 BY ALCOHOL USE DESCRIPTOR

	Alcohol Use Descriptors (Relative to Alcohol Disclosed by Patient)			
	Alcohol Level Known	Alcohol Paraphernalia On Scene	Smell of Alcohol	Other Substance Use Suspected
Intercept	0.076 [0.076,0.077]***	0.171 [0.170, 0.172]***	0.410 [0.409, 0.411]***	1.022 [1.019, 1.024]***
Age, years (*OR* [95%CI]) - Relative to 21-44 years-old population				
0-20	1.854 [1.831, 1.877]***	1.145 [1.133, 1.157]***	1.177 [1.169, 1.186]***	1.630 [1.621,1.639]***
45-54	0.763 [0.756, 0.770]***	1.128 [1.122, 1.135]***	1.000 [0.996, 1.004]	0.527 [0.526, 0.529]***
55-64	0.670 [0.664, 0.676]***	1.243 [1.237, 1.250]***	0.998 [0.994, 1.002]***	0.349 [0.348, 0.351]***
65-74	1.031 [1.020,1.041]***	1.382 [1.373, 1.391]***	0.971 [0.966, 0.976]***	0.335 [0.334 ,0.337]***
75-84	2.537 [2.506, 2.569]***	1.420 [1.404, 1.436]***	0.959 [0.950, 0.968]***	0.485 [0.481, 0.489]***
85+	5.597 [5.502, 5.694]***	1.963 [1.926, 2.000]***	1.287 [1.266, 1.308]***	1.267 [1.251,1.283]***
Race & Ethnicity (*OR* [95%CI]) - Relative to White race and ethnicity				
American Indian, Alaskan Native, Hawaiian, or Pacific Islander	1.115 [1.100, 1.131]***	0.964 [0.955, 0.974]***	1.205 [1.196, 1.213]***	0.403 [0.400,0.406]***
Asian	0.955 [0.928, 0.983]*	1.118 [1.097, 1.140]***	1.266 [1.248, 1.283]***	0.745 [0.736, 0.755]***
Black or African American	0.931 [0.924, 0.939]***	0.916 [0.911, 0.921]***	1.056 [1.052,1.060]***	1.217 [1.213, 1.221]***
Hispanic	0.745 [0.737, 0.753]***	1.075 [1.068, 1.081]***	1.196 [1.191,1.202]***	0.737 [0.734, 0.740]***
Gender (*OR* [95%CI]) - Relative to male gender				
Female	1.304 [1.296, 1.312]***	1.046 [1.041, 1.050]***	0.929 [0.926, 0.932]***	1.133 [1.130, 1.136]***
Unknown	1.757 [1.631, 1.892]***	1.131 [1.064, 1.201]***	0.869 [0.828, 0.912]***	1.325 [1.278, 1.374]***

* p <0.01, ** p < 0.001, *** p < 0.0001

APPENDIX F. GENERALIZED LINEAR MODEL FOR EMS TRANSPORT TIME OF ALTERED MENTAL STATUS PATIENTS FOR NEMSIS 2017-2023

	Odds Ratio	95% Confidence Interval
(Intercept)	11.386	[11.347,11.425]*
Patient age - Relative to 21-44 years-old population		
Age 0-20	1.217	[1.213,1.220]*
Age 45-54	1.032	[1.029,1.034]*
Age 55-64	1.052	[1.049,1.054]*
Age 65-74	1.042	[1.039,1.044]*
Age 75-84	1.004	[1.002,1.007]*
Age 85+	0.913	[0.911,0.916]*
Patient Race & Ethnicity - Relative to White race and ethnicity		
American Indian, Alaskan Native, Hawaiian, or Pacific Islander	1.034	[1.029,1.038]*
Asian	0.832	[0.827,0.836]*
Black or African American	0.853	[0.851,0.854]*
Hispanic	0.881	[0.878,0.883]*
Gender - Relative to Male gender		
Female	0.991	[0.990,0.992]*
Unknown	1.118	[1.101,1.134]*
Disposition - Relative to Closest Facility		
Diversion	1.629	[1.616,1.642]*
Family Choice	1.432	[1.428,1.435]*
Insurance	1.932	[1.909,1.937]*
Law Enforcement	1.323	[1.311,1.335]*
Medical Direction	1.589	[1.579,1.599]*
Other	1.829	[1.822,1.835]*
Patient choice	1.257	[1.255,1.260]*
Physician choice	2.158	[2.153,2.163]*
Protocol	1.199	[1.195,1.202]*
Regional Specialty	2.122	[2.117,2.127]*
Alcohol Use Descriptor - Relative to Alcohol Disclosed by Patient		
Alcohol Level Known	1.552	[1.541,1.562]*
Alcohol Paraphernalia	0.968	[0.962,0.974]*
Smell of Alcohol	0.936	[0.931,0.940]*
None	1.194	[1.190,1.198]*
Substance Use Suspected	1.001	[0.996,1.005]

* $p < 2e\text{-}16$

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RESEARCH REPORTS

ASSESSING PARAMEDICS' PERSPECTIVES ON AN EMERGENCY DEPARTMENT VIRTUAL OBSERVATION UNIT FALL PREVENTION PROGRAM

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Abstract

Introduction: Falls are the leading cause of fatal and nonfatal injury for older adults. We created the Emergency Department Virtual Observation Unit (EDVOU) to provide observation level care for older ED patients in their homes and better assess their fall risks. Mobile integrated health (MIH) paramedics visited patients' homes where they conducted a multicomponent fall evaluation and facilitated an emergency medicine telemedicine consult. We aimed to understand paramedics' experiences in our EDVOU Fall Program.

Methods: We conducted a qualitative study through semi-structured interviews of EDVOU Fall prevention paramedics to determine how comfortable they were with implementing the EDVOU fall program. Interviews were transcribed, independently reviewed by multiple team members, and subsequently coded into themes.

Results: Fifteen of thirty-six (42%) paramedics were interviewed. Three main themes emerged: 1) learning new skills otherwise not included in paramedic training, 2) having unique perspectives and interactions with patients in the home environment where most other clinicians do not have insight, and 3) being more integrated in a team to play a bigger role in patient care.

Discussion: MIH paramedics had an overwhelmingly positive experience with the program. Paramedics felt they played a pivotal role in fall prevention, as the program allowed them to learn more skills, form and share unique relationships and clinical perspectives given their role, and feel more valued as part of a patient team/care continuum. Paramedics' unique role of entering the home to provide medical care are an untapped resource in preventative care, particularly as part of a virtual fall program.

INTRODUCTION

Falls are the leading cause of fatal and nonfatal injury as well as injury-related death for adults 65 years or older, with approximately 1 in every 4 older adults reporting a fall every year and around half being recurrent falls (Akyol, 2007; "Centers for Disease Control and Prevention, National Center for Injury Prevention and Control," n.d.; R. Kakara et al., 2023; R. S. Kakara et al.,

2024). Furthermore, older adults have the highest risk of serious injury or death following a fall(Falls, n.d.). Of the estimated 2.4 million Emergency Department (ED) visits and >700,000 hospitalizations from injury mechanisms among adults 65 years old, unintentional falls accounted for 91.8% of incidences(Moreland & Lee, 2021). Despite the frequency of falls and ample ED opportunities to prevent their recurrence, fall risk is rarely assessed in the ED (Davenport, Alazemi, et al., 2020; Tirrell et al., 2015). A study found that physicians and advanced practice providers felt they lacked adequate time in the ED to assess for fall risks due to limited resources and ED crowding (Davenport, Cameron, et al., 2020).

Telehealth/Mobile Integrated Health (MIH) programs present an emerging option for assessment of fall risks (Jiang et al., 2025). We created the ED Virtual Observation Unit (EDVOU) in January 2022 to provide observation level care for ED patients in their homes (Harper et al., 2021; Hayden et al., 2024). Within the EDVOU program, a pilot falls prevention program was created to better assess and manage fall risks for older patients. A crucial aspect of the fall program was the MIH paramedic visits. During these visits to the patients' homes, which happened one day after ED visit and took on average 30-40 minutes, they conducted a home safety evaluation, a medication safety evaluation, and the Timed Up and Go (TUG) Test, a common functional test to determine fall risk (Jones et al., 2024).

In recent years, there has been a movement towards involving paramedics and/or Emergency Medical Service (EMS) personnel in healthcare, particularly in preventative services (Creating New EMS Education Standards, n.d.). The Community Health Assessment Program through Emergency Medical Services (CHAP-EMS) study found that EMS personnel successfully provided diabetes and cardiovascular health prevention through a weekly program (Agarwal et al., 2016). Given the untapped resource and potential benefits of paramedics being on scene to see patients in their homes, Speier et. al performed a literature review on the effectiveness of EMS's involvement in fall prevention (Speier et al., 2024). They found mixed to successful results for EMS's role in assessing and referring patients who had fallen or were at risk for falling. They also identified two studies in the United States that established a Community Paramedicine/Mobile Integrated Health (CP/MIH) program, both of which saw a significant decrease in falls and fall-related 911 calls (Camp et al., 2024; Quatman-Yates et al., 2022).

However, there is scant literature documenting paramedics' perspectives and experiences being involved in fall risk prevention programs, particularly a VOU Falls program. To date, only one study has investigated paramedics' experiences assisting older adults with falls and found that their experiences were mostly positive, aside from a lack of services and situations that required complex decision-making (Watkins et al., 2024). Yet, there is still little literature looking into paramedics' perspectives on being the central provider in a fall prevention program that includes an in-person MIH visit and ED telemedicine consult.

Given the gap in literature on MIH paramedics' perspectives on their central role in an EDVOU Fall Prevention program, our study objective was to better understand their experience. We specifically sought to understand their viewpoint, particularly in performing the multicomponent fall evaluation, to improve this program as well as other potential MIH programs.

METHODS

Study Design

We conducted a qualitative observational case study by interviewing paramedics involved in the pilot EDVOU Fall prevention program. Details of the EDVOU Fall prevention program have been published elsewhere (Jones et al., 2024). In brief, we implemented a pilot EDVOU Falls prevention program in July of 2022 at a tertiary academic ED with 120,000 annual visits and approximately 25% geriatric volume in the Northeast. The study was designed and conducted using the Consolidated Criteria for Reporting Qualitative Research (COREQ) criteria (Choo et al., 2015; Dossett et al., 2021; Ranney et al., 2015).

Subject Selection/Enrollment

All paramedics who staffed the EDVOU/MIH program were included and invited to be a part of this study, which was approved by MGB IRB and deemed exempt. All paramedics were emailed at least three times with invitations to participate in the study. Interviews were held in February and March of 2024.

Data Collection

We designed a semi-structured interview guide (Supplement) to determine how comfortable paramedics were with conducting the home safety evaluation, medication safety evaluation, and TUG test. We invited all 36 paramedics affiliated with the EDVOU to participate in interviews and conducted interviews until we reached thematic saturation. Trained female research assistant AEJ, BS and GW, MS/MPH, medical student conducted and recorded interviews on Zooms or Teams, which were transcribed via a transcription program TranscribeMe! All identifiable information was removed prior to any analyses.

Analysis

Several transcripts were independently reviewed by multiple team members, and subsequently one coded the rest after an agreed upon code list. Each co-investigator independently generated codes using an inductive approach, which were then coalesced using qualitative research methods based on grounded theory. Team members (SWL (MD), AEJ (BS), GW (MS/MPH), KS(MD)) met to discuss common themes generated using the codes. Data analysis occurred in tandem with data collection. Recruitment ended when thematic saturation was reached.

RESULTS

Fifteen paramedics were interviewed. Responses to semi-structured questions can be seen in Table 1. Three overarching themes emerged from our interviews and are as follows: 1) learning new skills otherwise not included in paramedic training, 2) having unique perspectives and interactions with patients in the home environment where most other clinicians do not have insight, and 3) being more integrated in a team to play a bigger role in the care of patients. Quotes from participants can be seen in Table 1.

Theme 1: Learning new skills otherwise not included in paramedic training

Interviewees expressed great interest and excitement in learning new skills and high levels of comfort in practicing new skills and the program itself. Specifically, paramedics appreciated learning how to perform the home safety evaluation, medication safety evaluation and TUG Test, tasks not included in their general paramedic training:

> *"It's the pinnacle of my career as a paramedic where I get to literally work at the highest end of my scope of practice." [UI 15]*

Once paramedics had obtained program training as part of the EDVOU Falls program, paramedics felt comfortable performing such evaluations. A majority of paramedics mentioned "using validated measures such as the TUG test or any other sort of fall assessment… that's not part of paramedic training, but I would say it was really easy" [UI 2] and being "fairly comfortable… have done it a few times. It's kind of become a second nature thing to me and my career." [UI 12] Overall, continuous learning and skill expansion increased paramedic satisfaction.

Learning and using new skills/role	But in EMS specifically, you're there only after someone calls you specifically and something bad happens, which is either the fall or you go somewhere for another medical emergency and you realize that there is a further fall risk there. And usually we don't have the time or the bandwidth of the resources to discuss fall mitigation in that instance. UI 10
	So like this is where we now kind of have this new role of a Community paramedic where that is the intent is to go in and almost prevent these falls from potentially even taking place. UI 15
	So I mean, we're getting specialized training and we kind of get to work a little bit outside of our regular protocols and scope of practice, which is nice… So it really does force you to actually still wanna learn and still wanna do a deep dive into medicine like you actually have to know what medicines our pre hospital. UI 15
Comfort with fall program and elements	It's kind of become a second nature thing to me and my career just generally when I walk into a home, I kind of start looking for hazards and stuff anyways, so I'm fairly comfortable with that. UI 12
First on scene and ability to see patients in their home	EMS has more access to patients' houses than I think anybody because you do have those patients that don't qualify for VNA or don't have the services or don't need the services. So you see EMS [sees] these residents more than any[one]. So they're the ones that are helping, and they're the ones that are seeing the situation. So I think out of most people in the medical community, they see it more than anything. UI 4
	I think that there's a unique perspective that EMS providers have because we see the patients in their home and the things that are around their home and kind of supports they may or may not have. So I think that that's unique to EMS. UI 6
	Uh, sure, I think, uh, we kind of have a unique perspective where we often are in the patients home. So we can really see trip hazards. You know how their housing is set up. You know where they keep various items like for a daily living and that sort of stuff. Uh, so I think we have a unique experience where we can kind of be the eyes on a situation that can hopefully help. You know, get geriatric patients set up for success and to help prevent falls in the future. UI 12

Table 1: Sample responses from paramedics by themes

Ability to hear patients' perspectives	So I think that they would listen to the provider if they're in the emergency room proper. But when they get home, they're like, 'Meh.' UI 1
	There's been a good amount of buy-in from the patients that I've worked with that they think it's great. They might not fully understand it either. I think that they just sometimes hear you know that we'll come to their house and try to work with them at home. And that's what they understand. Family members, I think, are really appreciative of it, though. I think that they really enjoy that aspect so that they don't have to go anywhere. UI 6
	You know, it might just be brushed over slightly during the intake or the patient might, in the moment, say, "Yeah, that's fine." Say they're sitting in the ER. They say, "Yeah, check. I agree. I understand they're going to do this with my meds. I agree. And then you get home." And then they go, "No, I didn't agree to that." Or no one told me what they're saying. So it's one of those things where you know we're trying to do it properly, but we're also trying to avoid unnecessary conflict and accommodate patients. UI 7
	Everyone's saying they love not hearing call bells and you know everything else. The demented patient two doors down. The last time they were in the hospital, they listened to scream for 10 days straight. UI 7
	You know, so they're just trying to maintain some sort of control over their over their own personal freedoms in, you know that that that, that can be a tough a tough hurdle, you know, a tough. We're doing this in their best interests and they may understand that, but at some point, you know, everybody wants to have control over their own personal being in, you know, it's hard to accept that it, you know, when you get to be in that age group. UI 11
	Some patients are initially hesitant, and it feels like a little intrusive, having us like, come into their homes and stuff, but the vast majority, once they've been in the program for a day or so, they much prefer it to being in a hospital. And I think most patients overall have a better outcome like you know medically and honestly, umm, like emotionally I think they really invest themselves. So I think a lot of patients really enjoy it. UI 12
	Excuse me, I have yet to come across a patient who does not at least appreciate the idea of it. I think there's some patients who, like I said, might not understand and I don't wanna use the word intrusive, but just how? We come to the home. I think that that is probably one of the biggest turnoffs I've seen and felt from patients as they're just like how many more are you coming today? When they are approached in the hospital, they may not get a full picture of what the program looks like because again, at that point we are just like up against the clock to like, hey, is this what you wanna do? … Ohh so I think we're obviously doing a really good thing and I think a majority I would say 99.3 percent of patients are over the moon about the program and the services they receive from it. UI 15
Forming unique relationships and interactions with patients	I get so much positive feedback from patients about it. I mean, I've worked pre-hospital for years, and I very rarely get complimented by patients for what we do. But since doing VOU, it's all positive feedback from all the patients. They love it. They love being able to be home and be treated there. UI 3
	That one's hard to pinpoint because I had a lot of good experiences. You can give a few if you can't pinpoint one, or? Honestly, it's just building these relationships with patients. You know They welcome you into their home and they want to make you breakfast. And you know there was one family that I was going to see for three days in a row, and his wife would send me off with a snack. Like I wouldn't sit down and you know because we were still wearing masks at the time. So she would send me you know say our goodbyes, and she always sent me with a snack and water, so. That's so nice. UI 5
	And therefore we're in their space for a lot longer. I joke with my staff that there is no such thing as a home game at home hospital every amount of care we provide is an away game because we're on the we're on the patient's turf. And so everything we do is in their space. And so it's up to us to respect their space. But in doing so, we get to build these connections with people. Who would you know who would know not have that opportunity? Otherwise, who would not have the opportunity to be heard to be, you know, felt to be listened to in the, you know, medicalized and sterilized hospital environment. And I think that that's been an experience that I've had more than once in my experience and an experience that a number of my paramedic team has, you know, referenced to me that how special that feels. UI 16

Table 1 (continued): Sample responses from paramedics by themes

Playing a bigger role in the care of patients	I mean, like I said, the one woman who just kind of threw a bunch of little white ones together, and they were like very varying different medications that were very intense to group together, like to just kind of take as a, "Oh, well, I think it's that one." So like I said, though, I had recommended to the doctor. Could we try to get her a V&A service or something to help her or like a blister pack from her pharmacy? UI 3
	I think you know as a paramedic for a very long time, there's been so many times where you know you recognize the problem. You know what the patient needs, and you still have to bring them to the hospital because you're limited as to what you can provide them. And to be able to see them in their home, work with a physician to you know get a proper diagnosis and a treatment plan and leave them in their home, to me, is like that is like the best part of my job is like because I think people do better when they are at home. And if we can bring medicine to them, you know I think outcomes are just better for that UI 9
Paramedics being more valued by other members of the care team	So when I go in and introduce myself as paramedic, they understand, but then they actually see what we do and they're impressed by the amount of stuff that MIH brings to the table. UI 11

Table 1 (continued): Sample responses from paramedics by themes

Theme 2: Having unique perspectives and interactions with patients in the home environment where most other clinicians do not have insight

All paramedics discussed having unique perspectives and interactions with patients given their role as EMS. As they are the first to be on the scene, MIH paramedics have the advantage of seeing patients in their home setting where most other clinicians do not have insight, which highlights the significance of this fall prevention program. Paramedics spoke highly of their unique position of being able to see patients, noting that

> *"it's one thing to have a patient go into an ER and have a doctor say, 'alright, take 40 Lasix,' it's another thing to make sure that that 40 Lasix got filled… [or] make sure that they have food in their refrigerator." [UI 4]*

This highlights the importance of home medication safety evaluation, which is the home safety portion of the EDVOU Falls evaluation program.

