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RESEARCH REPORT

COMPARISON OF OUT OF HOSPITAL FINGER AND NEEDLE THORACOSTOMY PERFORMED BY GROUND EMERGENCY MEDICAL SERVICES

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ABSTRACT

Introduction: Tension pneumothorax related to chest trauma is a rapidly lethal condition that requires immediate treatment, often prior to arrival at definitive care. Recent concerns regarding the safety and efficacy of needle thoracostomy (NT) have led to alternatives. Finger thoracostomy (FT) is a potential life-saving treatment performed by prehospital providers as an alternative to NT. We hypothesize that FT has improved rates of prehospital thoracic decompression and is a safe alternative to NT.

Materials and Methods: Retrospective cohort study of consecutive adult trauma patients presenting to a Level 1 trauma center who sustained chest trauma. A matched cohort of patients with an initial prehospital treatment with FT was compared to patients who underwent prehospital NT for thoracic decompression. Wilcoxon Rank Sum Test and Chi-Squared Analyses were performed for comparison of prehospital and in-hospital outcome variables.

Results: 34 patients were compared, of which 15 underwent prehospital FT and 19 underwent prehospital NT. Groups were well matched in terms of demographics and injury characteristics. No difference in transport times were observed. All 15 patients in the FT group sustained cardiac arrest prior to arrival with 20% achieving return of spontaneous circulation (ROSC), while 6/19 NT patients arrived in cardiac arrest, with 66.7% achieving ROSC (p=0.04). The rate of successful intrathoracic decompression was higher in the FT group (93.3% vs 47.4%, p<0.001). The NT group had a higher rate of chest tube placement (p=0.005). In-hospital mortality was not different between the two groups (p=0.213).

Conclusions: FT is a viable alternative to NT for emergent thoracic decompression. The higher success rate of intrathoracic decompression supports the use of FT as a primary or second line treatment to NT for prehospital tension pneumothorax, although future studies are needed to establish superiority and further evaluate mortality and in-hospital outcomes.

INTRODUCTION

Tension pneumothorax (PTX) secondary to chest trauma is a potentially life-threatening injury pattern that has significant mortality rate if untreated, but also able to be intervened upon if recognized early. Intervention by out of hospital providers may be critical in reducing mortality from tension PTX prior to definitive management (e.g., tube thoracostomy). Performance of needle thoracostomy (NT) is the traditional intervention for rapid treatment of tension physiology, but recent literature has called into question both the efficacy of thoracic decompression (Robitaille-Fortin, 2021; Axtman, 2019; Martin, 2012; Kaserer, 2017) and safety due to iatrogenic injuries sustained from placement of needle thoracostomy (e.g., cardiac, great vessel, lung).

The most recent Tactical Combat Casualty Care guidelines recommend early treatment of suspected tension PTX based on congruent mechanism of injury (e.g., chest trauma) and respiratory compromise (Butler, 2018). Finger Thoracostomy (FT) has been proposed after two unsuccessful attempts with NT. Several studies have raised concerns of adequate intrathoracic placement of needle decompression devices due to variations in technique, anatomical location of needle placement, and relative variability in chest wall thickness at different anatomical locations (Martin, 2012; Kaserer, 2017; Laan, 2016). Although FT (also referred to as open thoracostomy) has emerged as an alternative to needle thoracostomy, there is relatively little literature comparing finger and needle thoracostomy directly (Chesters,2016; Dickson, 2018; Massarutti, 2006; Hannon, 2020). Concerns regarding the safety of NT in the emergent settings have called it into question due to the risk of significant intrathoracic injury (Wernick, 2015), as well as finding an appropriate size device for adequate chest wall penetration that is capable of decompressing the thoracic cavity (Zengerink, 2008).

We hypothesize that out of hospital FT will be associated with increased rates of successful intrathoracic decompression, when performed by appropriately trained out of hospital emergency providers (defined as paramedics and emergency medical technicians who have had prior training by supervisor of physician in proper technique), without a delay in transport to definitive care.

MATERIALS AND METHODS

After approval by the Institutional Review Board for the University of Texas Health Science Center at San Antonio, data were queried from an institutional trauma registry of all patients who sustained chest trauma treated with prehospital thoracic decompression. The manuscript has been prepared in accordance with the Equator Network STROBE guidelines (www.equator-network.org). Subjects reviewed consisted of consecutive adult trauma patients presenting to a Level 1 trauma center who sustained chest trauma between January 1, 2017 and December 31, 2020. Patients were eliminated from consideration if it was deemed that they did not sustain chest trauma or did not have prehospital performance of thoracic decompression. Patients were also eliminated from consideration if they were transferred from another facility and/or had definitive thoracic decompression prior to arrival (e.g., tube thoracostomy). Training for the performance of NT were in accordance with national guidelines and the certification through the Advanced Trauma Life Support course. Training in the performance of FT was carried out by individual emergency transport companies for their providers. Protocols for performance of

NT and FT are based on recommendations from the regional emergency response agency, South Texas Regional Advisory Council (STRAC). Out of hospital providers who were compared in this study were all capable of performing FT and NT and were previously trained. EMS agencies that were not trained in either procedure or both were not included in the analysis.

Records regarding performance of NT or FT were obtained from emergency medical service agencies who report all out of hospital data to a prospectively collected trauma registry. Anatomical location of where NT was performed was at the discretion of out of hospital provider (4th/5th intercostal space at the anterior axillary line or 2nd intercostal space at midaxillary line). In-hospital data were collected from the institutional trauma registry and chart review process. Inclusion criteria for this study required subject to be over the age of 18, who sustained chest trauma and were transported directly to the Level I trauma center who had out of hospital concern for tension PTX and required NT and/or FT. Regional EMS providers serviced a large urban city as well as an catchment radius that included several rural counties, but all overseen by STRAC which provided standardized guidelines for performance of NT and FT which were in place and not modified over the duration of this study.

Rates of out of hospital NT and out of hospital FT were compared as well as in-hospital outcomes. Thoracic decompression was defined as clinical documentation by EMS providers of a rush of air or fluid upon placement of a needle decompression catheter. Similarly, successful determination of thoracic decompression by FT was based on out of hospital provider documentation of a rush of air or blood upon insertion of gloved finger after FT. Subgroup comparison of the crossover group (i.e., those that received NT and subsequent FT) were compared to those that received NT alone. Data collected regarding rates of thoracic decompression were obtained review of out of hospital records and clinical exam by out of hospital or trauma surgery providers.

Wilcoxon Rank Sum Test and Chi-Squared Analyses were performed for comparison of out of hospital and in-hospital outcome variables. Groups were matched based on demographic and injury characteristics to control for differences in sex, age, BMI, and injury severity. Case-control matching was performed in SPSS (IBM Corp. Released 2021. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp) with appropriate match tolerance for each included variable to create a matched cohort. Of subjects that met inclusion, 58 NT subjects were initially analyzed for matching. After matching 19 subjects from each cohort, four subjects were removed from the FT group due to chart review revealing inaccurate documentation of the performance of FT. All comparative statistical analyses were performed using SPSS.

RESULTS

Retrospective analysis was performed on a total of 34 patients, of which 15 (44.1%) underwent FT and 19 (55.9%) underwent NT without subsequent FT. Of the 15 FT subjects, six underwent attempt of NT prior to FT. Groups were well matched in terms of demographic factors and injury characteristics. There were no statistical differences in terms of age ($p=0.30$), sex ($p=0.70$), BMI ($p=0.54$), blunt mechanism rate ($p=0.151$), ISS ($p=0.76$), and chest AIS ($p=0.29$). See Table 1 for full tabulation of demographics and injury characteristics.

There was a significantly higher number of patients in the FT group that sustained out of hospital cardiac arrest (15 vs 6, p=0.001). Of those patients there was a higher percentage of patient in the NT group that achieved ROSC (66.7% vs 20.0%, p=0.040). See Table 2 for full results tabulation of out of hospital hemodynamic parameters.