Paramedics also mentioned being able to

> *"tell if their homes are safe for them pre-hospital with the VOU program… assessing the homes and seeing if there's any trip hazards and fixing them as we can or [linking] the patients with the people that they need to help them make their homes safe." [UI 5]*

Finally, paramedics mentioned being the "eyes on a situation that can hopefully help… [and] get geriatric patients set up for success and to help prevent falls in the future." [UI 12]

As the ones directly interacting with patients in their home, paramedics also expressed the importance of being able to hear directly from patients regarding their experiences. According to the paramedics interviewed in the study, the program has been well received by patients who have "really enjoyed having us meet them halfway…were grateful to be home," [UI 6] "saying they love not hearing call bells and you know everything else," [UI 7] and "really enjoy it." [UI 12] Paramedics have also found that older patients

> *"managed to learn from the information… stuck a little bit better when they were in their home as opposed to in the hospital… they can kind of focus and they have a more familiar environment." [UI 6]*

When asked about positive experiences, most paramedics mentioned their appreciation of forming unique relationships and interactions with patients. One paramedic mentioned having "worked pre-hospital for years and very rarely get compliments by patients for what [they] do, but since doing VOU, it's all from all the patients." [UI 3] One shared that patients "welcome you into their home, and they want to make you breakfast…and she always sent me with a snack and water, so that's so nice." [UI 5] Another shared that after several visits, a patient

> *"would open up a little more, a little more, and a little more about his frustration with the healthcare system. I shared with him some of my own personal stories. We got to become more or less friends, and he had a little brighter outlook. I genuinely think that we made an impact on each other. Those types of relationships don't typically get to happen in the same way in hospital medicine… and through home hospital is, there's just a different feel. So those are the experiences that I think are really, really valuable when we're talking about patient-centered medicine from the hospital." [UI 13]*

Many paramedics feel that through this program, they have been able to play a bigger role in the care of their patients. A paramedic recalled recognizing that a particular patient did not have a safe medication system and "recommended to the doctor, 'could we try to get her a VNA service or something to help her or like a blister pack from her pharmacy?'" [UI 3] One paramedic shared his/her frustrations with the broken system where paramedics

> *"show up, and they have to take them to the hospital… why can't I just give them 100 of Lasix and just sit here with them for a half hour and just see how they go.. and see how things turn out? … So I think that's where the VOU's niche kind of plays a role in it." [UI 4]*

Another commented that this program allows them "to be able to see them in their home, work with a physician to... get a proper diagnosis and a treatment plan and leave them in their home, to me, is like that is like the best part of my job." [UI 9]

Theme 3: Being more integrated in a team to play a bigger role in the care of patients

With the VOU program, paramedics felt more integrated, respected, and valued by other care team members. One mentioned certain pre-existing challenges, especially that

> *"we're not really regarded as healthcare professionals… The public still sees us as the ambulance driver, so they don't always take what you know we say to them as you know pertinent. I think with the mobile integrated health role, when you're affiliated with a hospital and you have team members that are nurses and doctors … [and] physical therapists and occupational therapists that we have as resources, I think our credibility elevates a little bit and we probably have more pull when we do our home hospital visits." [UI 9]*

One paramedic mentioned that now, "when I go in and introduce myself as a paramedic, they understand, but then they actually see what we do and they're impressed by the amount of stuff that MIH brings to the table." [UI 11] A paramedic concluded that

> *"as EMS prehospital medicine continues to evolve where we are now starting to actually be viewed as part of the patient care continuum. I think what we see is prehospital providers is starting to actually be valued where we can sit." [UI 15]*

DISCUSSION

We found that MIH paramedics in the EDVOU Falls prevention program had an overwhelmingly positive experience with the program. The paramedics felt they played a pivotal role in fall prevention, as the program allowed them to learn more skills, form and share unique relationships and clinical perspectives given their role, and feel more valued as part of a patient team/care continuum. This study is one of few to look at the perspectives and experiences of MIH paramedics involved in a geriatric fall prevention program. The findings indicate clinically pertinent roles that they provide for older adults to prevent future falls at their homes.

The EDVOU Fall program involved extra training for paramedics on skills and responsibilities not normally included in paramedic training. More programs seem to be utilizing MIH paramedics and thus expanding their skill sets. A program created in rural New York consisted of a unique collaboration between the Department of Health, the Office for the Aging (OFA), Tri-County Family Medicine, and the University of Rochester who recognized a need for additional EMS training and created an EMS training program on various aging programs, such as trauma and falls (Shah et al., 2010). Quatman-Yates et. al also created and looked into a community paramedic program's optimization of Community centered Fall Intervention Team (Community-FIT), a fall prevention delivery system (Quatman-Yates et al., 2022). Another study in the UK also conducted a cluster randomized study comparing intervention paramedics to control paramedics with the former having received training on older adult falls (Snooks et al., 2017). All agreed that paramedics needed additional training to play a key role in preventing falls and complement our study's findings that our MIH paramedics appreciate expanding their skill set.

Our study also highlighted the unique perspective EMS brings to patient care, especially in the MIH programs. Traditionally viewed as first responders to primarily traumatic and medical emergencies, EMS' roles and responsibilities have evolved to include assessment, referral, education, and communication as a result of the aging population (van Vuuren et al., 2021). Community paramedics programs have been found to positively impact the health of older patients as well as the health system. Paramedics have the unique advantage of interacting with patients in their homes, allowing them to be advocates, mediate between the healthcare system and community, as well as "identify people with risk factors, and opportunities to provide information, brief interventions and [direct] people to locally provided services." (Schofield & McClean, 2022) Torres et. al highlight that "despite the wide range of vital and highly skilled services that EMS clinicians provide, their contributions are often unknown to, or misunderstood and not acknowledged by, other health care professionals" ("How to Better Value EMS Clinicians as Key Care Team Members," 2022). Yet, there is a movement towards including EMS in multidisciplinary efforts in fall prevention programs, which has yielded mostly positive and some mixed results (Agarwal et al., 2016; Camp et al., 2024; Creating New EMS Education Standards, n.d.; Quatman-Yates et al., 2022; Speier et al., 2024).

An overwhelming number of paramedics interviewed in this study expressed excitement and gratitude for the EDVOU program. Many of them mentioned that prior to the program, their responsibilities, role, and expertise had been misunderstood and undervalued, which parallels findings from another study regarding paramedics' perceptions of another VOU program (Jung et al., 2023). Yet, through the program, they felt very

supported by other members of the program administrative team, much more valued amongst other healthcare providers in the care of their patients, and part of a team where their roles and expertise were highlighted and understood. When interviewed, paramedics in community paramedicine programs enjoyed being able to help patients in a way that differed from traditional EMS roles, building rapport with patients, ensuring a sense of community in which there is improvement in patients' health and well-being, and being able to witness positive outcomes first-hand (Paramalingam et al., 2024). In particular, paramedics felt that collaboration with providers and different services led to improved career satisfaction, and they felt respected and part of a valued healthcare team. This collaboration provided better coordinated care and showcased paramedics' clinical skills beyond that of transport and ambulance-driving to other healthcare professions."

EMS have the potential to be utilized in unique ways and provide more services than their traditional roles, especially in the role of preventative services (Agarwal et al., 2016; Creating New EMS Education Standards, n.d.; Jiang et al., 2025). A literature review done by Bonner et. al highlighted multiple studies that demonstrated a positive impact on recurrent falls, independence due to activities of daily living and patients' wellbeing when paramedics were involved in referring older adult falls patients to fall-prevention programs (Bonner et al., 2021). A national retrospective cross-sectional study concluded that there is potential for development of community paramedic services and referrals to community intervention programs to provide EMS clinicians with more tools and information on older adult falls (Joiner et al., 2023). A study found that the implementation of Stopping Elderly Accidents, Deaths, and Injuries (STEADI) fall prevention program through EMS services turned out to be effective and cost-saving for addressing older adults' fall prevention (Camp et al., 2024). These imply that we are currently underutilizing potentially valuable paramedic workforce who can be trained to execute certain clinical tasks well, including those pertaining to older patients at-risk for falls.

Our study seems to imply that programs like our EDVOU are appealing to paramedics as it allows them to expand their skill set, highlights their unique experiences and perspectives in the healthcare continuum, and allows them to feel that they are being better integrated in their patients' care team. This implies that expanding programs such as the EDVOU Fall program and other geriatric-centric programs could improve care of older patients at a higher level. This type of hybrid program that utilizes in person MIH paramedics along with a telemedicine consult could be a way of incorporating the best of both worlds. Our findings are important as paramedics play an integral role in the provision of healthcare and including their perspective on how they can contribute to patient care is important to inform health policy, patient care and/or systems improvement, especially when contemplating innovative, efficient program design.

LIMITATIONS

One limitation to this study is potential for social desirability bias among interviewed paramedics. All paramedics were invited to be interviewed, and it is quite possible the views of those who consented and participated differed from those who did not. There also could have been bias in the patients who consented to participating in the EDVOU Falls program, which could have influenced paramedics' experiences. Furthermore, we limited our interviews to paramedics already participating in the EDVOU Falls program;

results may not reflect all paramedics. Lastly, due to the small sample size and study conduction through an MIH, findings may not be generalizable to other study settings and locations. We acknowledge that including the perspective of multi-stakeholders could have offered a more comprehensive viewpoint and actionable items; however, we were limited by limited RA time/resources. Nevertheless, this is the first study that described the potential for MIH involvement for fall prevention at home. Future studies should include the viewpoints of other stakeholders.

CONCLUSION

Paramedics with their unique role of entering the home to provide medical care are an untapped resource and can potentially play a pivotal role in preventative care, particularly in fall prevention in older patients. In this study, paramedics reported a positive experience working in an EDVOU fall program given they learned new skills on fall prevention, developed unique relationships with and perspectives of patients, and felt more part of the patient care continuum. Paramedics have a unique viewpoint of patients' living environments, and future fall prevention programs should consider this as part of their strategy.

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SUPPLEMENT 1: CONSOLIDATED CRITERIA FOR REPORTING QUALITATIVE STUDIES (COREQ): 32-ITEM CHECKLIST

Developed from:

Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care. 2007. Volume 19, Number 6: pp. 349 – 357

No. Item	Guide Questions/Description	Reported on Page #
Domain 1: Research Team and Reflexivity		
Personal Characteristics		
1. Interviewer/ facilitator	Which author/s conducted the interview or focus group?	6. Trained research assistants (AEJ, BS and GW, MS/MPH) conducted and recorded interviews on Zooms or Teams
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	6. Trained research assistants (AEJ, BS and GW, MS/MPH) conducted and recorded interviews on Zooms or Teams
3. Occupation	What was their occupation at the time of the study?	6. Research Assistant and Medical student
4. Gender	Was the researcher male or female?	6. Both are female
5. Experience and training	What experience or training did the researcher have?	6. Experience with performing and analyzing qualitative interviews
Relationship with participants		
6. Relationship established	Was a relationship established prior to study commencement?	6. No, the interviewers had no prior relationships prior to the study
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	6. Participants did not know about the research other than that we sought their perspective on the program and their experience
8. Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	6. Research interests in EDVOU Fall Prevention Program.
Domain 2: Study Design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	6. Grounded theory
Participant selection		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	6. We attempted to interview all MIH paramedics.
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	6. We emailed all MIH paramedics.
12. Sample size	How many participants were in the study?	7. Fifteen
13. Non-participation	How many people refused to participate or dropped out? Reasons?	7. 21 did not participate
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	6. Via Zoom or Teams
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	6. No
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	7. Interviews were held from February to March of 2024
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	6. Added as supplement
18. Repeat interviews	Were repeat interviews carried out? If yes, how many?	7. None
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	6. Zoom/Teams

No. Item	Guide Questions/Description	Reported on Page #
20. Field notes	Were field notes made during and/or after the interview or focus group?	6. No
21. Duration	What was the duration of the interviews or focus group?	6. Interviews ranged from 26 to 42 minutes.
22. Data saturation	Was data saturation discussed?	6. We conducted interviews until data saturation
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No
Domain 3: Analysis and Findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	6. Four
25. Description of the coding tree	Did authors provide a description of the coding tree?	6. Yes. Please see Table 1 of quotations by themes.
26. Derivation of themes	Were themes identified in advance or derived from the data?	6. Derived from data
27. Software	What software, if applicable, was used to manage the data?	6. No software used
28. Participant checking	Did participants provide feedback on the findings?	No
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	7-11. Yes
30. Data and findings consistent	Was there consistency between the data presented and the findings?	7-11. Yes
31. Clarity of major themes	Were major themes clearly presented in the findings?	7-11. Yes
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	7-11. Yes

SUPPLEMENT 2: SEMI-STRUCTURED INTERVIEW GUIDE

1. How has your experience been with geriatric fall patients in general in your career?
2. What role do you think EMS has in assessing fall risk among geriatric patients?
3. What role do you think EMS has in fall prevention among geriatric patients?
4. How many fall patients did you have in the ED Falls VOU Program?
5. How comfortable are you with performing the Timed Up and Go (TUG) test? Explain.
6. How familiar were you with the TUG test before the ED Falls VOU Program? Explain.
7. How was your experience conducting the TUG test with the ED Falls VOU Program patients?
8. How much effort did it take to perform the TUG test? Explain.
9. Moving to the home safety evaluation, how comfortable are/were you with conducting the home safety evaluation?
10. How long did it take to conduct the home safety evaluation?
11. What were some of the common home safety issues you noted?
12. If you did not have a fall patient, how comfortable would you be in conducting the home safety evaluation?
13. Let's chat about the medication safety portion of the ED Falls VOU Program. How did you identify whether the medication system was safe?
14. How comfortable were you with identifying whether the patient had a safe medication system?
15. What issues did you experience when evaluating the patient's medications?
16. How would you improve the ED Falls VOU Program?
17. What the best aspects of the ED Falls VOU Program?
18. What are the challenges/barriers to implementing the ED Falls VOU Program?
19. Did you have any particularly positive experiences while taking part in the ED Falls VOU Program? If so, please describe them:
20. Did you have any particularly negative experiences while taking part in the ED Falls VOU Program? If so, please describe them:
21. How do patients feel about the ED Falls VOU Program?
22. How do you feel about EMS conducting fall prevention work?

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RESEARCH REPORTS

UNDERSTANDING THE EMERGENCY MEDICAL TECHNICIAN TRAINING PIPELINE: AN INITIAL EVALUATION OF A STATEWIDE HYBRID EMT TRAINING PROGRAM

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ABSTRACT

High-quality emergency medical services (EMS) training with high licensure exam passage rates are crucial for a robust prehospital emergency care system. This study examines the EMS training pipeline, focusing on hidden steps and trainee characteristics that facilitate successful progression. Current research emphasizes course completion and licensure exam passage but often overlooks the final step of trainees working or volunteering as EMS professionals, particularly in rural areas. Data was collected via a survey distributed to 386 participants of three hybrid EMT courses in 2022-2023, with a 25.1% response rate. The survey gathered demographic data, licensure status, willingness to pay for training, and confidence in performing EMT duties. Demographic information included age, sex, race, education, and ZIP code, which was cross-referenced to determine rural residency. Participants were asked about their current stage in the EMT licensure process and their maximum willingness to pay for the course. Confidence was measured using a 5-point Likert scale. Analysis involved three logistic regression models to identify factors influencing taking the NREMT exam, passing the exam, and working or volunteering as an EMT. Several trainee characteristics show statistically or practically significant effects on a students' post-training progression through the pipeline including the previously unexplored step of taking the required licensing exam. The analysis also identified that rural trainees face greater challenges taking and passing the licensing exam than non-rural trainees but are more likely to work or volunteer as an EMT than their non-rural counterparts. This evaluation also examines the role of monetary value and training outcomes and identified some positive association between the amount students were willing to pay and their progression through the EMS workforce pipeline. The study's findings inform program design and highlight the need for recruitment from younger populations to grow the EMS workforce, particularly in rural areas.

INTRODUCTION

High quality emergency medical service (EMS) training with minimal course attrition and high licensure exam passage rates are the foundation of a strong prehospital emergency care system. This educational pipeline ensures that EMS clinicians are prepared to meet the challenges and expectations of the profession and that there is an adequate supply of clinicians to

meet patients' prehospital care needs. Current understanding of this pipeline focuses on course completion and subsequent passage of the requisite licensure exam. Trainees start the course, complete the requisite modules with satisfactory proficiency, graduate from the course, and then pass the required licensure exams. What is not included in the research is the end goal of the trainee working, or more likely volunteering in the case of many rural emergency medical technicians (EMTs), as an EMS professional. In the operation of a statewide EMT training program, there are several hidden steps in the training pipeline currently not discussed in the research. The purpose of this paper is to highlight these additional points along the pipeline and identify trainee characteristics that facilitate successful movement through the pipeline.

Current research has focused on course completion, exam passage, and program and trainee characteristics associated with higher completion and passing rates. Moungey et al. (2021) examined data from the national licensure exams for EMTs and paramedics to identify program characteristics associated with higher pass rates, finding a positive association between higher pass rates and program size, as well as geographic region. Other examinations of program characteristics with positive effects on pass rates include longer program length, accreditation, smaller class sizes, and instructor and instructional material quality (Ball et al., 2023; Dickison et al., 2006; Russ-Eft et al., 2010). Examinations of trainee characteristics focus on trainee demographics, such as sex, previous education, and completing a pre-course training (Chapman et al., 2016; Fernandez et al., 2008; Powell et al., 2021; Renkiewicz & Hubble, 2015). Both Powell et al. (2021) and Renkiewicz and Hubble (2015) consider trainees outside the traditional pipeline with the former looking at trainee characteristics as they relate to retesting after failing an exam and the latter examining the impact of pre-course training on EMS on course completion.