	All (n=34)[1]	FT (n=15)[1]	NT (n=19)[1]	p-value[2]
Age	41.6 (18.2)	39.1 (20.7)	43.5 (16.4)	0.494
Male Sex	26 (76.5)	11 (73.3)	15 (78.9)	0.702
BMI[3]	28.1 (7.1)	30.1 (9.4)	26.6 (4.0)	0.153
Blunt Mechanism	23 (67.6)	8 (53.3)	15 (78.9)	0.151
ISS[3]	35.6 (18.2)	36.3 (23.2)	35.0 (13.6)	0.843
Chest AIS[3]	3.56 (1.28)	3.87 (1.60)	3.32 (0.95)	0.219
On Scene Time[4]	14.6 (9.2)	12.4 (4.3)	16.4 (11.5)	0.209
Total Transport Time[4]	40.3 (17.5)	36.8 (18.0)	43.0 (17.1)	0.317

[1]Variables represented as n (%) or mean (SD).
[2]Variables compared using Chi-squared analysis (categorical) or Mann U Whitney Test (continuous).
[3]BMI: body mass index, ISS: injury severity score, AIS: abbreviated injury scale
[4]Transport times expressed in minutes

Table 1. Comparison of demographics and injury characteristics of matched cohort.

The two groups were also compared for in-hospital outcomes and further thoracic interventions. The FT group had a significantly higher rate of successful thoracic decompression compared to the NT group (93.3% vs 47.4%, p=0.004). Of the subjects that obtained cross sectional imaging after arrival, it was noted that one subject in the NT group sustained a subclavian artery injury after placement of NT. Although this was originally documented as a rush of fluid, this was later deemed to be unsuccessful intrathoracic decompression therefore was not included in the 9 subjects in the NT group with successful intrathoracic decompression. There was a significantly higher percentage of patients in the NT group (p=0.005) requiring subsequent tube thoracostomy placement after initial intervention, although this is not unexpected as NT is not a definitive treatment and it is expected that these patients undergo definitive thoracic decompression or operative intervention if indicated after arrival to the hospital.

	All (n=34)[1]	FT (n=15)[1]	NT (n=19)[1]	p-value[2]
HR[3]	88 (0, 123)	0 (0, 133)	108 (92, 132)	0.001
SBP[3]	73 (0, 108)	0 (0, 60)	98 (88, 116)	0.009
Shock Index	1.14 (0.89, 1.43)	1.59 (0, 1.71)	1.14 (0.89, 1.34)	0.487
PH[3] Cardiac Arrest	21 (61.8)	15(100.0)	6 (31.6)	0.001
ROSC[3]	7 (33.3)	3 (20.0)	4 (66.7)	0.040

[1]Variables represented as n (%) or median (IQR).
[2]Variables compared using Chi-squared analysis (categorical) or Mann U Whitney Test (continuous).
[3]ROSC: return of spontaneous circulation; PH: prehospital; HR: heart rate; SBP: systolic blood pressure

Table 2. Comparison of out of hospital hemodynamics.

Overall, 66.7% (n=10) of FT subjects and 94.7% of NT subjects required further thoracic interventions after the initial intervention. In the FT group, 8 subjects (53.3%) went on to receive chest tube and/or resuscitative thoracotomy. Only 1 subject in the FT underwent thoracotomy in the OR, but this is likely attributable to the high mortality rate in this group. Of the 18 subjects that required further thoracic intervention in the NT group, 18 required chest tube placement and 9 (47.4%) required resuscitative thoracotomy. There was no difference in the rate of resuscitative thoracotomy performed between the groups (p=0.730). There was a higher percentage of patients in the NT group that required thoracotomy in the operating room (p=0.001), although this may be affected by a higher

rate of FT patients that expired prior to being transported to the operating room. There was no difference in mortality between the groups (86.7% vs 68.4%, p=0.213). See Table 3 for full tabulation of results.

	FT (n=15)[1]	NT (n=19)[1]	p-value[2]
Thoracic Decompression	14 (93.3)	9 (47.4)	0.004
Chest Tube Placement	8 (53.0)	18 (94.7)	0.005
Resuscitative Thoracotomy	8 (53.0)	9 (47.4)	0.730
Thoracotomy in OR	1 (6.7)	12 (63.2)	0.001
Mortality[3]	13 (86.7)	13 (68.4)	0.213

[1]Variables represented as n (%) or median (IQR).
[2]Variables compared using Chi-squared analysis (categorical) or Mann U Whitney Test (continuous). 3Representative of in-hospital mortality, all of which occurred within 48 hours of presentation.

Table 3. Comparison of thoracic decompression and in-hospital outcomes.

Subgroup analysis was performed for the crossover group (i.e., subjects that received NT and then subsequent FT) and compared to patients who received NT alone. Of the 15 out of hospital FT patients, 6 (40%) also underwent NT. There was no significant difference (all p>0.05) in terms of age, sex distribution, EMS on-scene time, EMS total transport time, ISS, or AIS Chest. Additionally, there were no observed differences between the crossover group and the FT only group in terms of arrival SBP, HR, or shock index. There was no significant difference between the groups in terms of in hospital outcomes (vent days, ICU days, hospital LOS, all p>0.05). There was also no significant difference between the groups in terms of requirements for chest tube placement (p=0.833), resuscitative thoracotomy (p=0.833), OR thoracotomy (p=0.205), or mortality (24-hour and 30-day; p=0.525 and 0.143, respectively).

DISCUSSION

This study supports the growing body of literature in support of FT as a viable alternative for out of hospital thoracic decompression due to its relative reliability for thoracic decompression (Wernick, 2015). No techniques are used in isolation, as there may be some advantages to utilization of NT, such as in those patients with large body habitus where a gloved finger may not be able to reach into the thoracic cavity. Neither of these techniques are definitive management for pneumothorax, but this study shows that not only was FT more successful in thoracic decompression, but also there were no differences in transport time, thus this technique does not contribute to any delays in definitive management. It was noted that based on provider discretion there were subjects that originally received NT, but subsequently required FT. When looking at the group that crossed over to the FT group (originally treated with needle decompression), there were no significant differences between the groups in terms of arrival characteristics, in hospital procedures, outcomes, or mortality. Overall, this comparison further supports the use of FT as a first line or second line alternative, but this study was not specifically intended to detect differences between these groups. Further analysis with a larger cohort is needed to make a definitive determination.

Although not statistically different, there was a trend towards short on-scene and total transport times in favor of FT suggest a possible area of further investigation. In future studies, this should be specifically analyzed to determine if transport times are different between these two procedures may impact outcomes as they are allowing for more rapid presentation to definitive trauma care.

There is a widespread range of success of NT in the out of hospital setting. Lesperance and colleagues (Lesperance, 2018) showed a range of successful needle decompression of 24% to 61%. This study showed a rate similar to this and other studies and is consistent with the current literature. This relatively low success rate is postulated to be secondary to a variety of factors including challenging conditions in out of hospital transport, chests wall anatomy (Martin, 2012; Laan, 2016), and concomitant traumatic injuries. Each method of thoracic decompression has its benefits and pitfalls, therefore clinical judgement centered on a patient-specific approach is warranted as this study cannot make a definitive statement to the best method for all patients.

LIMITATIONS

This cohort is small and severely injured in terms of chest trauma with a high mortality rate. Future prospective multicenter trials are necessary to further evaluate mortality and outcomes to make any definitive conclusions regarding the preferred technique. Another limitation to this study was the fact that all the FT group subjects sustained out of hospital cardiac arrest. Although in the matched groups, there was no difference in ISS or chest AIS scores, the significantly higher number of subjects in PH cardiac arrest in the FT group compared to the NT group suggests these patients were more severely injured. Evans and colleagues (Evans, 2016) estimate an overall rate of survival to hospital discharge of 6.3% in those that sustained out of hospital traumatic arrest, with a higher percentage of survival in those that sustain blunt injury. In this study, all subjects of the FT group sustained cardiac arrest compared to 6 out of 19 in the NT group, thus suggesting a possible higher severity of injury. Therefore, the significantly higher percentage of patients that obtained ROSC in the NT group is not unexpected and likely due to injury severity factors as opposed to factors related to the method of thoracic decompression. Future studies are warranted comparing groups with and without out of hospital arrest to better compare these methods of thoracic decompression.