The aim of this analysis is to apply and extend these known trainee characteristics to a single EMT training to identify areas of improvement for this program. This analysis will look at three events in the post-training pipeline, taking the NREMT, passing the NREMT, and working or volunteering as an EMT to analyze how the trainees move through this pipeline. The research questions for this analysis include:

- How do trainee characteristics influence a trainee taking the NREMT?
- What effect, if any, does living in a rural area have on a trainee's progression through the EMS pipeline?
- What effect, if any, does a trainee's reported willingness to pay for EMT training have on their progression through the EMS pipeline.

The first question has not been studied before in the published peer-review literature, but remains a crucial drop-off point for the EMT training program under analysis. The other two questions test additional trainee characteristics also not present in the literature, but that are also crucial factors for the training program given its focus on training rural residents as EMTs and potential for alternative tuition funding methods at the federal, state, and local levels. The results of this analysis will inform program design for the EMT training program and serve as a foundation for further research into the EMT training pipeline.

METHODS

Data Collection

Data was collected through a survey distributed via email to the 386 individuals who participated in three hybrid EMT courses held in 2022 and early 2023. Prior to administering the survey, the University of South Dakota Institutional Review Board reviewed the project and determined it was exempt from human subject's regulations due to it being an evaluation. All trainees who were enrolled in the EMT training program were invited to participate in the survey. The survey was open for responses for a total of four weeks, from mid-July 2023 to mid-August 2023. Eight participants (2.1%) were not reached due to invalid email addresses. Out of the 378 participants who received the emails asking them to complete the survey, 95 (25.1%) completed the survey.

The survey questions collected demographic data on participant's licensure status, willingness to pay for the EMT training, and confidence in performing EMT duties. Demographic information included age, sex, race, education, and ZIP code. ZIP codes were cross-referenced with the Health Resources and Services Administration's rural ZIP Code file to determine rural residency (Federal Office of Rural Health Policy, 2025). Participants were asked about their current stage in the EMT licensure process. They were also asked about the maximum amount they were willing to pay for the course, starting at $50 and increasing incrementally by $100 to $1,000. If they were unwilling to pay $50, their response was recorded as 0. Confidence was recorded using a 5-point Likert scale with 1 being "Not at all confident" and 5 being "Very confident" on a variety of EMT skills including patient assessment, cardiopulmonary resuscitation and first aid, and documentation and reporting.

Participant Characteristics

Participants were asked to report their demographics to assist in identifying potential characteristics that may impact students' taking the National Registry of Emergency Medical Technicians (NREMT) exam, passing the NREMT exam, and working or volunteering as an EMT. The full demographic results can be found in Table 1 below. The typical respondent lives in a rural area, 67 (70.5%), is female, 65 (68.4%), and is white, 90 (94.7%). There was variation in terms of the age categories respondents selected, with 33 (34.7%) respondents reporting an age of 18-24 and the next two highest being 35-44, 26 (27.4%) and 25-34, 22 (23.2%). The largest group for education level was high school diploma or equivalent with 23 (24.2%) responses. The next categories with the highest response rates were 22 (23.2%) reporting some college credit but no degree, followed by 18 (18.9) possessing a bachelor's degree. Dummy variables were created for sex, race, and education to simplify analysis due to small subpopulation numbers.

In addition to these characteristics, there was also significant variation in the two additional trainee characteristics added to the analysis: participants' maximum amount they are willing to pay and their overall confidence in their ability to respond to a variety EMS emergencies. The maximum amount participants reported being willing to pay ranged widely from 6 (6.3%) of respondents reporting they would not pay even $50 for the course to 10 (10.5%) of respondents reporting they would pay $1,000 or more for the training. The amount with the highest number of respondents was $100 with 24 (25.3%). Trainees' answers to the confidence questions were summed individually into a final

confidence score with the maximum possible value being 120 and the minimum possible value being 24. The mean score for this confidence index was 98.6 with a median of 102 and a standard deviation of 17.0.

ANALYSIS

Analysis of this data involved three separate logistic regression models for taking the NREMT exam, passing the NREMT exam, and working or volunteering as an EMT. The outcome variables examined in these models where binary variables measuring if a participant took the NREMT exam, passed the NREMT exam, and is working or volunteering as an EMT. Predictors of these outcome variables include the maximum amount the participant would be willing to pay, their total confidence in their EMT skills, age category, and binary variables indicating if the participant is a rural resident, male, white, and has at least some college education. Initial testing for possible confounding variables yielded no statistically significant results for the included variables, indicating no need for the addition of interaction terms.

RESULTS

The results of the logistic regression models reveal statistically significant factors for success, although no one factor was statistically significant ($p<0.05$) across all three models. The sample size included 95 respondents who had successfully completed the EMT training under evaluation. The respondents tended to come from rural areas (67, 70.5%), be female (65, 68.4%), and have some college education (71, 74.8%).

Demographics	n	%
Rural Resident		
Yes	67	70.5%
No	28	29.5%
Age		
17 or Younger	1	1.1%
18-24	33	34.7%
25-34	22	23.2%
35-44	26	27.4%
45-54	7	7.4%
55-64	5	5.3%
65 and Older	1	1.1%
Sex		
Male	30	31.6%
Female	65	68.4%
Race		
Alaska Native	0	0.0%
American Indian	2	2.1%
Black or African American	0	0.0%
Asian	1	1.1%
Native Hawaiian or Other Pacific Islander	0	0.0%
White	90	94.7%
Prefer Not to Say	2	2.1%
Education		
Some High School, No Diploma	1	1.1%
High School Diploma or the Equivalent	23	24.2%
Some College Credit, No Degree	22	23.2%
Trade/Technical/Vocational Training	9	9.5%
Associate Degree	14	14.7%
Bachelor's Degree	18	18.9%
Master's Degree	5	5.3%
Other	3	3.2%
Trainee Status in EMS Educational Pipeline		
Completed the Course	95	100.0%
Taken the NREMT	54	56.8%
Passed the NREMT	45	47.4%
Working/Volunteering as an EMT	33	34.7%
Note: Percentages may not total exactly to 100% due to rounding		

Table 1: Participant Characteristics.

For factors influencing taking the NREMT exam (Table 2), the variable showing statistical significance was respondents' total confidence in their abilities, which was positively associated with a 3.73% increase in the odds of taking the NREMT exam for each unit increase in confidence. Also, the maximum amount participants were willing to pay was positively associated with a 0.13% increase in taking the NREMT per additional dollar willing to pay, which was not statistically significant at $p<0.05$ but remains practically significant. Being white also had a practically large effect size with a 219.78% increase in

the odds of taking the exam. This is likely due to respondents being predominantly white, with only 5.3% of respondents being nonwhite. Male, rural, and partially college educated participants had decreased odds of 30.55%, 42.93%, and 30.26% respectively of taking the exam.

	Taking NREMT Exam	Passing the NREMT	Working / Volunteering as EMT
Intercept	0.0275 (0.0006-0.9154)	0.0165 (0.0003-0.6222)	0.0395 (0.0004-2.1387)
Maximum Amount Willing to Pay	1.0013 (0.9997-1.003)	1.0019 (1.0003-1.0036)	1.0014 (0.9997-1.0031)
Total Confidence	1.0373 (1.0091-1.0691)	1.043 (1.0129-1.0783)	1.0262 (0.9953-1.0615)
Age	0.8531 (0.5417-1.3168)	0.7371 (0.4521-1.1583)	0.5145 (0.2852-0.8603)
Rural Resident	0.5707 (0.1919-1.6231)	0.6472 (0.2161-1.888)	3.2002 (0.9965-11.6503)
Is Male	0.6945 (0.2608-1.8354)	0.9765 (0.3597-2.6484)	0.999 (0.3596-2.7131)
Is White	3.1978 (0.4705-29.5022)	1.0546 (0.1469-9.7172)	1.0252 (0.1079-23.6077)
Has at Least Some College Education	0.6974 (0.189-2.4463)	1.5955 (0.4582-5.7041)	2.6492 (0.7175-10.8607)

Table 2: Logistic Regression Results – Odds Ratios (95% Confidence Intervals).

For factors influencing passing the NREMT exam, two variables showed statistical significance at the $p<0.05$ level. Increases in the maximum amount students were willing to pay led to a 0.19% increase in the odds of passing the exam for each additional dollar. Additionally, a one unit increase in the participant's total confidence in their EMT skills led to a 4.3% increase in the odds of passing the exam. Having at least some college education also had a positive, practically significant, increase in a participant reporting passing the NREMT exam, with a large effect size, leading to a 59.55% increase in the odds of passing the NREMT exam. Participants in older age categories and living in rural areas had practically significant decreases in their odds of passing the exam at 26.29% and 35.28% respectively.

When looking at factors influencing a participant working or volunteering as an EMT, a few important factors influence this stage of the EMS pipeline. The first was age, as an increase in age category was negatively associated with working or volunteering as an EMT and decreased the odds of passing by 26.29%. Practically significant variables included being a rural resident and having at least some college education, leading to increases of 220.02% and 164.92% respectively of working or volunteering as an EMT. No other variables had statistically or practically significant variables for this model.

DISCUSSION

In the aftermath of the COVID-19 pandemic, the shifting size and composition of the EMS workforce is crucial to a robust pre-hospital care system by ensuring that there is an adequate supply of EMS clinicians (Gage et al., 2024; Woodward et al., 2025). The first step to maintaining and growing that workforce is to find ways to support potential new EMTs and assist them in navigating their initial training. This analysis identifies several variables with statistical or practical significance at multiple points in a trainee's journey to working as an EMT. These variables identify important barriers and facilitators in this journey to improve the structure and design of the hybrid EMT training program under evaluation.

The training program evaluated primarily focuses on training new EMTs who are younger and living in rural areas. Challenges for rural EMT training have long been

known but previous research has focused on examining regional pass rates for programs instead of focusing on individual characteristics (Freeman et al, 2009, Moungey et al., 2021). While this analysis lacks the larger sample size of these analyses, the significant negative effects on taking and passing the NREMT and significant positive effects on working or volunteering as an EMT for trainees from rural areas should not be ignored. Rather this information highlights the need for new learning strategies and supports increasing the odds of rural trainees taking and passing the NREMT exam, especially since these rural residents are much more likely to end up working or volunteering as an EMT than their non-rural counterparts.

The results of this evaluation also provide further context for literature exploring trainee demographics associated with passage of the NREMT by looking at the previously unexamined step of taking the NREMT. Several prior studies report positive associations for being a male trainee and passing the NREMT, but male trainees in the evaluated program were less likely to even attempt taking the NREMT (Dickison et al., 2006; Fernandez et al., 2008; Powell et al., 2021). This is partially due to the trainee demographics for the training program being representative of the areas the training is provided in and not a national sample as others have examined, but it does underscore the need to reevaluate how NREMT result rates are interpreted. While this will complicate the discussion around pass rates, the group of non-NREMT taking trainees needs to be included in the discussion as they are a ready population with almost all qualifications needed to serve as an EMT.

Evaluation of training costs in relation to training outcomes is another important area of research largely untouched by the current EMS and broader health professions literature (Foo et al, 2019). This evaluation was concerned with the monetary value the trainees gave to the training to identify any possible associations between this value and the outcome variables in question. This monetary value was positively associated with an individual passing the NREMT and led to an important shift in design for the program evaluated. Before this evaluation, EMT tuition and textbook were provided at no-cost due to state, federal, and private funding for many trainees. Based on this analysis, the program was redesigned so that all trainees were required to pay for the textbook, which would cover part of the total training cost while the rest remained covered by other funding. Evaluation of this change is ongoing to determine the effect of limiting the amount of financial support for each individual trainee given that the program wants to build a more robust EMS workforce in the state it serves while also being a responsible steward of the funding provided.

LIMITATIONS

This evaluation is limited by its intended scope as well as a low response rate. The intent of this analysis was to inform program design for the EMT training program under evaluation and cannot be generalized to all EMT trainings. First, the demographics of the trainees who responded to the survey do not align with national statistics especially given that the program has mostly white students from rural areas. This skewed population does create potential response bias which may have a particularly strong effect on the results of the model analyzing probability of taking the NREMT. This analysis also only focuses on one training program in particular, which further limits generalizability of the study findings.

The survey also had a low response rate, which additionally limits the generalizability of the findings. Only 95 (25.1%) respondents were included in the final analysis because they completed the training. This response rate is low which introduces the possibility of non-response bias leading to non-response error, but this error is likely low due to the large enough absolute sample size. There were 5 respondents who did not complete the training but did respond to the survey that were excluded because they would not be eligible to progress further in the steps under analysis in this study. Additionally, the survey was administered in July and August 2023 to trainees who participated in three EMT courses held in 2022 and first half of 2023, which creates another opportunity for bias with participants from the more recent classes having less time to progress down the pipeline.

CONCLUSION

The EMS workforce plays a critical role in pre-hospital care and a strong pipeline to sustain and grow that workforce is necessary for a robust prehospital system. There are statistically and practically significant factors influencing an EMT trainee's pathway to licensure which provide valuable insight into the design and provision of EMT training. The results of this analysis find the rural trainees face greater challenges taking and passing the NREMT than non-rural trainees but are more likely to work or volunteer as an EMT than their non-rural counterparts. Additionally, findings indicate the need for further research into the entire pathway to working or volunteering as an EMT, such as taking the NREMT, which may lead to more innovations in program design and improvement. This evaluation also examines the role of monetary value and training outcomes and identified some positive association between the amount students were willing to pay and their progression through the EMS workforce pipeline. Further research should be done into this area as well since there is little known in this area related to EMS or even broader health profession training.

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RESEARCH REPORTS

EFFECTIVENESS OF COMMUNITY PARAMEDICS AT PREDICTING 30-DAY READMISSION IN HEART FAILURE PATIENTS

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Keywords: mobile integrated health care, community paramedicine, heart failure, readmission, emergency medical services, EMS, paramedicine

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ABSTRACT

Objective: Heart failure (HF) patients are at high risk for 30-day hospital readmission which is a negative predictor of patient-centered outcomes. Community paramedicine (CP) has emerged with a goal of reducing readmissions and currently no model exists to accurately predict those at highest risk. We seek to analyze factors associated with readmission among participants in a CP program.

Methods: Design: A retrospective review of consecutive patients with a HF-related diagnosis who received a home visit by a community paramedic after a hospital admission. Setting: A suburban, academic medical center with an established CP program. Inclusion criteria: All patients with a HF-related diagnosis who received a home visit over the study period. Factors including age, sex, hospital length of stay, time to home visit, discharge destination, participation in other transitional care/home health programs, chronicity of heart failure, care team, and perceived risk of readmission by the community paramedics at the time of home visit were retrospectively reviewed and analyzed. The outcome of interest was 30-day, all-cause readmissions.

Results: From 4/7/2017 to 4/6/2018 there were 592 patients who received home visits. The median age was 70 [IQR 60-79] and 41.9% were female. The overall 30-day readmission rate was 11%. For readmitted patients, the median time to home visit was 6 days [IQR 4-11] versus 10 days [IQR 5-23] for those not readmitted (p=<0.01). Patients deemed to be at risk for readmission by the community paramedics were readmitted more often than those who were not (*OR* 2.68, 95% CI [1.59-4.52]).

Conclusion: Along with time to home visit, perceived risk of 30-day readmission at the time of a home visit by a community paramedic correlated with rates of readmission. In the HF population, comprehensive models to predict 30-day readmission might be improved by including a subjective assessment by a trained clinician.

INTRODUCTION

Decreased hospital readmission rate is an important patient centered outcome and is financially advantageous for health systems (Fernandez-Gasso et al., 2017; Kwok et al., 2021). Heart failure (HF) is a common cause for admission and readmission to the hospital with rates of 30-day readmission estimated between 18 and 22% (Fernandez-Gasso et al., 2017; Khan et al., 2021;

Kimmoun et al., 2021; Parizo et al., 2020). Community prevalence of HF is expected to rise due to aging of the population and advancing therapeutics (McCullough et al., 2002). A means to identify HF patients at highest risk for readmission with the goal of providing targeted interventions would be beneficial to patients and health systems alike.

The ability to predict readmission, particularly in the HF population, is limited. Pre-existing prediction scores validated for the general hospitalized population such as HOSPITAL, LACE and LACE+ do not perform well when applied uniquely to the HF population (Ibrahim et al., 2020). In prior attempts to predict readmission, risk variation was unable to be explained by objective measures alone (Philbin & DiSalvo, 1999). Subjective variables have been shown to improve discrimination of predictive models (Huynh et al., 2016) and may be important when deriving heart failure readmission scores (Emdin et al., 2017).

Community paramedicine (CP) programs have been developed to utilize emergency medical services (EMS) clinicians, typically paramedics, in roles that support community health. These programs are often used to support patients who are at risk for high healthcare utilization or require additional assistance navigating the healthcare systems (Chan et al., 2019). Community paramedics often provide in-home services allowing them to develop a holistic impression of the patient's health and social support to address various patient centered outcomes. The aim of this study was to correlate various patient-centered and systemic factors, including the community paramedic's perceived risk of readmission, on 30-day hospital readmission amongst participants in a CP program for heart failure.

METHODS

Study Design

This is a retrospective review of consecutive patients who received a home visit by a community paramedic in a CP program for HF. Data regarding perceived risk for readmission was collected prospectively at the end of each home visit. Other variables including age, sex, hospital length of stay, chronicity of HF, time to home visit, presence or absence of transitional care or home health services, discharge destination, and care team members were reviewed retrospectively by a community paramedic who performs home visits. The outcome of interest in this study was all cause readmission to the hospital within 30-days of discharge for patients with a HF-related diagnosis. The study protocol was approved by the University's institutional review board (STUDY00008404).