No autopsies were performed in these patients, thus potential life-threatening injuries, if present, were unable to be obtained. As noted previously, upon further review of post-arrival imaging one subject in the NT group sustained a subclavian artery injury that was mistaken for decompression of a hemothorax, while no patients in the FT group had documentation of thoracic organ or great vessel injury. Although this finding is notable, no definitive claim can be made regarding the safety profile of NT and FT as this study is underpowered to detect a difference. Future, large-scale studies focusing on complications of out of hospital thoracic decompression are warranted. In a larger cohort with additional post-mortem examination, there may be potential to identify any injuries that may have been sustained from out of hospital thoracic decompression. True incidence of tube thoracostomy or resuscitative/operative thoracotomy are unknown as some subjects were deceased or has higher level procedures performed before other procedures could be performed (i.e., resuscitative thoracotomy performed before chest tube placement). Lastly, subjective confirmation of successful placement of NT and FT were utilized, which does introduce a certain degree of bias, but this was done as the authors deemed it inappropriate to compare a radiologic confirmation of NT placement with a subjective confirmation of FT by the provider.

CONCLUSIONS

As the practice becomes more widespread, comparisons for FT and NT in patients with less significant chest trauma may yield additional results compared to this cohort, given the high severity of chest wall trauma and overall injury severity in this group. Additionally, a randomized trial in which patients are either treated with NT or FT may be beneficial to see the potential differences in efficacy of thoracic decompression. Continued education of out of hospital providers is necessary to educate them on alternatives to the current standard of care, especially if this technique is unsuccessful. There is a significant variability in the current literature regarding success of thoracic decompression by NT (Martin, 2012; Laan, 2016), therefore it is vital to re-assess our current standards for better alternatives to have improved patient outcomes. Additionally, with the increasing scope of out of hospital providers and the ability to perform additional procedures, our institution has deemed it vital that the standard techniques have mechanisms of quality control measures in place (e.g., reporting of rates of successful thoracic decompression or major injury from NT) to allow for process improvement.

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RESEARCH REPORT

THE EFFECT OF PARAMEDICS IN EMERGENCY DEPARTMENT TRIAGE ON AMBULANCE PATIENT OFFLOAD TIMES: A RETROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT:

Background: Emergency Department (ED) overcrowding limits patient care in the prehospital and hospital system. A program was implemented to decrease the time to patient handoff from EMS arrival to ED staff, also known as the delivery interval and total turnaround interval. Paramedics were added to the ED ambulance triage staff to receive verbal reports and perform certain tasks done traditionally by nurses. We hypothesized adding paramedics to the ED triage process would reduce delivery interval times and total turnaround times.

Methods: This was a retrospective observational study comparing delivery and turnaround intervals for patients brought to the ED by ambulance, before and after the addition of a paramedic in triage. The study period included all adult ED patients brought in by ambulance between 11 AM and 11 PM. Pediatric patients (<21 years old), direct-to-inpatient interfacility transfers, and critical patients requiring immediate care in the resuscitation area and thus bypassing normal triage processes were excluded. The data was analyzed with two-sample t-tests with a confidence interval of a = 0.05.

Results: Delivery interval pre-implementation of the program was 15:48 minutes (95% CI [15:28, 16:09]) compared to 14:04 minutes (95% CI [13:44, 14:25]) post-implementation. The mean turnaround interval pre-implementation was 35:21 minutes (95% CI [35:01, 35:42]) and 36:04 minutes (95% CI [35:40, 36:29]) post-implementation. The mean difference for the delivery interval was shortened by 01:44 minutes ($p<0.0001$; 95% CI [01:15, 02:13]). The mean turnaround interval increased by 00:43 seconds ($p<0.01$; 95% CI [00:11, 01:16]).