Selection of Participants

Patients were referred to the CP program either by their care team or discovered via a search of the electronic health record (EHR) for 11 specific discharge diagnosis (ICD-10 codes) pertaining to HF (Figure 1). Patients eligible for a home visit must live within 90 minutes of the medical center, be discharged home or to a short-term rehabilitation facility, and carry a diagnosis consistent with the program's criteria. Adult patients who met criteria for program enrollment and who completed at least one home visit were included in the study. Patients who declined to participate, were readmitted before their first home visit, or otherwise were unable to have a home visit performed, were not included. Patients residing greater than 90 minutes from the medical center or who were

I11.0	Hypertensive disease with heart failure
I13.0	Hypertensive heart and chronic kidney disease with heart failure and stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease
I13.2	Hypertensive heart and chronic kidney disease with heart failure and with stage 5 chronic kidney disease, or end stage renal disease
I50.1	Left ventricular failure
I50.20	Unspecified systolic (congestive) heart failure
I50.21	Acute systolic (congestive) heart failure
I50.22	Chronic systolic (congestive) heart failure
I50.23	Acute on chronic systolic (congestive) heart failure
I50.30	Unspecified diastolic (congestive) heart failure
I50.31	Acute diastolic (congestive) heart failure
I50.33	Acute on chronic diastolic (congestive) heart failure
I50.41	Acute combined systolic (congestive) and diastolic (congestive) heart failure
I50.43	Acute on chronic combine systolic (congestive) and diastolic (congestive) heart failure
I50.9	Heart failure, unspecified

Figure 1: International Classification of Disease, 10th Revision (ICD-10) codes for included heart failure-related diagnoses

discharged to long-term care facilities, long-term acute care hospitals, or skilled nursing care were excluded from the program and therefore also from this study.

Setting

This study was conducted at a suburban, tertiary care referral center with an active heart failure program. The mission of the CP program is to utilize paramedics outside traditional emergency roles to provide scheduled post-acute home visits for targeted high-risk populations. The goal is to reduce negative outcomes such as 30-day all-cause readmissions. Patients were recruited either in person by a member of the CP team prior to discharge, or via telephone after discharge, with the former being the preferred method. Participation was voluntary.

All community paramedics were certified by the Commonwealth of Pennsylvania (EMT-P) and/or the National Registry of Emergency Medical Technicians (NRP) to the level of paramedic. Beyond what is included in the paramedic curriculum, training for community paramedics included a combination of clinical observation, hands-on skill acquisition for pertinent physical exam techniques, and exposure to nursing-driven follow-up programs that existed prior to the development of the CP program.

Home visits consisted of a patient assessment, including signs and symptoms of compensated versus decompensated heart failure. Community paramedics provided patient education related to medication compliance, diet, review of discharge instructions and care plans, and disease prevention strategies. Laboratory testing and therapeutics, including intravenous diuresis, were available per protocol. The timing of home visit was based upon scheduling and availability and was not directed by disease severity or the perceived need for expedited services.

Data Collection and Processing

Documentation of the encounter was included in the health system EHR. At the conclusion of the home visit, the community paramedic documented whether they felt the patient was at risk for 30-day readmission using a binary “yes” or “no” scale which was

documented in EHR. This exercise was performed at the conclusion of each home visit. The community paramedic's decision was purely subjective and not based upon any pre-determined criteria or scoring. These data were continually compiled as part of an ongoing quality improvement and quality assurance program then analyzed retrospectively, for the purposes of this study, after ethics approval.

Data Analysis

Descriptive statistics were performed on the study participants. Continuous variables were reported using mean (standard deviation) and median (interquartile range). For continuous variables, a two-sample T-test was used to compare means. Chi-squared analysis was used to compare categorical variables. Odds ratio and 95% confidence interval were calculated for perceived risk of readmission by the community paramedics. Analysis was performed using SAS (SAS Institute, Cary, North Carolina, USA).

RESULTS

From 4/7/2017 to 4/6/2018 a total of 592 patients who met inclusion criteria were included for analysis (Table 1). The median age was 70 [IQR 60-79] and 41.9% were female. The median hospital length of stay was 4 days [IQR 3-8] and heart failure was a new diagnosis in 13.3% of patients. Most of the patients were discharged home (92%, 545), 80.2% (475) received transitional care services, and 45.2% (267) received home health services. The majority (88.7%) of patients were treated by a cardiologist within the health system. Age, sex, hospital length of stay, chronicity of HF, presence or absence of transitional care or home health services, discharge destination, and care team members did not reach statistical significance to correlate with readmission rate.

The 30-day all cause readmission rate was 11% (65) with 0.6% (4) being readmitted multiple times. For readmitted patients, the median time from discharge to home visit by a community paramedic was 6 days [IQR 4-11] versus 10 days [IQR 5-23] for those not readmitted (p=<0.01). Patients who were perceived to be at risk for readmission by the community paramedic at the time of home visit had an 18.2% rate of readmission versus 7.6% in those deemed low risk (p= <0.01).

DISCUSSION

The objective of this study was to correlate patient-centered and systemic factors on 30-day hospital readmission amongst participants in a CP program for heart failure. Our overall, all-cause, 30-day readmission rate was found to be 11%, expectedly lower than the national average. All patients in the study accepted and received a home visit by a community paramedic, which has been shown to decrease readmission rates (A. Burnett et al., 2023; Misra-Hebert et al., 2021; Severson et al., 2023). Patients readmitted prior to their first home visit were excluded and therefore may skew the data slightly towards a lower readmission rate. While other studies have also correlated various objective measurements and risk for readmission in the HF population, no unifying model exists to date (Kansagara et al., 2011; Saito et al., 2016). The Readmission After Heart Failure (RAHF) scale developed by Chamberlain et. el. revealed a readmission rate of 7.58% in their low-risk group compared to the 7.6% observed in this study (Chamberlain et al., 2018).

It was observed that a shorter time to home visit correlated with an increased risk of readmission. It is generally accepted that timely post-discharge follow up is beneficial for hospitalized patients, but other studies have failed to find correlation between timing and risk of readmission (Misky et al., 2010). Patients often have difficulty comprehending hospital discharge instructions (Townshend et al., 2023) and can find the information overwhelming on the day of discharge (Slatyer et al., 2019). In disease processes such as HF that require significant lifestyle modification, patients may benefit from spaced repetition of discharge instruction favoring delayed home visits. It warrants further discussion and research to determine where and when CP can most effectively be integrated into the continuum of post discharge care.

	Readmission		
	No (*n*=527)	Yes (*n*=65)	*p*-value
Age-median [IQR]	71 [60-180]	65 [58-79]	0.3
Length of Stay a -median [IQR]	4 [3-8]	5 [3-7]	0.61
Time to Home Visit b-median [IQR]	10 [5-23]	6 [4-11]	<0.01
Sex-n(%)			
Female	227 (91.5)	21 (8.5)	0.11
Male	300 (87.2)	44 (12.8)	
Discharged To-n(%)			
Home	483 (88.6)	62 (11.4)	0.46
Inpatient Rehab	44 (93.6)	3 (6.4)	
Home Health-n(%)			
No	289 (89.2)	35 (10.8)	0.9
Yes	237 (88.8)	30 (11.2)	
Heart Failure Type-n(%)			
Chronic	455 (88.7)	58 (11.3)	0.7
New	72 (91.1)	7 (8.9)	
In-network Cardiologist c -n(%)			
No	62 (92.5)	5 (7.5)	0.41
Yes	465 (88.6)	60 (11.4)	
HF Transitional Care Program-n(%)			
No	110 (94)	7 (6)	0.07
Yes	417 (97.8)	58 (12.2)	
Risk for Readmission-n(%)			
No	374 (92.4)	31 (7.6)	<0.01
Yes	153 (81.1)	34 (18.2)	

a. Hospital length of stay, b. Time to home visit by community paramedic, c. defined as cardiologist within the health system. HF = heart failure.

Table 1: Risk factors for readmission versus 30-day readmission

We found that the perceived risk of readmission by the community paramedic at the time of home visit correlated well with rate of readmission. During a home visit, community paramedics are uniquely poised to provide a holistic assessment of a patient's health. Medication literacy and psychosocial support, for example, influence readmission rates and EMS clinicians are particularly effective in assessing these and other social determinant of health (S. J. Burnett et al., 2023; Naimi et al., 2023). Community paramedics likely integrate objective and subjective data into a comprehensive assessment of the patient's risk of readmission. Notably, this study was not designed to assess the community paramedic's medical decision-making process but insight into how they made their decisions could be valuable. This is a promising area for further research.

This study offers a unique perspective suggesting that a trained clinician, in a patient's home, can provide a reliable assessment of their tendency towards readmission. Validated clinical decision tools for other populations such as the HEART Score (Six et al., 2008) and Well's Criteria (Wells et al., 2001) give emphasis to clinician impression, or "gestalt." Subjective variables have been shown to improve discrimination of predictive models including attempts to predict HF readmissions (Emdin et al., 2017; Huynh et al., 2016). The combination of a clinical assessment by a community paramedic combined with other

objective measures may facilitate the derivation of a readmission prediction instrument that has eluded investigators thus far.

LIMITATIONS

This study is limited predominantly by its retrospective and observational design and can only comment on correlation of these variables with hospital readmission. While the breadth and scope of CP programs have evolved since the data were collected, the study outcome is related to the fundamental skill of assessing patients with HF which remains relevant to current practice. Confounding variables such as response to prior treatments and history of readmissions may contribute to the CP's decision. We do not know what factors ultimately contributed to the community paramedic's decision to consider a patient at risk for readmission. Qualitative analysis of the decision-making process may shed light on important patient and environmental factors that drive readmissions.

CONCLUSION

In this study, the community paramedics perceived risk of readmission correlated well with readmission rates. Subjective analysis of patients' risk for readmission is a promising avenue to explore and could help identify patients at risk for readmission, which is currently underway. Derivation of future readmission prediction models may utilize subjective analysis by clinicians, such as community paramedics, to optimize their predictive value.

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REVIEWS

THE USE OF NALOXONE IN CARDIAC ARREST MANAGEMENT: A RAPID REVIEW

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ABSTRACT

Introduction: Naloxone is a mu-opioid receptor antagonist that is best known for reversing opioid overdose by restoring spontaneous respirations and level of consciousness. It has been postulated that naloxone may possess antiarrhythmic properties as well as the ability to reverse endogenous opioid-related myocardial depression and stimulate catecholamine release, suggesting utility in cardiac arrest. The survivability of cardiac arrest is relatively low, and the impact of opioid toxicity deaths is staggeringly high. Optimizing the medical management of patients in cardiac arrest, particularly in the context of opioid use, is a priority.

Research Question: Does naloxone improve rates of return of spontaneous circulation (ROSC) and survival to hospital discharge when administered during cardiac arrest?

Methods: Pubmed and EMBase were searched with 187 articles progressing to the screening stage. Inclusion criteria included cardiac arrest patients receiving naloxone pre-hospital or in-hospital with outcomes relating to resuscitation rates and/or survival. Exclusion criteria included traumatic cardiac arrests and pediatrics. Eleven articles were chosen following title and abstract screen, full text review, and data extraction.

Results and Discussion: Five randomized controlled trials with animals found that intra-arrest naloxone improved rates of ROSC, particularly when combined with epinephrine. Two human case reports describe patients receiving naloxone during cardiac arrest and experiencing spontaneous improvement in cardiac rhythm, neither with favourable neurological outcomes. Over the past five years, evidence includes a retrospective cohort study, two observational studies, and one case-control study. Two reported higher ROSC rates and improved survival to discharge with naloxone, while the others found no significant differences between exposure groups.

Conclusion: Currently, there is conflicting evidence on whether naloxone improves rates of ROSC and survival to hospital discharge. Although naloxone does not appear to be harmful when administered in the context of cardiac arrest, further research is needed to determine its efficacy for this indication.

INTRODUCTION

Naloxone is a mu-opioid receptor antagonist that can reverse the effects of both exogenous and endogenous opioids, restoring spontaneous respirations and level of consciousness in the context of opioid overdose (Lavonas et al., 2023). If untreated with oxygenation and a reversal agent like naloxone, opioid overdose

can swiftly progress from central nervous system and respiratory depression towards apnea and cardiac arrest.

In contrast, the utility of naloxone in the context of cardiac arrest is much less understood. It has been postulated that naloxone may reverse endogenous opioid-related myocardial depression and stimulate catecholamine release, thus improving blood pressure and heart rate (Dillon et al., 2024). It has also been suggested that naloxone may have antiarrhythmic properties (Strong et al., 2024). Despite this, much is still unknown about naloxone's efficacy in cardiac arrest management, and there are no prospective studies to provide guidance for practice. It is also questioned whether naloxone has benefit in all causes of cardiac arrest, or purely opioid-induced cardiac arrests. At the time of the American Heart Association 2023 guideline update, there was not enough evidence to support routine administration of intra-arrest naloxone, and they recommend that naloxone should only be considered if the delivery of high-quality cardiopulmonary resuscitation (CPR) is not impacted (Lavonas et al., 2023). However, only 1 in 10 people are prospected to survive an out-of-hospital cardiac arrest (OHCA) in Canada (Heart and Stroke, 2024) and the benefit of epinephrine, the current first-line drug, is controversial when considering mortality (Chen, Xie et al, 2006). Furthermore, from January to March 2024, there were 1,906 opioid toxicity deaths, or 21 deaths per day on average in Canada (Government of Canada, 2024). Therefore, optimizing the medical management of patients in cardiac arrest, particularly in the context of opioid use, should be a priority.

RESEARCH QUESTION

Does naloxone improve rates of return of spontaneous circulation (ROSC) and survival to hospital discharge when administered during cardiac arrest?

METHODS

Two electronic databases, Medline and EMBase, were searched in November 2024 with results demonstrated in Figure 1. Inclusion criteria included studies involving cardiac arrest patients receiving naloxone both pre-hospital and in-hospital with outcomes related to rates of resuscitation and/or survival. Exclusion criteria included traumatic cardiac arrests, pediatrics (<18 years old), and non-English results. Medline was searched via Pubmed using search terms and Boolean operators (Naloxone OR Narcan) AND (Cardiac AND Arrest), generating 127 results, and (Naloxone OR Narcan) AND ((Cardiopulmonary AND Resuscitation) OR (CPR)), generating 92 results. EMBase was then searched using search terms and Boolean operators (naloxone:ti OR narcan:ti) AND 'cardiac arrest':ti, generating 25 results, and (naloxone:ti OR narcan:ti) AND ('cardiopulmonary resuscitation':ti OR 'cpr':ti), generating 14 results. Search results were imported to Covidence and duplicates were removed, generating 187 studies which were screened by title and abstract. 30 studies were selected for full text review, with 18 not meeting the inclusion and exclusion criteria. Data was extracted from 12 studies into an extraction form, and the results then converted into a table which underwent quality assessment. Studies varied in strength upon critical appraisal, and one study was eliminated at this stage for lacking a control group. The resulting data table was utilized for synthesis and analysis. Ultimately, 11 studies were included in the final synthesis. Data was organized by study methodology and subject type to compare similar studies.

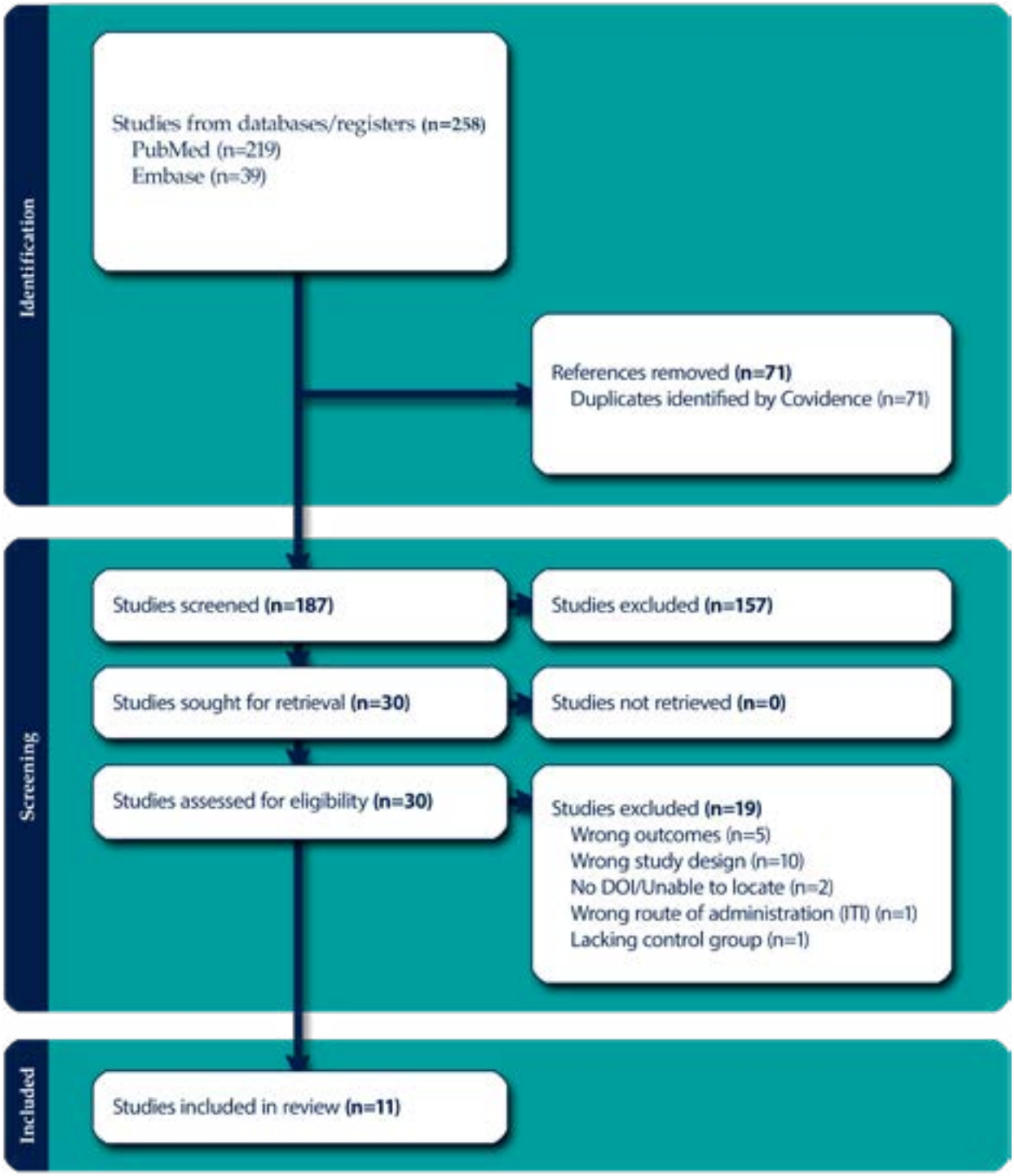

Figure 1. Search Strategy.

RESULTS

Experimental Animal Studies

Four randomized controlled trials (RCTs) from China studied the effects of naloxone in asphyxia-induced cardiac arrest with samples of 24 rats (Chen, Liu, et al., 2006; Chen, Xie et al., 2006; Wang et al., 2008; Wang et al., 2010). One additional RCT was included from the USA, which looked at 10 dogs in ventricular fibrillation (VF) (Rothstein et al., 1985).

All subjects received standard CPR, including chest compressions and ventilation, prior to the treatment being randomized and administered synchronously (Chen, Liu, et al., 2006; Chen, Xie, et al., 2006; Rothstein et al., 1985; Wang et al., 2008; Wang et al., 2010). Rothstein et al. (1985) followed up the naloxone treatment with attempted defibrillation of increasing joules. Treatment group sizes by Chen, Liu et al. (2006), Chen, Xie et al. (2006), Wang et al. (2008), and Wang et al. (2010) were eight per treatment. Rothstein et al. (1985) had smaller treatment groups of five. All groups were randomized. The relatively small sample sizes and the use of animal samples in all five studies limits generalizability to a greater human population. All four rat-based studies included a placebo control treatment group that received 1 mL normal saline, strengthening internal validity (Chen, Liu, et al., 2006; Chen, Xie, et al., 2006; Wang et al., 2008; Wang et al., 2010). Rothstein et al. (1985) did not include a placebo control group, although the dogs treated with epinephrine could act as a concurrent active treatment control group relative to the naloxone.

Chen, Liu et al. (2006) compared low dose 0.5 mg/kg IV naloxone, high dose 1 mg/kg IV naloxone, and a control group of normal saline. ROSC was observed in 12.5% of the control group, 37.5% of the low-dose naloxone group, and 87.5% of the high-dose naloxone group (Chen, Liu et al., 2006). There was a significant difference between the high-dose naloxone and control group ($p<0.05$) but the difference between the low-dose naloxone group and the other two groups was insignificant, suggesting dose-dependence (Chen, Liu et al., 2006). In another study, Chen, Xie et al. (2006) utilized 1 mg/kg IV naloxone, and compared outcomes to 0.04 mg/kg IV epinephrine and a control group. ROSC was observed in 12.5% of the control group, 87.5% of the naloxone group, and 87.5% of the epinephrine group ($p=0.01$) (Chen, Xie et al., 2006). Wang et al. (2008) compared rats receiving 0.05 mg/kg IV epinephrine, the same dose of epinephrine augmented with 1 mg/kg IV naloxone, and a saline control group. ROSC was obtained in 25% of the control group, 75% of the epinephrine group, and 87.5% of the naloxone and epinephrine group (Wang et al., 2008). The difference was statistically significant when comparing the control group to the naloxone and epinephrine group ($p<0.05$) (Wang et al., 2008). Wang et al. (2010) repeated this study with the same outcomes in terms of ROSC, but added additional metrics of interest including survival three days post-arrest. It was found that one rat from the control group (12.5% of original sample), three from the epinephrine group (37.5%), and five from the naloxone and epinephrine group (62.5%) survived (Wang et al., 2010). The difference between the naloxone and epinephrine group was statistically significant ($p<0.05$) when compared to the control group, but not to the epinephrine group (Wang et al., 2010).

Rothstein et al. (1985) treated dogs in VF with either 5 mg/kg naloxone or 1 mg epinephrine by central venous injection, followed by attempted defibrillation until ROSC was obtained. If unsuccessful after increasing the joules to the maximum energy dose, the opposite treatment was administered, and the attempted defibrillation regime was repeated (Rothstein et al., 1985). Four dogs receiving epinephrine as their first treatment converted to pulseless electrical activity (PEA) and then subsequently converted to a perfusing rhythm once naloxone was later given (Rothstein et al., 1985). For the group receiving naloxone as a first treatment, none achieved an organized rhythm after the first sequence of shocks, but four regained a perfusing rhythm once epinephrine was subsequently given and the second sequence of shocks were initiated. The difference in defibrillation outcome between the dogs receiving naloxone vs. epinephrine prior to

shock was statistically significant (p=0.02), and the medications demonstrated synergism at achieving ROSC (Rothstein et al., 1985).

Human Case Reports

Two case reports from Brazil and Scotland described patients receiving naloxone during cardiac arrest who experienced a spontaneous improvement in cardiac rhythm (Martins et al., 2008; Marsden & Mora, 2008). Martins et al. (2008) describes a 55-year-old woman in persistent PEA receiving standard cardiac arrest management in a hospital setting due to an opioid-induced cardiac arrest. ROSC was obtained shortly after the administration of 2 mg IV naloxone. One week later this same patient had a Glasgow Coma Score (GCS) of 15 but had developed paraparesis and anterior spinal artery syndrome. Martins et al. (2008) also conducted a brief review of literature to accompany this case study, utilizing three reviewers and a standardized extraction form to reduce bias. The reviewers suggested that naloxone may have utility in opioid and hypoxia-related cardiac arrest (Martins et al., 2008). Marsden and Mora (1996) reported on a prehospital patient who experienced an opioid-induced cardiac arrest. Normal cardiac arrest management protocol was followed with the addition of two doses of 0.4 mg IV naloxone by paramedics to a total of 0.8 mg. This patient converted from asystole to PEA following the first dose, then to a perfusing sinus tachycardia following the second dose. Once in hospital, this patient seized and was declared brain dead with cerebral anoxia 24 hours later (Marsden & Mora, 1996). Even though improved cardiac rhythms and subsequent ROSC was observed after naloxone administration, it is not possible to conclude that ROSC was exclusively due to the naloxone and no other confounding variables. The poor outcomes of both patients require further consideration (Martins et al., 2008; Marsden & Mora, 2008).

Retrospective Human Studies

Research regarding naloxone use in cardiac arrest is currently growing, with new literature including one retrospective cohort study from the USA (Dillon et al., 2024), two retrospective observational studies from the USA (Quinn et al., 2024; Strong et al., 2024), and one retrospective case-control study from China (Lv et al., 2019). Dillon et al. (2024) extracted data from the Cardiac Arrest Registry to Enhance Survival of 8195 adults treated by five emergency medical services (EMS) agencies for OHCA in Northern California from 2015 to 2023. 7030 patients received usual care, while 1165 were treated with adjuvant naloxone. Strong et al. (2024) extracted data from 1807 medical records obtained from the Portland Cardiac Arrest Epidemiologic Registry from January 2018 to December 2021, 57 of which received naloxone prior to vascular access and 1750 who did not. Quinn et al. (2024) extracted 769 medical records of OHCA patients at a single urban hospital-based EMS system in New Jersey from January 2017 to June 2022. 175 cardiac arrest patients received naloxone, whereas 594 received usual care. Lv et al. (2019) extracted medical records of adults receiving in-hospital CPR in specific acute care units from January 2011 to December 2016 in China, with 59 patients having received naloxone, and 285 having received usual care.

Dillon et al. (2024) and Strong et al. (2024) both found that naloxone significantly improved patient outcomes when compared to the unexposed group. Dillon et al. (2024) considered any patient receiving intra-arrest naloxone, whereas Strong et al. (2024) looked specifically at intramuscular (IM) or intranasal (IN) naloxone administered to

adults in cardiac arrest with non-shockable rhythms prior to vascular access. However, within the unexposed group, patients were included who later received intravenous (IV) or intraosseous (IO) naloxone, potentially confounding the results (Strong et al., 2024). According to Dillon et al. (2024), among patients receiving naloxone intra-arrest, 34.5% sustained ROSC for >20 minutes at the end of EMS care and 15.9% survived to hospital discharge. This is contrasted with the unexposed group, where 22.9% sustained ROSC and 9.7% survived to discharge, and the difference between exposed and unexposed groups was found to be statistically significant ($p<0.001$). The number needed to treat with naloxone was nine for ROSC, and 26 for survival to discharge (Dillon et al., 2024). Strong et al. (2024) found that among those who received naloxone prior to vascular access, 42.1% obtained ROSC, which was not statistically significant compared to 31.6% from the unexposed group. However, there was a statistically significant difference in patients who had ROSC upon arrival to the ED, which was 35.1% of patients who received early naloxone compared to 21.6% of those who did not ($p=0.022$) (Strong et al., 2024). Similarly, there was a statistically significant difference between the 14% of patients who survived to discharge in the group who received naloxone prior to vascular access compared to 3.3% for those who did not ($p<0.001$), following a similar trend to the findings by Dillon et al. (2024) (Strong et al., 2024). Following adjusted 1:1 propensity score matching, there was still a significant difference between the survival to discharge of these two matched groups (Strong et al., 2024). A logistic regression model was used to demonstrate that naloxone was more beneficial in patients with presumed opioid-related OHCA (Dillon et al., 2024). When respiratory and substance-use etiologies were controlled for in the early naloxone administration group, adjusted odds were higher for all outcomes for both PEA and asystole (Strong et al., 2024). This study by Dillon et al. (2024) utilized a robust sample size and propensity score-based models and analyses to adjust for potential bias. Despite this, the study lacked data regarding the timing of naloxone administration, route of naloxone, and whether bystander naloxone was administered, which could influence the interpretation and practical application of the results (Dillon et al., 2024). Additionally, younger, healthier patients are more likely to survive cardiac arrest, and younger patients with fewer comorbidities were more likely to receive naloxone by paramedics which introduces a selection bias, potentially confounding results further (Dillon et al., 2024). Strong et al. (2024) acknowledged these sources of potential for bias and performed multivariable logistic regressions to adjust for characteristics like age, sex, and initial rhythm. Further, when controlling for heart rhythms, early naloxone was also shown to improve adjusted odds of survival for patients in PEA, and ROSC at emergency department arrival for patients in asystole (Strong et al., 2024).

Quinn et al. (2024) authored a retrospective observational study with contrasting results to Strong et al. (2024) and Dillon et al. (2024). In the study by Quinn et al. (2024), confounding variables like age, initial cardiac rhythm, and chronic comorbidities were controlled for using a matched cohort analysis. 2.0 mg was the most common dose of naloxone used. Using a logistic regression model, it was found that there was no statistical significance between both matched and unmatched groups for all outcomes including ROSC and survival to discharge (Quinn et al., 2024). Within the in-hospital setting, Lv et al. (2019) found that naloxone use was not associated with a statistically significant increase in recovery of sinus rhythm, although the sample size used was the smallest when compared to the other three retrospective studies.

DISCUSSION

Whether naloxone has utility in cardiac arrest management is a recently evolving area of research. It appears naloxone is not harmful when given intra-arrest, and there is some data that suggests it may be helpful, but more research is ultimately needed. Animal studies generally found treatment with intra-arrest naloxone improved rates of ROSC, particularly when combined with epinephrine (Chen, Liu, et al., 2006; Chen, Xie, et al., 2006; Rothstein et al., 1985; Wang et al., 2008; Wang et al., 2010). Wang et al. (2010) also found that rats who received a combination of epinephrine and naloxone demonstrated better survivability at the 3-day mark, and this metric has important implications as it may indicate better long-term outcomes. It was also found by Chen, Liu et al. (2006) that the response to naloxone is dose-dependent, with 1 mg/kg IV being more efficacious than 0.05 mg/kg. This is notable for future studies, as the dose of naloxone may need to be optimized to see the intended effect. Despite all studies having statistically significant findings in support of naloxone use, small-sample animal experiments have limited generalizability to a human population. These studies serve as an initial first step when considering whether naloxone has utility beyond the current standard indication.

Two case studies highlight two patients who had a spontaneous improvement in cardiac rhythm and ROSC shortly after administration of naloxone in suspected opioid-overdose related cardiac arrests. One patient suffered significant neurological deficits following her resuscitation, and the other experienced seizures and an anoxic brain injury. Although these cases are thought-provoking, being uncontrolled, non-comparative, retrospective, and having only a sample size of one, there are limited conclusions that can be drawn from them.

In the last five years, new research has looked retrospectively at the effect of naloxone on cardiac arrest outcomes with mixed results. Two studies with robust data sets demonstrated higher rates of ROSC at the end of EMS care and improved survival to discharge when cardiac arrest patients were given naloxone, with Strong et al. (2024) looking specifically at early naloxone administration for non-shockable rhythms prior to vascular access and Dillon et al. (2024) considering any timeline of intra-arrest naloxone administration. Strong et al. (2024) chose early administration of IM/IN naloxone as the target of their study, and the exposed and unexposed groups were not limited by naloxone being administered after IV/IO access. This creates the possibility of both groups ultimately receiving naloxone at different time points. In contrast to the favorable findings by Strong et al. (2024) and Dillon et al. (2024), Quinn et al. (2024) and Lv et al. (2019) both found that there was no significant difference in outcomes between patients who received or didn't receive naloxone intra-arrest prehospitally and in-hospital, respectively.

There is ample potential for confounding variables when studying the administration of intra-arrest naloxone retrospectively. There is the question of how clinical gestalt leads healthcare providers to administer naloxone in cardiac arrest patients, as this decision-making process could further introduce bias in these retrospective studies. With substance-users being younger on average, this leads to naloxone administration to a younger population with less comorbidities, confirmed by Dillon et al. (2024), Strong et al. (2024), and Quinn et al. (2024). This could skew outcomes, as younger cardiac arrest patients generally have better outcomes, but this was controlled for by Strong et al. (2024) and Quinn et al. (2024) by comparing matched groups, and both studies yielded contrast-

ing results. Quinn et al. (2024) acknowledged that it is possible naloxone was being administered to patients with longer cardiac arrests without ROSC, with the thought process of 'try it all by the end.' Quinn et al. (2024) only gathered data from one EMS system, and if this is common practice within that system, this thought process could certainly introduce a confounding variable and contribute to the lack of improvement observed in patient outcomes with naloxone administration. Attempts to control confounders improves validity, however retrospective observational studies are bias-prone and not useful to ascertain causality. Despite this, they present insightful preliminary data that can direct future studies. Dillon et al. (2024) and Strong et al. (2024) suggested that naloxone may be more efficacious in presumed opioid-related OHCA, highlighting the need for future research to consider the mechanism of cardiac arrest. Despite this, Strong et al. (2024) did demonstrate that naloxone may cause mild improvement in some outcomes for patients specifically in asystole.

Ultimately, whether naloxone has utility in cardiac arrest management can only be confirmed by robust randomized controlled trials spanning large areas with multiple EMS systems. Several retrospective observational studies have recently provided provocative data regarding this intervention, however determining whether an overall practice change is warranted necessitates further evidence. A placebo would need to be implemented, along with a naloxone treatment group, and EMS providers would need to be blinded to which treatment they are administering. An area with a higher concentration of substance use would be useful to include, as this may help to compare which populations may benefit most from naloxone in the context of cardiac arrest management.

LIMITATIONS

Although rapid reviews allow for quick synthesis of data, which can be useful in instances such as this when there is new and evolving data on a topic, limitations do exist. Having one reviewer may introduce an unavoidable risk of bias in article selection and interpretation. This rapid review also only included two search databases, which may result in some relevant articles being missed.

CONCLUSION

Currently, there is conflicting evidence on whether naloxone improves rates of ROSC and survival to hospital discharge. Cardiac arrest management can be a task-saturating undertaking, and adding additional treatments without sufficient evidence may take away from evidence-driven interventions, such as high-quality CPR, airway management, and ventilation. Despite this, the question of whether naloxone has utility in improving resuscitation rates and survivability is important to answer, as only 1 in 10 people survive an OHCA in Canada (Heart and Stroke, 2024). A randomized controlled trial involving a wide area of EMS systems and hospitals may be the next step to address this question. Therefore, although naloxone does not appear to be harmful in the context of cardiac arrest, further research is needed to determine whether it is truly efficacious.

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REVIEWS

AN OVERVIEW OF THE SIDE EFFECTS AND ADVERSE EVENTS IN PREHOSPITAL KETAMINE ANALGESIA FOR TRAUMA: A SYSTEMATIC REVIEW

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ABSTRACT

Introduction: In the United Kingdom, pain management is a frequent reason for ambulance use. The benefits of adequate pain management are well documented and have been shown to improve patient outcome and quality of life. Ketamine has been shown to be an effective analgesic in international prehospital settings, yet it does not feature in the scope of practice of all UK paramedics.

The aim of this literature review is to identify the type and incidence of adverse events and side effects when Ketamine analgesia is administered for traumatic pain in the prehospital setting.

Methods: A systematic electronic search was performed to identify literature documenting adverse events and side effects of analgesic ketamine in the prehospital setting. Additionally, manual reference screening and a snowballing technique were used to identify additional relevant material. A thematic analysis of their findings was undertaken to identify the range of side effects reported.

Results: Eight studies, containing a total of 1301 patients, met the inclusion criteria of this review. Four were randomised controlled trials and four were retrospective database reviews. Thematic analysis of reported side effects included cardiovascular, neuropsychological or gastrointestinal effects , and airway or respiratory compromise. Additional effects such as hypertonia, clonus and allergic reactions were reported in three studies.

Conclusion: A broad range of side effects were reported following analgesic ketamine for the treatment of traumatic pain. The incidence of serious adverse events was low. Variation in the dosing regimes, routes of administration, definitions of side effects, observation periods, and inclusion criteria was observed and may limit generalisability. This study provides an overview of the complications that may occur following administration and the requirement to carefully consider how Ketamine is utilized. When administered to appropriately selected and risk-assessed patients, Ketamine may be a useful tool in the paramedic's pain management armory.

INTRODUCTION

In England in 2019, 4.3 million patients were transported to the emergency department by ambulance, with up to 2.8 million of those patients presenting with pain (Whitley et al., 2023). The benefits of pain management are well documented and have been shown to improve patient outcome and quality of life

(Vysokovsky et al., 2021). Despite this, up to 45% of adults suffering from pain in the prehospital setting are inadequately treated (Siriwardena et al., 2019; Ferri et al., 2022). This could be attributed to a lack of available analgesic options, with little to no alternative between paracetamol for mild to moderate pain, or morphine for moderate to severe pain (Lord and Nicholls, 2014; Hodkinson, 2016).

Ketamine is a relatively new analgesic agent in the UK prehospital setting but has been used effectively for many years in international civilian and military arenas (Buckland et al., 2018). Analgesic Ketamine administration currently only features in the scope of practice of appropriately trained specialist paramedics in the UK (Association of Ambulance Chief Executives, 2019). Several comparative studies have reported that Ketamine is as effective, if not better, at relieving traumatic pain when compared to opioids (Kator et al., 2016; Sobieraj et al., 2020). Although the recent publication of the PACKMaN trial reported no significant difference in the analgesic efficacy of Ketamine compared to Morphine (Smyth et al., 2025). Nevertheless, Ketamine appeared to be faster acting and achieved a higher rate of significant improvements in pain after administration than Morphine. Despite this, its duration of action was shorter than Morphine and both groups of patients still experienced moderate or severe pain on arrival at hospital, thus indicating a need to continue to explore further analgesia strategies for prehospital clinicians.