Conclusion: Staffing a paramedic in ED triage decreased delivery interval by 1:44 minutes but did not affect ambulance turnaround times. Further research is needed to determine if the decrease in delivery interval improved patient outcomes and ways to translate the time saved in the delivery interval to total turnaround times.

INTRODUCTION

Emergency department (ED) crowding is a multifactorial problem with a myriad of downstream effects, one of which results in delays in transferring patients from emergency medical services

(EMS) to hospital staff (Morley, 2018; Derlet, 2001; Hwang, 2011; Schull, 2001). Not only is care delayed, but EMS providers waiting to hand off patients are consequently unavailable to respond to calls for other subsequent patients in need (Li, 2019; Eckstein, 2004; Cone, 1998; Pham, 2006).

The problem has become serious enough that some services have considered billing hospitals for their time delays as an incentive to help tackle this problem (Wolfberg, 2021). The American Ambulance Association (AAA) provides EMS leaders with a "Wall Time Toolkit" that encourages agencies to engage with hospital staff to find creative solutions with an emphasis on EMTALA responsibilities and transportation officers that coordinate patient arrivals (AAA, 2022). The California Hospital Association (CHA) issued a similar toolkit that described effective strategies such as integrated quality improvement initiatives between hospitals and EMS departments, regular reports to ED administrators, and dedicated protocols for reducing offload time (CHA, 2014).

At Hernando County EMS and Fire Services, offload times have proved disruptive enough for commissioners to approve a fine of over $200 hourly for hospitals with offload intervals over thirty minutes in duration (Burns, 2022). Another EMS agency has successfully utilized a transportation destination officer to coordinate incoming EMS crews and reduce simultaneous arrivals (Scharf, 2022). The COVID-19 global pandemic has only worsened the problem with increased ED length of stay for admitted patients as well as nursing shortages caused by stress to front-line healthcare workers, early retirement, or more staffing moving into short-term contractual work (Baugh, 2020; Lucero, 2021; Sandhu, 2022).

A common operational intervention to tackle ED overcrowding and ambulance offload delays has traditionally been ambulance diversion. In a 2011 position statement, the National Association of EMS Physicians stated that the time it takes to transfer a patient to an ED stretcher and for the ED staff to assume the responsibility of the care of the patient may have more impact on ambulance turnaround times than diversion towards another accepting facility (Cooney, 2011). By traveling to a further facility, the time to return to service may be as long, if not longer, than going to the nearest facility facing overcrowding. One strategy to shorten delivery interval, or time from EMS arrival to patient handoff to ED staff that avoids ambulance diversion is placing a paramedic in ambulance triage. In particular, paramedics who already function under physician medical direction can easily transition to hospital-based physician extenders, providing a natural and potential solution to continued hospital staffing shortages (Oglesby, 2007). Silvestri et al. (2014) demonstrated that an ED paramedic-staffing model focused on receiving EMS-arrived patients when the ED is at full bed capacity significantly reduced the delivery interval time for EMS units.

In this New York City ED, EMS crews experienced a mean of 15:48 minutes before patient handoff and a total turnaround interval from arrival to back-in-service time of 35:21 minutes. A push was made to reduce this time to improve patient experience, patient safety, and EMS system performance. We aimed to replicate the approach described in Silvestri et al. by staffing paramedics in our ED triage from 11 a.m. to 11 p.m. to reduce delivery interval and turnaround times. The primary outcome of this study seeks to assess the impact of adding one paramedic to ED triage on these two intervals. Adding

paramedics to the ED triage process would reduce delivery interval times and total turnaround times.