Ketamine acts as an N-methyl-D aspirate (NMDA) antagonist. It decreases the frequency and mean opening time of ion channels by binding to the phencyclidine site on postsynaptic channels (Li and Vlisides, 2016). At lower concentrations ketamine prominently blocks closed channels giving an analgesic effect. At higher concentrations of ketamine, both open and closed ion channels are blocked giving anesthetic effects (Zorumski, Izumi, and Mennerick, 2016). NMDA receptors can be found in spinal, thalamic, limbic, and cortical regions of the brain. The drug is often referred to as a dissociative analgesic because it disrupts sensory input to higher centers of the central nervous system, impacting pain and emotional reactions along with memory (Best, Bodenschatz and Beran, 2014). Ketamine has a rapid transfer across the blood-brain barrier due to its water and lipid solubility but low protein binding ability. This allows the drug to be administered via various routes including intravenous (IV), intramuscular (IM) and intranasal (IN) (Gao, Rejaei, and Liu, 2016). The broad therapeutic range makes it versatile in both anesthesia and pain management (Rosenbaum et al., 2024).

Common side effects include anxiety, abnormal behavior, confusion, diplopia, nystagmus, nausea and vomiting, increased muscle tone, tonic clonic movements, and sleep disorders (Joint Formulary Committee, 2024a). Emergence phenomena - a term grouping anxiety, feeling of unease, hallucinations, floating sensation, vivid dreams, and delirium may also occur; however this is more common in higher doses of ketamine (Gales and Maxwell, 2018). Other uncommon side effects include arrythmias, hypotension and respiratory disorders (Joint Formulary Committee, 2024a). Several of these side effects have led to concerns over the routine use of Ketamine as an analgesic medication (Vadivelu et al., 2016; Gales and Maxwell, 2018).

To improve the understanding of how Ketamine analgesia may be considered for wider adoption within prehospital care, the safety profile should be explored. This literature

review aims to provide an overview of the range of side effects that arise from the prehospital administration of analgesic ketamine for the treatment of pain in trauma.

METHODS

Search Strategy

An electronic database search of the Cumulative Index to Nursing and Allied Health (CINAHL) Ultimate, PubMed, and Excerpta Medica (EMBASE) databases was performed. CINAHL Ultimate was accessed using the EBSCOhost platform and EMBASE searched via the Ovid platform. This review was structured using the Preferred Reporting Items for Systematic reviews and Meta-analysis (PRISMA) guidelines (Page et al., 2021)

Search Terms

The search terms were established by identifying relevant keywords in the titles, abstracts, and full texts of articles already known to be eligible for inclusion. These terms were later enhanced by adding synonyms. Boolean operators and truncation were used to link search terms. An accuracy check was performed on the chosen databases to ensure that already known articles featured in the results. The full search strategy used can be seen in Table 1. The literature search was performed on the three documented databases between 23/04/2025 and 15/05/2025.

Search	Field	Search term
S1	Title / abstract	Ketamine AND Prehospital OR Pre-hospital OR out of hospital OR Paramedic* OR EMS OR emergency medical service* OR ambulance*
S2	Title / abstract	Analgesia OR acute pain OR pain management OR pain relief OR analgesic* OR traumatic pain AND Adverse event* OR side effect*
S3	S1 AND S2	

Table 1: Search strategy. (* truncation, OR AND Boolean operators)

When the literature search identified literature reviews, the original references were identified and assessed for inclusion. Additionally, a snowball sampling technique was used to identify other relevant material not obtained through the initial database searches. This process involved looking for further relevant literature from additional sources, such as suggested articles, similar authors, and manually reviewing identified article reference lists (Aveyard, 2019). The ProQuest (2023) platform was also used to search for PhD and MSc theses relevant to the research question.

Table 2 summarises the inclusion and exclusion criteria. Only studies using ketamine specifically for analgesia were included. Studies using only sedative or anesthetic doses were excluded to maintain relevance to the subject. Children were excluded due to differing pharmacodynamics and immature physiology. Non-English literature was excluded due to resource constraints. Grey literature was included to reduce publication and outcome bias and help identify adverse events not reported in commercially published stud-

Inclusion	Exclusion
• English language only • Prehospital setting • Civilian population • Analgesic Ketamine use • Adults • Published 01/01/2014 onwards	• No full text available • In-hospital studies • Military studies • Conference abstracts, letters • Ketamine used for another indication e.g. sedation or anaesthesia • Paediatrics

Table 2: Summary of inclusion and exclusion criteria.

ies. To ensure up to date evidence and reflect current practice, only studies published from 1st January 2014 onwards were included. Title and abstract screening, and full-text review was undertaken by both authors. Discrepancies were resolved via discussion, with a third reviewer available if a consensus on inclusion could not be reached.

Following the identification of articles eligible for final inclusion and data extraction, a thematic analysis of their respective findings was undertaken.

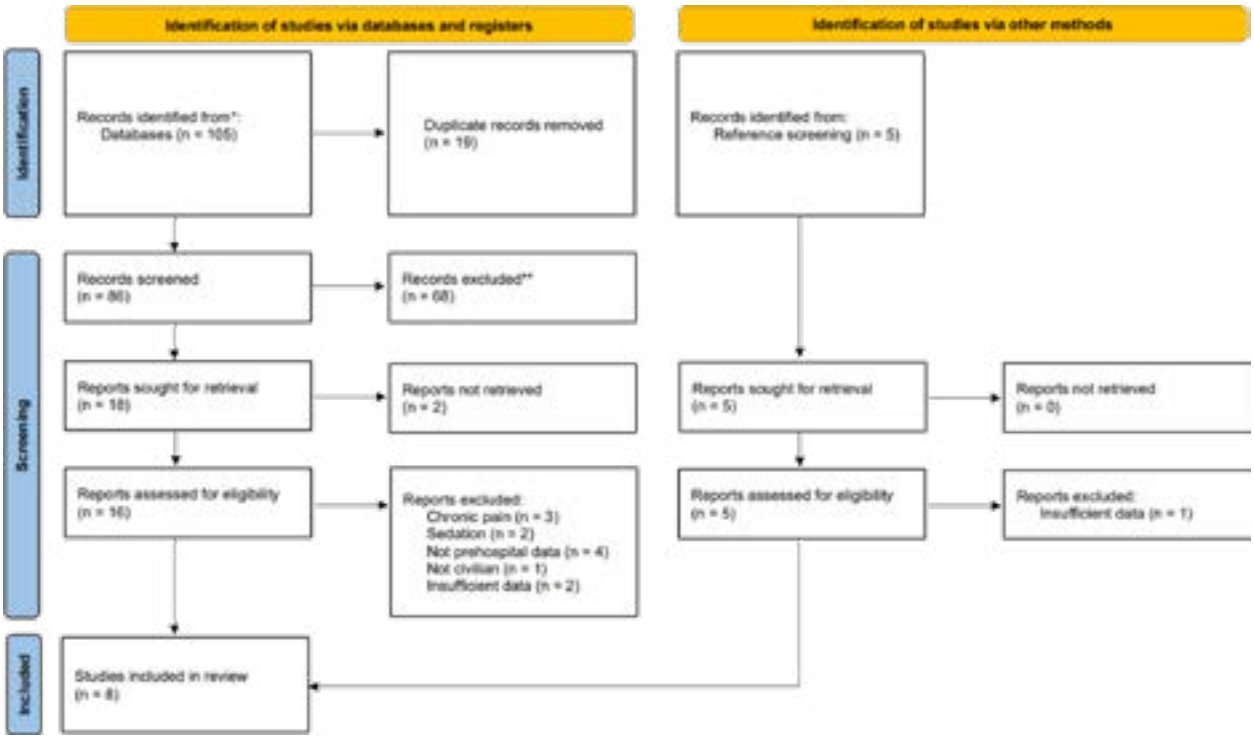

Figure 1: PRISMA diagram.

RESULTS

Gastrointestinal Effects

Nausea or vomiting was the most frequently documented side effect and featured in seven of the included papers (Tran et al., 2014; Cowley et al., 2018; Vanolli et al., 2020; Andolfatto et al., 2020; Le Cornec et al., 2023; Smyth et al., 2025). Some studies differentiated between the sensation of nausea and episodes of vomiting whilst others combined them when reporting side effects. The PACKMaN trial recorded 34 (16%) patients reporting nausea after receiving Ketamine and vomiting in 16 (7%) (Smyth et al., 2025). The multi-center KETAMORPH study of 251 patients Le Cornec et al. (2023) recorded events of nausea and vomiting separately. In the ketamine cohort of 120 patients, nausea was the third highest adverse event and vomiting the fourth, at 6.6 % and 5% respectively. Similarly, eight of the 169 (4.73%) patients who received Ketamine in a cluster RCT by Tran et al. (2014) experienced nausea and vomiting. Vanolli et al. (2020) reported nausea and vomiting as a combined side effect and found it to be present in 10% of their study population. Andolfatto et al. (2019) evaluated intranasal Ketamine administration and found 68% of patients were reported to experience at least one side effect or adverse

event, with nausea the third most frequent, contributing to 17% of all side effects. Vomiting was not present in any patients within this study.

Airway or Respiratory Compromise

A range of airway or respiratory sequelae were reported. Vanolli et al. (2020) reported the development of bradypnea, respiratory depression, apnea or desaturation in 26% (n = 10), 13% (n = 5), 10 (n = 4) and 26% (n = 10) of patients respectively. Additionally, one patient developed airway obstruction, and one developed laryngospasm. Cowley et al. (2018) and Zietlow et al. (2019) also reported respiratory depression within their cohorts, in three (0.6%) and eight (5%) patients. Smyth et al. (2025) found 15 (7%) of patients desaturated, however just one required ventilatory support. Excess salivation was documented in two studies (Tran et al., 2014; Vanolli et al., 2020) with a wide variation in incidence. Vanolli et al. (2020) reported 41% (n = 16) of patients experienced hypersalivation following ketamine administration whereas Tran et al. (2014) found just three (1.7%) of 169 subjects receiving ketamine experienced excess salivation.

Cardiovascular Effects

An increase in systolic blood pressure was reported in six studies (Tran et al., 2014; Cowley et al., 2018; Zietlow et al., 2019; Vanolli et al., 2020; Le Cornec et al., 2023; Smyth et al., 2025). Zietlow et al. (2019) found seven (4.4%) hypotensive patients became normotensive following ketamine administration and both Le Cornec et al. (2023), and Tran et al. (2014), reported a slight increase in mean systolic blood pressure when compared to pre-administration recordings. Cowley et al. (2018) also observed 6 cases (1.37%) of patients having a transient blood pressure increase. Smyth et al. (2025) recorded 17 (8%) cases of hypertension and 6 (3%) of hypotension following Ketamine administration. Conversely, Bronsky et al. (2018) recorded a mean systolic blood pressure decrease of 4.2mmHg following analgesic ketamine administration. Both Vanolli et al. (2020) and Smyth et al. (2025) reported occurrences of tachycardia or arrhythmia in 15 (38%) and 3 (1%) patients within their study populations.

Neuropsychological Effects

Neuropsychological effects were reported in six studies (Tran et al., 2014; Cowley et al., 2018; Andolfatto et al., 2020; Vanolli et al., 2020; Le Cornec et al., 2023; Smyth et al., 2025). The definition varies between studies within this review with some not documenting their defining symptoms of EP, whilst others recorded the symptoms individually. Tran et al. (2014) reported 19 of 169 patients as becoming agitated following Ketamine administration. Le Cornec et al. (2023) recorded EP as a group of symptoms including dysphoria, agitation or hallucinations. EP was the most common adverse event in the ketamine group, with 19% of patients experiencing symptoms. Visual disturbance was recorded as a separate adverse event. Cowley et al. (2018) reported mild EP in two (0.45%) of the 449 patients in their study, however there was no indication of what symptoms were considered mild EP. Vanolli et al. (2020) defined EP as vivid visual hallucinations or dreaming during the recovery phase and found hallucinations (72%) and agitation (49%) were the two most common side effects recorded. Interestingly, whilst hallucinations were frequently encountered, it was reported these were mostly a positive patient experience. Andolfatto et al. (2019) recorded individual symptoms which are considered EP. Of the 37 subjects reporting adverse events, 2% were recorded as experiencing hallucinations

whilst another 2% reported a change in hearing. 27% of patients experienced the feeling of unreality and a further 20% reported dizziness. 5% recorded a mood change. This was the only study in present literature review which administered ketamine intranasally. Finally, Smyth et al. (2025) documented sedation 23 (11%), excitatory movements 2 (1%), and adverse behavioral reactions 22 (10%). Adverse behavioral reactions, which were not specifically defined, were the most common occurring adverse event in the ketamine cohort.

Other

Other uncategorised side effects or adverse events included hypertonia (13%), clonus (5%) and hiccups (5%), and all featured within the study by Vanolli et al (2020). Both Vanolli et al. (2020) and Smyth et al. (2025) reported allergic reactions to Ketamine administration in 2 (5%) and 1 (<1%) patients.

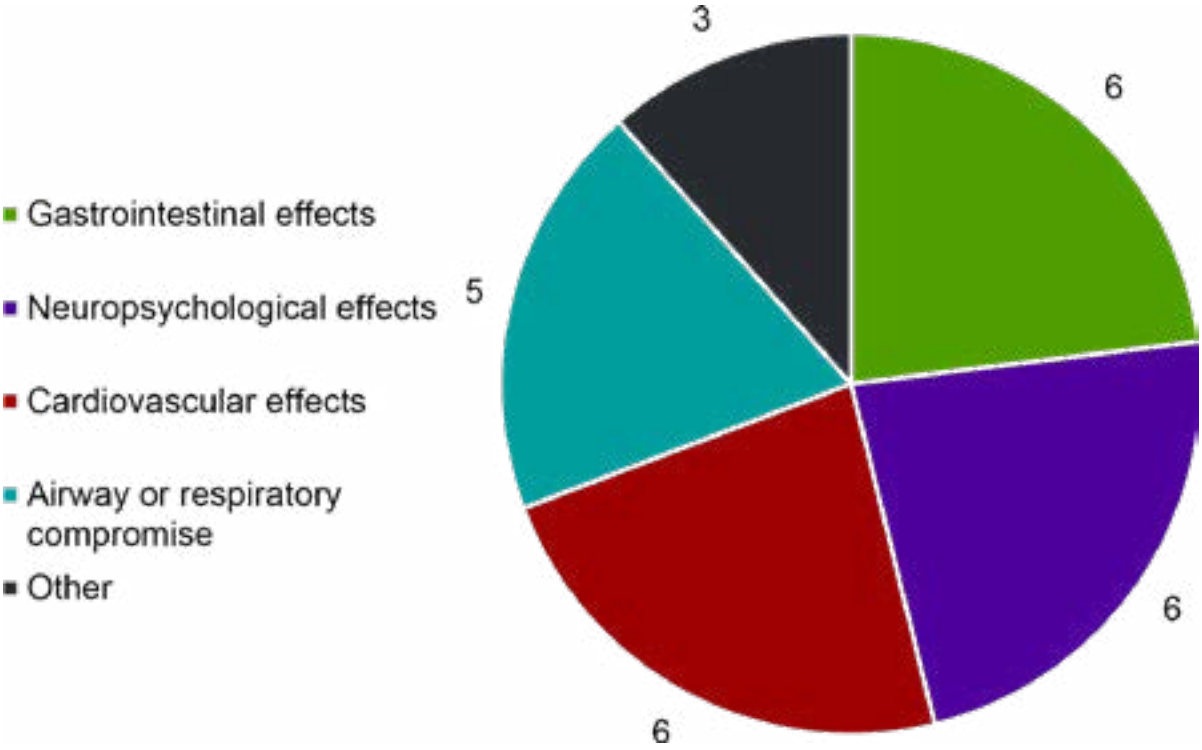

Figure 2: Number of studies reporting side effects.

Theme	Gastrointestinal effects	Airway or respiratory compromise	Cardiovascular effects	Neuropsychological effects	Other
Side effects reported	• Nausea • Vomiting • Nausea and vomiting (combined)	• Bradypnea • Desaturation • Respiratory depression • Apnea • Airway obstruction • Laryngospasm • Need for advanced airway management or ventilation • Hypersalivation	• Tachycardia • Hypertension • Transient increase in blood pressure • Hypotension • Arrhythmia	• Hallucinations • Agitation • Anxiety • Emergence reaction • Stereotypy • Visual disturbance • Mood change • Hearing disturbance • Fatigue • Distress • Excitatory movements • Sedation	• Hypertonia • Clonus • Hiccups • Dizziness • Anaphylaxis • Allergic reaction

Table 3: Thematic Analysis.

DISCUSSION

The aim of this literature review was to identify the frequency and nature of side effects and adverse events reported when Ketamine is administered as an analgesic for traumatic pain treatment in prehospital settings. Neuropsychological, cardiovascular and gastrointestinal effects were all frequently reported. Additionally, instances of airway or respiratory compromise was also described in four of the eight included studies. Whilst some of these effects can be life threatening, the frequency of serious adverse events reported across all studies was low. When combining the populations of all studies within this review, side effects following Ketamine administration were recorded in 19% of the population, with most described as clinically insignificant and not requiring intervention.

The difference in analgesic duration seen between Ketamine and other medications has often necessitated treatment with multi-modal analgesia. However, coadministration of ketamine with other analgesics was associated with increased adverse events across several studies (Bronsky et al., 2018; Tran et al., 2014). A systematic review by Yousefifard et al. (2020) found a 33.4% increase in adverse effects when ketamine was combined with morphine. Similarly, Sandberg et al. (2020) reported more adverse events with ketamine-opioid combinations than with ketamine alone. Bansal et al. (2020) observed heightened neuropsychological effects with ketamine-morphine coadministration. Despite the increased side effect profile, Ketamine may have an opioid-sparing effect (Cohen et al., 2022; Guo et al., 2023), and thus analgesic strategies involving co-administration of other medications may be cautiously considered.

Airway or respiratory compromise, including apnea and the requirement for ventilatory support, were reported in four studies. Reassuringly, the overall incidence within these was low, however, this provides an important reminder of the need for pre-administration preparation and risk assessment. Excessive salivation, which may increase the risk of airway compromise, was also reported as a complication within two studies. Ketamine-induced laryngospasm is a known rare complication following administration and has been well described in pediatric populations (Green et al., 2010). This complication may be managed with prompt airway management, positioning and positive pressure ventilation (Butler, 2015). Moreover, gastrointestinal effects, including the onset of vomiting, were also frequently reported. These factors reinforce the requirement for clinicians to ensure airway management equipment is readily available and patients can be accessed and positioned for airway management if required.

When compared to opioid analgesia, multiple studies found that patients receiving ketamine experienced fewer instances of nausea and vomiting (Tran et al., 2014; Le Cornec et al., 2023; Smyth et al., 2025). The significance of these findings is particularly relevant in trauma care. Vomiting can lead to airway compromise in immobilised or unconscious trauma patients, or those positioned supine for spinal precautions (Purvis, Carlin, and Driscoll, 2017). Additionally, vomiting is known to increase intracranial pressure (ICP), potentially posing risks for patients with head injuries (Zamani et al., 2015).

Ketamine may hold an advantage over opiate medications in patients with hemodynamic instability. This review found multiple studies reporting small increases in systolic blood pressure following administration. The RCT of Ketamine and Morphine in trauma

patients by Tran et al. (2014) found Ketamine beneficial in a subgroup of patients with systolic BP below 80 mmHg. This result aligns with an experimental study by Watso et al. (2023), where low-dose Ketamine increased BP and provided superior analgesia compared to Morphine in simulated hypovolemic conditions. These findings continue to support the role of Ketamine as an analgesic option for hemodynamically unstable patients, or where avoiding hypotension is important, such as in the setting of traumatic brain injury.

A frequent concern over the use of ketamine often relates to the incidence and management of associated EP, including hallucinations and agitation (Martinez et al., 2015; Gales and Maxwell, 2018). These may present challenges in treatment in the presence of prolonged or complex extrications (Tran et al. 2014), such as those carried out from remote locations by Hazardous Area Response Teams [HART] in the UK. An audit of ketamine administered by HART Paramedics by Metcalf et al. (2018) identified no incidents of severe negative psychological symptoms. Anxiety was observed following administration on a few occasions and was managed non-pharmacologically to good effect. Reducing stimuli and creating a calm environment prior to administration can decrease the likelihood of such reactions (Green and Li, 2000). This can be difficult to achieve in the prehospital setting, and efforts should be made to ensure the surrounding environment is controlled wherever possible. Simulation should involve all clinicians and agencies expected to be in attendance at such cases to maintain a shared awareness. Furthermore, the development and use of pre-administration checklists, incorporating scene and logistical factors, should be considered as an additional means of enhancing safety.

The co-administration of Ketamine with benzodiazepines has been shown to mitigate neuropsychological side effects (Perumal et al., 2015; Gonsalvez et al., 2018; Vanolli et al., 2020). Services adopting Ketamine into their drugs formulary should consider the availability and use of benzodiazepines, such as Midazolam, in these circumstances. It is recognized that this approach carries a risk of iatrogenic over-sedation and therefore should be reserved for use by clinicians with experience and capability in managing sedated patients.

LIMITATIONS

This systematic review has several limitations. Firstly, there was heterogeneity in the drug dosing regime, route of administration and definition of adverse events in the evaluated literature. Secondly, there was variability in how adverse events and side effects were recorded, with many being documented as a secondary outcome or having no formal method for recording them within the study design. This may have resulted in detection bias or misrepresentation of the data where some findings have been unreported. Thirdly, inclusion criteria varied throughout individual studies with some studies excluding certain injury groups, such as head injuries and dislocations. Fourth, although no studies with a primary focus on pediatric analgesia were included, a small number of articles contained a small amount of pediatric data within their findings. Finally, adverse events and side effects were largely recorded until arrival at hospital, therefore could have missed adverse events occurring after this timepoint.

Reference	Setting	Methodology	# Patients	Results	Limitations
Tran, K., P. et al (2014).	Vietnam	• Cluster RCT-regional sector, divided into 2 sectors with alternating treatment monthly. • Adverse events registered throughout evacuation until arrival at ED. • Ketamine dose: 0.2-0.3mg/kg slow IV. • Blood pressure, respiratory rate was recorded prior to analgesic administration and on arrival at hospital	• 169 • Sub analysis of haemorrhage cases with systolic blood pressure less that 90mmHg: 32 in ketamine group • Sub analysis of 28 ketamine patients with traumatic head injury	• Nausea and vomiting: 5% • Agitation: 11% • Excessive salivation: 1.8% • No significant impact on respiratory rate. • All patients maintained airway responsiveness and O2 sats. • Mean blood pressure was 9.3mm higher post Ketamine in the haemorrhage subgroup. • 27/ 28 ketamine patients had the same conscious level on arrival at ED in the head trauma subgroup.	• No blinding, possible observer bias • Small subset analyses • Study based in a previous war zone with a large number of trauma injuries from undetected land mines. • Study included 24 children • Some patients in very rural, low- resource locations with initial evacuation by bicycle or motorbike. Could affect adverse events.

Table 4: Characteristics of included studies.

CONCLUSION

This literature review has identified a broad range of side effects reported following analgesic ketamine for the treatment of traumatic pain. The frequency of adverse events and side effects was low whilst ranging from short-lasting and clinically insignificant neuropsychological effects to airway compromise. The relative cardiovascular stability of this medication was frequently reported, with multiple studies reporting moderate increases in blood pressure following administration. This study provides an important overview of the complications that may occur following administration, and the requirement to carefully consider how Ketamine is utilized within an analgesic strategy. When administered to appropriately selected and risk-assessed patients, Ketamine may be a useful tool in the paramedic's pain management armory.

The majority of studies identified compared Ketamine with Morphine. Whilst this provides a direct comparison to a medication currently widely used in prehospital care, newer analgesic options are now becoming available, such as inhaled Methoxyflurane. Further evaluation and comparison of the side effects of alternative medications may help to evaluate options and guide wider implementation. Further research should also explore the pre-administration characteristics of patients who experience complications to identify those at risk. Additionally, the long-term effects of adverse events following Ketamine administration should be studied.

Reference	Setting	Methodology	# Patients	Results	Limitations
Bronsky et al (2018)	United States	• 2-year retrospective review • Ketamine: 0.3mg/kg administered IV every 20 minutes. Max 3 doses. • Adverse events recorded from scene arrival through to emergency department discharge.	• 79	• Slight reduction in BP following administration • No significant AE recorded in patients receiving Ketamine	• Retrospective • Increased BP, intracranial pressure excluded from study at discretion of paramedic. • Adverse events are a secondary outcome. • Only 'significant' adverse events were recorded. • Dysphoria or altered mental state not recorded.
Cowley, A. et al. (2018).	United Kingdom	• 4-year retrospective review • Dosing IV: 0.1mg/kg titrated. Max 0.5mg/kg over 30 minutes intervals. • (40-70kg: 5mg aliquots, <70kg: 10mg aliquots) • All adverse events recorded whilst patient in care of critical care paramedic.	• 449	• 16 AE recorded 3.6%. • BP increase: 6 • Respiratory depression: 3 • Vomiting: 3 • Mild emergence phenomena: 2 • Distressed: 1 • Accidental overdose: 1 • All recorded AE caused no harm to patients.	• Retrospective • Study included some Ketamine use for sedation and did not separate AE, although mean dosing was the same for both groups. • Study included some children over 12 years old • Antiemetic use or co-administration with other analgesics not recorded in study. • AE were not recorded by clinicians in a formal way. Free text box used. Therefore, open to reporting bias. • Some AE may have been unreported due to lack of recall by clinician.
Andolfatto et al (2019)	Canada	• Single-centre RCT • Ketamine (0.75mg/kg) administered intranasal. Half dose to each nostril alongside the usual use of nitrous oxide. • Patients were assessed every 15 minutes for AE until hospital arrival. • AE considered serious if intervention was required or higher-level clinicians were called to scene.	• 60 receiving Ketamine	• 37 (62%) of patients in the Ketamine group experienced AE. • Some patients experienced more than 1 AE. Total of 52 recorded. • Feeling of unreality: 27%, • Dizziness: 20% • Nausea: 7% • Fatigue: 10% • General discomfort: 5% • Mood change: 5 % • Hallucinations: 2% • Hearing change: 2% • No significant change in vital signs • All AE considered minor, with no intervention	• Single centre research • Small sample size may not allow incidence of rare AE. • Component of unblinding. 63% of paramedics correctly identified Ketamine. • Co administration alongside Nitrous oxide. Difficult to differentiate between AE
Zietlow et al (2019)	United States	• 2-year retrospective review • Dosing IV or IO: 0.5-2mg/kg over 1-2 minutes followed by 0.25mg/kg • every 5-10 minutes. • IM dosing: 2-5mg/kg repeated as needed.	• 158 patients	• No significant difference in HR, BP, RR, or SpO2 pre or post administration of Ketamine • No emergence episodes encountered. • 5% (n=3) had either decreased RR or Sp02 requiring ventilation. • All recovered in less than 30 seconds	• Single centre study • Retrospective • 3.2% (n=5) of patients were <18years of age • Study included Ketamine administration for sedation as well as analgesia all recorded in the same group.

Table 4 (continued): Characteristics of included studies.

Reference	Setting	Methodology	# Patients	Results	Limitations
Vanolli K., et al (2020)	Switzerland	• Retrospective survey of physician's experience in the use of Ketamine.	• 39	• Most common AE witnessed was visual hallucinations. • Hallucinations: 78% • Agitation: 49% • Hypersalivation: 41% • Tachycardia: 38% • Bradypnea: 26% • Desaturation:26% • Emergence: 23% • Respiratory depression: 13% • Nausea & vomiting: 10% • Airway obstruction: 3% • Concluded that AE was seldom reported, and all participating physicians considered Ketamine safe.	• Retrospective • Single centre, small sample size. • Survey self-reported. Results subjective to individual physician with no way of verifying answers to study • Unable to establish Ketamine dose administered. • Survey did not ask if AE occurred with Ketamine alone or when co administered. • Midazolam administered by 36% of those surveyed to avoid hallucination.
Le Cornec et al (2023)	France	• Multi-centre RCT • Ketamine dose: 20mg over 2 minutes followed by 10mg every 5 minutes. • Adverse events documented at 30-minute intervals until arrival at ED.	• 128 receiving Ketamine	• After 30 minutes of administration the ketamine (K) group reported 49/120 (40.8%) patients had adverse events. • Nausea: 6.7%, • Vomiting: 6%, • Decreased consciousness: 8%, • Visual disturbance: 17.5% • Emergence phenomenon: 20% • Hypertension: 4.2% • No patients experienced severe adverse events or required intervention to manage adverse events.	• Single blinded, crew not blind to medication. • Non-Anglo-American EMS system. • Hypotension not reported. • Follow up period only prehospital so may miss later complications. • Head injuries, unstable patients, fractures needing relocation excluded from study. • Potential for publication bias in not reporting hypotension. • Some conflict of interest recorded for 2 authors. • No mention of other medications such as antiemetics or haemodynamics.
Smyth et al., (2025)	United Kingdom	• Multi-centre RCT across two regional ambulance services • Ketamine dose: 15mg over 5 mins, with second 15mg if pain continued 5 mins post initial dose	• 219	• Serious AE: 4 (2%) • Experienced AE: 106 (48%) • Vomiting: 16 (7%) Advanced airway management: 1 (<1%) • Desaturation: 15 (7%) • Need for ventilatory support: 1 (<1%) • Arrhythmia: 3 (1%) • Hypotension: 6 (3%) • Hypertension: 17 (8%) • Sedation: 23 (11%) • Excitatory movements: 2 (1%) • Adverse behavioural reactions: 22 (10%) • Allergic reaction: 1 (<1%) • Nausea: 34 (16%) • Naloxone administered: 2 (1%) • Midazolam administered: 7 (3%)	• Potential for unblinding due to predictable side effects of Ketamine
AE- adverse events, BP- blood pressure, ED – emergency department, HR- heart rate, IV- intravenous, IO- intraosseous, RCT – randomised controlled trial, RR-respiratory rate					

Table 4 (continued): Characteristics of included studies.

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CASE REPORTS

DID YOU SAY MY PATIENT WAS RADIOACTIVE? A CASE REPORT

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ABSTRACT

A local Advanced Life Support (ALS) ambulance was dispatched for a medical patient experiencing a respiratory emergency. Part of the additional information presented from the Public Safety Answer Point (PSAP) reported that the patient had received radioactive therapy, and they were warned not to come into contact with other people due to radiological concerns. The crew on the ALS unit immediately realized that while they were trained in accordance with OSHA 29 CFR 1910.120 at the technician level, they had neither the equipment nor specialized experience in radiation to know best practices for this situation. They requested the Hazardous Materials Duty Officer to assist with medical guidance and radiological understanding. Thankfully the on duty Hazardous Materials Duty Officer (HMDO) was also a paramedic and the designated radiological officer was able to offer clinical guidance, but this incident demonstrated the deficiencies that exist in the paramedic knowledge set and the need for specialized training options. The patient believed they were having an allergic reaction resulting in respiratory distress while the crew were traversing an unknown territory of brachytherapy and how that may be impacting the patient. While the patient was able to be managed relatively easily based on their symptoms with minimally invasive therapies, this highlighted the need for specialized resources and access to experts.

INTRODUCTION

Brachytherapy is a common therapy for specific types of cancer treatment including thyroid cancer. It is well documented that the thyroid has a particular attraction to iodine. For radiotherapy Iodine-131 is typically used to focus the therapy at the thyroid (Wei et al., 2021). The patients' therapy resulted in the successful planting of iodine within the thyroid as confirmed prior to her department from the medical appointment. However, the patient returned home and noticed that she was having trouble breathing, a life-threatening emergency, and promptly called 911. As she was instructed to, she warned the PSAP that she had received radiotherapy, was considered radioactive and, people should be instructed to avoid her. The responding paramedic, unsure of what to do, called for a specialist. As a field paramedic, they found themselves struggling to find the balance between how best to treat the patient while at the same time keeping

themselves and their crew safe, a dichotomy we often find ourselves in EMS struggling with.

CASE INITIAL ASSESSMENT

By fortunate coincidence, the HMDO arrived as EMS was preparing to make contact. The ALS unit provided medical monitoring equipment and the HMDO provided a Geiger counter capable of detecting gamma radiation, a deliberate choice. The patient was a well appearing 77-year-old female who did not appear to be in any acute distress. While crews were advised that contamination was not a concern and minimal monitoring would occur until levels could be established and safe work zones determined. The HMDO, as a credentialed paramedic, started non-invasive monitoring of the patients' vital signs while gathering background readings. This was done to minimize the number of people impacted should the radiation levels be concerning enough. Knowing that contamination was a minimal risk factor, short of an insult to thyroid resulting in the isotope being released. universal precautions would be adequate (Radiation Emergency Medical Management, n.d.). The patient's examination was rather unremarkable, but therapies were deferred to local protocol and patient need by the transporting paramedic. Ultimately, she would receive medical monitoring and a nebulized beta-2 agonist for mild wheezing. The latter therapy was the therapy the transporting paramedic was most concerned with and its impact on contamination and exposure.

RADIOLOGICAL ASSESSMENT

The thyroid was surveyed at both near contact and at one foot distance. This gave the ability to not only give guidance on safe distances but also estimate the crew's exposure. Following the principals of the inverse square law (Ionactive Consulting Limited, 2024), we can calculate the reading that would be found in various distances and thus could safely conclude that the on contact reading was 200 mR/hr (milli-Roentgens per hour) and the one foot reading was 20 mR/hr, which was the most likely dose rate they would receive during general patient care. The transport time to the closest appropriate hospital was estimated to be 20 minutes. Utilizing the dose rate and transport time we calculated their transport dose to be 400 mR. The dose would increase slightly while unloading the patient into the emergency department and transferring at bedside but would not exceed safe limits (Occupational Safety and Health Administration, n.d.) for emergency workers. The crew was given just-in-time training to understand their risks, understand their exposure, and give them guidance on safe practices including As Low As Reasonably Achievable (ALARA) through the act of time, distance, and shielding. Spending the least amount of time, further away from the patient, and with objects between you would significantly reduce their exposure. This meant sitting at the far end of the ambulance near the patients' feet would reduce exposure. Additionally the driver would be better protected as they would not only be further away from the patient but would benefit from partial coverage from the ambulance structure. Crews were advised that any therapy they may wish to do would not cause radiological contamination including aerosol generating procedures but a surgical airway, something considered highly unlikely in this patient, may result in contamination. Once the crews' concerns were placated, they were given contact information for the HMDO should they have follow-up questions or concerns. The patient was transported uneventfully to the hospital and crews returned to service without further issue. Something worth reviewing and a limitation in the re-

sponse model for the HMDO is that they carry a Geiger counter that is designed to evaluate gamma radiation with an optional probe to evaluate contamination with sensitivity for alpha, beta, and gamma. Specifically missing from the equipment cache is an isotope identifier which would have utilized the gamma spectrum released from the isotope allowing the crews to identify the isotope without any question (Smith & Kearfott, 2018). This was not necessary at this time as the patient was able to produce relevant documentation on what isotope was utilized and calculations could be made knowing the specific activity from the reporting documentation. This created a post incident discussion on deployment of specific resources and practical limitations after the incident.

FOLLOW UP AND OUTCOME

Utilizing a software link within the patient care report and the hospital system known as the "Health Data Exchange" allowed prehospital crews to evaluate the notes written by the physicians and discharge summary. For this patient she was monitored in the emergency department for several hours to evaluate for acute changes in condition and allow for the emergency physician to speak with the onsite health physicist for further care planning. The patient was discharged home to self-care.

DISCUSSION AND CONCLUSION

Reading over this case, you can probably tell that this case was, on its surface, both rather unique and, thankfully, a case that could be managed without a great deal of strain. The patient was arguably hemodynamically stable for the duration of care. The crews not only had access to a resource that could provide expert testimonial and respond to the scene to give guidance from both a medical perspective as well as a radiological specialist perspective. In Lancaster County, PA we have a dedicated volunteer hazardous materials team with a duty officer available at all hours and a non-transport paramedic unit that is available to assist in these special cases. This brings to the forefront the very real concerns that exist in a system that does not have access to such a resource. In nearly every response district there is some radioactive risk factor this could be something as simple as your local dentist office, medical office, radiotherapy service, industrial settings including a recycle center or paper mill who all benefit from the usage of radioactive elements. Prehospital providers need to be prepared to manage patients who are either exposed or contaminated with radiological materials. Ask yourself: Is this resource available to me? Had I been dispatched to this incident would I have been able to safely protect myself and my patient from harm? If the answer is no, then a serious discussion needs to be had about how best we can keep our community safe.

PATIENT PERSPECTIVE AND CONSENT

Sadly, in reaching out to the patient after the incident to gather perspective and consent it was determined the patient had expired sometime in the years following therapy.

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CONCEPTS

FROM HARM TO HEALING: ADDRESSING THE NOCEBIC EFFECTS OF NEGATIVE LANGUAGE IN EMERGENCY CARE

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ABSTRACT

This article investigates the significant role of nocebic-effect inducing language in shaping patient outcomes within paramedicine, emphasizing how negative communication can heighten anxiety and intensify pain. It explores the neurophysiological mechanisms underlying these effects, including the activation of stress pathways, disruption of pain modulation, and amplification of emotional distress. The article underscores the critical importance of positive communication strategies in mitigating these adverse effects, fostering patient trust, and enhancing recovery. By advocating for structured training in empathetic and constructive communication, it highlights the potential to transform patient experiences and sets a new standard for compassionate, effective prehospital care.

To become ever more effective, the future of paramedicine will benefit from being shaped by advancing research into the ways language influences patient mental and physical states, just as it is informed by the wider clinical evidence base. The phenomenon of nocebic-effect inducing language, which involves verbal expressions that unintentionally heighten a patient's anxiety and perception of pain, is increasingly well understood and documented in health research (Benedetti et al, 2007; Manaï et al, 2019; Nasiri-Dehsorkhi et al, 2024). It has also been recognized as both frequently present and almost always avoidable, (but in practice rarely avoided) in paramedic practice, (Newton 2024).

This area of study is important because it underscores how a healthcare professional's language, both verbal and non-verbal, can significantly affect both short and possibly longer-term patient outcomes, particularly in terms of anxiety and pain perception. For example, de Soir has suggested that thoughtfully constructed language employed during the acute phase of traumatic injury and acute illness, may reduce the incidence of PTSD (2020). For paramedics, who often operate in high-stress, acute

Author Interview:
https://youtu.be/K5aQx3-GKz8

scenarios, understanding and mitigating nocebic language is therefore relevant to all patient encounters.

Information that is communicated to patients can either reduce or worsen their anxiety levels. In emergency medical situations, paramedics frequently need to explain complex procedures quickly and clearly. Studies have demonstrated that patients who receive detailed verbal briefings about procedures often experience increased anxiety, especially if the information is presented negatively. For instance, when a paramedic explains an urgent medical intervention, using calm, positive language, this can significantly reduce patient anxiety and contribute to better outcomes (Lin et al., 2016).

A relatively new theory has emerged that pushes the limits of "nocebic communication," or nocebic-effect inducing language, also termed "nocebic terminology" (Häuser et al, 2012). This is the understanding that, while nocebic-effect inducing language can occur during any clinician-patient encounter. During the critical first hour following a medical emergency or trauma, patients enter a "modified state of awareness" (Bierman, 1989). This period involves a heightened state of vulnerability, rendering patients highly susceptible to verbal suggestions. This hyper-suggestible condition mirrors a state akin to hypnosis which, for the purpose of this paper, the authors take to mean a form of focused attention (sometimes referred to as a "trance equivalent state") where the words spoken around the patient can significantly influence cognition, thereby affecting their mental and emotional state.

During this vulnerable time, patients often experience confusion, paired with hypnotic phenomena, which heightens the likelihood that they may view statements from paramedics and other responders in a negative light (Erickson & Haley, 1967). The language used by healthcare professionals can, therefore, amplify these effects. Thus, necessitating careful and compassionate communication to prevent exacerbating anxiety and pain. This understanding emphasizes the importance of employing positive and reassuring language (Jacobs & Duffee, 2023).

Linguistic factors that include specific word choice and syntax influence cognitive processes underlying anxiety and pain perception. Anxiety can impair cognitive functions like working memory and decision-making, which are vital in processing verbal information. For example, research has shown that individuals with high anxiety exhibit impaired verbal fluency and memory performance, complicating their ability to engage with healthcare providers effectively (Vytal et al., 2013). This cognitive disruption can create a feedback loop, where increased anxiety leads to poorer communication and understanding, ultimately resulting in worse outcomes.

There is, therefore, a clear parallel between the form of perceptional changes that occur in subjects who undergo hypnosis and the "natural trance [type] state" that occurs in traumatic and medical emergencies (Hansen & Zech, 2019). Given that the "medical environment" is so replete with negative suggestions, there is a consequent opportunity for a paramedic, or other provider, to influence a patient's psycho-physiological functions, without the necessity to conduct a hypnotic induction (Hansen et al, 2010).

The interaction between communication styles in medical emergencies and patient outcomes is deeply rooted in neurophysiological and psychological mechanisms. The weight of evidence underscores that communication during the first critical hour can

either amplify or dampen stress and physiological maladaptions. These effects are mediated by neurotransmitter systems, the hypothalamic-pituitary-adrenal (HPA) axis, and limbic activation, interwoven with psychological states of fear and suggestibility.

Neurotransmitter Activity and Modulation of Pain

Neurotransmitters like dopamine, endogenous opioids, and cholecystokinin (CCK) are central to moderating pain and emotional distress during trauma. Endogenous opioids, which are integral to natural analgesia, activate μ-opioid receptors to suppress nociceptive input (Zubieta et al., 2005). However, nocebic communication has been shown to stimulate CCK release in the central nervous system, antagonizing opioid receptor activity and exacerbating pain (Arrow et al., 2022).

Conversely, dopamine, another key neurotransmitter, facilitates reward signaling and stress resilience. Studies linking dopaminergic activity to communication reveal that positive verbal reinforcement activates dopaminergic pathways, not only alleviating pain but also improving emotional states (Benedetti & Piedimonte, 2019). Furthermore, functional neuroimaging has demonstrated that regions such as the anterior cingulate cortex (ACC) and insula show increased activity during positive clinician-patient interactions, indicative of dopamine and endogenous opioid activation (Bensing & Verheul, 2010).

HPA Axis and Stress Regulation

The HPA axis orchestrates the body's response to acute stress, which is often magnified during medical emergencies. Upon encountering a perceived threat, the hypothalamus releases corticotropin-releasing hormone (CRH), triggering the pituitary gland to secrete adrenocorticotropic hormone (ACTH). This cascade culminates in adrenal cortisol release, leading to heightened glucose availability and temporary suppression of non-essential functions (Hadamitzky et al., 2018).

Nocebic interactions amplify this stress response by increasing amygdala activity, which sends excitatory signals to the hypothalamus. This hyperactivation perpetuates the HPA axis cycle, contributing to sustained cortisol elevation, impaired cognitive function, and heightened pain perception. Neuroimaging studies have identified heightened connectivity between the amygdala and HPA axis-related regions during exposure to negative language, confirming the exacerbation of stress states (Scott et al., 2007).

Limbic System Activation and Emotional Dynamics

The limbic system, particularly the amygdala and hippocampus, plays a pivotal role in processing emotional stimuli, including responses to nocebic or placebo communication. Negative verbal cues intensify amygdala activation, augmenting fear and hyperalgesia. Sajid (2018) demonstrated that nocebic terminology disrupts the neural circuitry responsible for emotional regulation, compounding both psychological and somatic symptoms.

Importantly, framing language positively has been shown to downregulate amygdala activity and promote parasympathetic response, which counteracts the sympathetic overdrive caused by stress. Neuroimaging techniques like functional MRI (fMRI) reveal that during positive clinician-patient interactions, increased activity in prefrontal areas dampens maladaptive limbic responses (Benedetti et al., 2005).

Suggestibility and Hypnosis in Prehospital Care

Trauma and acute critical illness, often induces a heightened state of suggestibility, akin to a natural trance. This state amplifies the impact of verbal suggestions, making it critical for prehospital providers to adopt constructive communication strategies. Research into hypnotic communication shows that framing painful procedures with neutral or positive language can significantly reduce pain perception and stress markers (Erickson & Rossi, 1980).

Expectancy also plays a vital role in modulating these effects. Positive verbal reinforcement has been shown to elicit placebo responses through activation of the medial prefrontal cortex and subcortical areas such as the periaqueductal gray (PAG), which are central to pain modulation networks (Zubieta & Stohler, 2009).

Placebo and Nocebo Mechanisms in Clinical Outcomes

Placebo effects demonstrate the influence verbal, and non-verbal communication has on physiological states. Neurobiological studies show that placebo responses activate endogenous opioid systems across multiple brain regions, including the ACC, orbitofrontal cortex, and hypothalamus (Scott et al., 2008). These activations correspond to reductions in pain and improvements in stress regulation.

Conversely, nocebo effects represent the negative side of this phenomenon. Negative expectations induced by nocebic language activate exaggerated pathways, impair cortisol regulation, and intensify maladaptive fear responses. Neural imaging reveals increased connectivity across the cingula-frontal pain network during nocebo-driven hyperalgesia (Wager et al., 2004).

Integration of Neurophysiology into Clinical Communication

Clinical communication that incorporates an understanding of neurophysiology can drastically improve patient outcomes. Positive communication primes neurobiological mechanisms that enhance resilience, while negative interactions exacerbate physiological stress altogether. Strategies leveraging these insights include structured training in linguistic reframing, active listening, and the use of calm, empathetic language to mitigate hyperactivation of stress and pain pathways.

Explaining Procedures:

Nocebic Communication: "This procedure is going to hurt, but we have to do it."

Positive Communication: "You might feel some altered sensation during this procedure, but we'll do everything we can to make you comfortable and it'll help you get better."

Providing Updates:

Nocebic Communication: "Things are not looking good right now, but we're trying our best."

Positive Communication: "The worst is behind you now and we are making progress step by step."

Reassuring During Transport:

Nocebic Communication: "The ride might be bumpy, but we have your seatbelts on."

Positive Communication: "We'll make the ride as smooth as possible and this safety harness will help us keep you safe. Let us know if you need anything to feel more comfortable."

Addressing Patient Concerns:

Nocebic Communication: "There's a lot that can go wrong, but we'll see what happens."

Positive Communication: "Your body is naturally working in the background even when you are not fully aware of it. We're working with those processes doing everything that is necessary to ensure the best outcome for you. Feel free to share any concerns you have."

Effective communication is not merely about conveying information; it is a multidimensional process that encompasses active listening and empathetic engagement, both of which are pivotal in fostering positive patient outcomes (Moeini et al, 2019). For paramedics, who often operate in high-pressure environments, these skills can significantly influence recovery trajectories. Active listening involves attentively understanding patient concerns, which not only alleviates anxiety but also empowers patients by validating their feelings and experiences. "Learnable language Structures" (Cyna, 2020) which involve consciously applied formats of communication are, therefore, key.

In acute medical situations, communication nuances, including non-verbal cues, are also essential for building trust and rapport between patients and paramedics. Non-verbal communication constitutes a substantial part of interpersonal interactions, with studies indicating that effective non-verbal communication correlates with higher patient satisfaction and compliance (Kelly et al, 2018; Liu et al, 2016). This is particularly relevant in emergency settings, where patients may experience high stress and anxiety, making them more sensitive to the emotional tone and body language of caregivers (Hall et al, 2021).

By prioritizing empathetic communication and trust-building, paramedics can forge therapeutic relationships that promote recovery and elevate their effectiveness (Duffee, 2023). This rapport facilitates a connection that extends beyond immediate medical needs, laying the groundwork for a supportive environment where patients feel understood and cared for. For instance, when explaining a procedure, a paramedic who takes the time to listen to a patient's fears and responds with empathy can demystify the process thereby reducing apprehension. Similarly, when providing updates using a calm, reassuring tone, while actively engaging with the patient's questions, can reinforce trust and confidence in the care being provided.

Reassurance during transport, or addressing patient concerns with empathy, further solidifies this trust. When paramedics express genuine concern for patient comfort and well-being, it not only enhances the immediate care experience but also contributes to better psychological and emotional outcomes for patients. Evaluating these skills involves observing how paramedics interact with patients, noting their ability to listen, respond empathetically and adapt their communication style to meet the needs of the individual. Such practices underscore the importance of interpersonal skills in medical

emergencies, where the positive, human touch can profoundly impact healing and recovery.

Effective communication is at the heart of paramedicine, underscoring the profound influence language has on patient care and outcomes. Understanding the impact of nocebic-effect inducing language reveals the crucial need for paramedics to adopt strategies that foster reassurance and trust. Positive, empathetic communication not only mitigates anxiety and pain but also builds the therapeutic relationships essential for healing and recovery. By refining their verbal and non-verbal interactions, paramedics can greatly enhance patient experiences, offering support during moments of vulnerability. As ongoing research continues to uncover the complexities of language and its neurobiological effects, the future of paramedicine lies in integrating these insights into practice, paving the way for compassionate and effective care that benefits both patients and practitioners alike.

It is important to acknowledge the profound harm that negative language can inflict on patients, it is essential for healthcare providers to implement proactive communication strategies that alleviate stress, cultivate positive expectations, and harness the therapeutic potential of placebo effects (Wiech, 2016; Peerdeman et al., 2016). A new look at ethical practice in healthcare demands an intentional effort to avoid language that may cause harm and replace it with empathetic and supportive communication styles that promote both emotional and physical health. Integrating training programs focused on positive communication skills could serve as a critical step toward minimizing nocebic effects and ensuring ethical compliance in patient care (Ellis et al., 2017; Légaré et al., 2018).

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LITERATURE SURVEILLANCE

PARAMEDICINE CONTENTS: JUNE-AUGUST 2025

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To help paramedicine professionals keep current with the literature in our discipline, the 'Paramedicine Contents' section shares recent tables of contents of scholarly journals that are primarily focused on the paramedicine discipline.

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Volume 22 Issue 4, July 2025

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LITERATURE SURVEILLANCE

PARAMEDICINE LITERATURE SEARCH: JUNE-AUGUST 2025

SECTION EDITORS: Shaughn Maxwell, PsyM, EMT-P[1]; Brenda M. Morrissey, DPA, FP-C, FACPE*[2,3]

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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. This 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 July 4, 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 "pre-hospital"[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 June 1, 2025 to August 31, 2025.

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International Journal of Paramedicine

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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.

SUBMISSION CHECKLIST

Authors need to register with the journal prior to submitting or, if already registered, can simply log in and begin the submission process.

Download the following worksheets to assist with the submission process. Complete the forms, use them to assist with the submission process, then upload with the submission.

- Complete one of these forms per submission: IJOP Submission Info Form
- Complete one of these forms per author: IJOP Author Info Form

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:

Documents

- 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.

Manuscript

- 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.
- Authors are strongly encouraged to follow any EQUATOR (Enhancing the QUAlity and Transparency Of health Research) Guidelines that apply to their type of submission. These include, but are not limited to:
  - Randomized trials
    - CONSORT and its extensions
  - Observational studies
    - STROBE and its extensions
  - Systematic reviews
    - PRISMA and its extensions
  - Study protocols
    - SPIRIT and the PRISMA-P extension
  - Diagnostic/prognostic studies
    - STARD and the TRIPOD extension
  - Case reports
    - CARE and its extensions
  - Clinical practice guidelines
    - AGREE and the RIGHT extension

- Qualitative research
  - SRQR and the COREQ extension
- Animal pre-clinical studies
  - ARRIVE
- Quality improvement studies
  - SQUIRE and its extensions
- Economic evaluations
  - CHEERS

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 numbers for each author.
- You also include social media handles (e.g., Facebook, Twitter, LinkedIn) for each author.
- Please ensure that everyone who meets the International Committee of Medical Journal Editors (ICMJE) requirements for authorship is included as an author (http://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html).
- If an author changes their affiliation during the peer-review process, the new affiliation information can be given to the Editorial Team and will be handled as any other manuscript revision. Please note that no changes to affiliation can be made after the pre-publication galleys of the manuscript have been accepted for final publication.
- 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].
  - For multiple agency grants: This work was supported by the [Funding Agency #1] under Grant [number xxxx]; [Funding Agency #2] under Grant [number xxxx]; and [Funding Agency #3] under Grant [number xxxx].

- 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.
- The manuscript should use a minimum of formatting. If there are multiple levels of heading and sub-headings, please indicate the heading level by placing (H1) directly after the heading text for the top level heading, H2 for sub-headings, H3 for sub-sub headings, etc.
- 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.

References

- 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.
- In each endnote reference, include hyperlink whenever possible to the referenced document. A DOI hyperlink is preferred, which will have a format of https://doi.org/XXXXX. If a DOI is not available, provide a link to the source journal, publisher website or similar source.
- Authors are responsible for the accuracy of all references, links and in text citations.

Appendices

- Where applicable, any appendices to the manuscript are inserted next.

ICMJE Forms for Disclosure of Potential Conflicts of Interest

- One form per author should be submitted.
- The form is available at: https://icmje.org/disclosure-of-interest/

Supplemental Media Files

- If the submission includes any supplemental tables or figures, they would be each be uploaded individually for inclusion at the end of the article.
- For spreadsheets used to generate tables, upload them as individual files and clearly indicate which table they are associated with.
- If there are any supplemental media files (e.g., spreadsheets, slide decks, audio or video files), provide links to where readers can access them. They must be readily accessible without passwords or other restrictions.

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.
- Concept Description – Provide a description of the concept 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 concept 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.

Dialogues (≤1,000 words)

- 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.
  - The narrative of the correspondence.

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.

Educational Methods and Processes (≤3,000 words)

- 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:
  - Introduction - The introduction should describe the problem, issue, or circumstance that the educational process, approach, or method is intended to address. Where applicable, address the current literature that demonstrates a gap and any pertinent background information.
  - 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.

Empirical Investigations / Original Research (≤4,500 words)

- 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.

Methodology (≤2,000 words)

- 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.
- Along with other standard submission file elements, the primary manuscript body pages file for Methodology papers should contain appropriate elements from the EQUATOR guidelines, as described for empirical investigations.

Quality Improvement Project Reports (≤3,000 words)

- *IJOP* acknowledges the importance of quality improvement activities to optimize EMS system performance and patient outcomes and welcomes manuscripts describing quality improvement projects.
- United States regulations do not require quality improvement activities to have Institutional Review Board (IRB) or Research Ethics Board (REB) approval. The distinction between manuscripts requiring or not requiring IRB/REB approval may be subtle. Manuscripts not requiring approval will generally be those which do not apply clinical treatments or diagnostic methods that have not been previsouly established in the literature. A manuscript that explores different ways to implement a clinical treatment or diagnostic method may not require approval.
- The *IJOP* shall reject manuscripts that appear to have framed an activity as quality improvement to circumvent research compliance, conduct, or reporting standards.
- Authors may contact the editorial office if they are uncertain whether their work should be submitted as a quality improvement or a research manuscript. If there any dounbdt, authors are encouraged to submit QI projects to an IRB is to obtain their independent judgement of the need for IRB oversight.
- Quality improvement project reports should adhere to the Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines (http://www.squire-statement.org). With permission of the Editorial Team, authors may submit manuscripts that use other generally accepted improvement project frameworks (e.g., IHI Model for Improvement; DMAIC).
- 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.