MATERIALS & METHODS

Study Design

This retrospective observational pre-post-study design involved patients transported to an urban hospital ED via the 911 EMS system. The hospital supplies fourteen BLS and ALS ambulances for the 911 system, and paramedics in this study were hospital employees who staff the 911 system and interfacility transport units. The ED staffing plan included paramedics working 11 a.m. to 11 p.m. 7 days a week, which matched peak patient arrivals per hour. Outside these hours, the standard triage process using triage nurses and a physician was utilized. Analysis of our wall-time performance showed that turnaround interval times are lengthiest during these hours, and we proposed using affiliated paramedics to reduce turnaround time. Paramedics were paired with triage nurses to train them in the offload process on shift. No formal didactics were employed. The primary responsibility of ED paramedics was to receive EMS hand-offs and assume care for patients who arrived via EMS until a triage nurse was available for the patient. ED paramedics also placed intravenous peripheral catheters, obtained vital signs, performed electrocardiograms, and provided other basic life support functions.

The "turnaround interval," the total time that an ambulance spends at the hospital, is the sum between the "delivery interval" and the "recovery interval" (Carter, 2007; Cooney, 2011; Oglesby, 2007). The delivery interval began when the paramedics arrived at the hospital with the patient and ended when the EMS paramedic transferred care to the ED triage provider. This traditionally ends with a signature from the receiving clinician. The "recovery interval" began when the delivery interval was completed and terminated when the ambulance and crew were ready to return to service.

Setting

This study occurred in a tertiary-care 711-bed teaching hospital in New York City with an annual ED volume of 105,000 patients. The ED is an adult level I trauma center, a pediatric level II trauma center, and hosts an emergency medicine residency program. During the study periods, there were 68 ED beds, including a 14-bed pediatric, and 4-bed resuscitation areas. This ED does not have a waiting room. All patients, after registration and triage, are immediately assigned to an ED bed. Temporary care spaces can be created if all ED beds are full. Approximately 32% of the annual ED volume arrives via EMS. The overall admission rate for ED patients is 27%. The hospital-based EMS system has 14 ambulances that receive approximately 60,000 911 dispatches annually and transport patients to the main medical center and other unaffiliated hospitals. The hospital also receives patients who arrive via ambulance from private EMS agencies, fire-based agencies, volunteer agencies, and other hospital-based agencies. We only collected the data of patients who arrived via the hospital's own EMS system, which accounted for 43% of the patients who arrived in ambulance triage. The study authors could not obtain records of patients transported by other EMS agencies.

Selection of Participants

All patients were deemed eligible if they arrived via the hospital-based EMS service to ambulance triage during the study periods. Patients excluded include pediatric patients (<21 years old), inpatient interfacility transfers, and critically ill patients directed straight to the resuscitation bay and bypassed ambulance triage. Three cohorts were separated in our data collection:

1. a pre-paramedic implementation cohort measured from March 1st, 2021, to August 31st, 2021
2. A wash-out period cohort measured from September 1st, 2021 to October 31st, 2021 while paramedics were undergoing ED orientation and having their initial shifts
3. A post-paramedic implementation cohort measured during November 1st, 2021 to April 30th, 2022.
4. All cohorts had their data collected during the same days of the week and time of day (Figure 1).

Methods of Measurement

Data was collected from HealthEMS (Sansio Inc., Duluth, MN), an electronic patient care record system that this hospital-based EMS uses for documentation and is stored in a secure cloud. Paramedics documented the time of arrival at the ED ambulance entrance after patient care was transferred to ED triage staff and the time of ED departure. The "turnaround interval" is the total time an ambulance spends at the hospital and is comprises the delivery and recovery interval. The delivery interval begins on arrival to the ED and ends when handoff is given to ED staff. The recovery interval begins after handoff and ends when the ambulance is fully stocked and ready to return to service.

Data Analysis

Statistical differences were calculated using IBM SPSS (IBM Corp, Armonk, NY). Significance was set at an alpha of 0.05. A two-sample t-test was used to compare the means of delivery interval, recovery interval, and turnaround interval. The data was assumed to be normally distributed. The means, along with 95% confidence intervals, are reported.

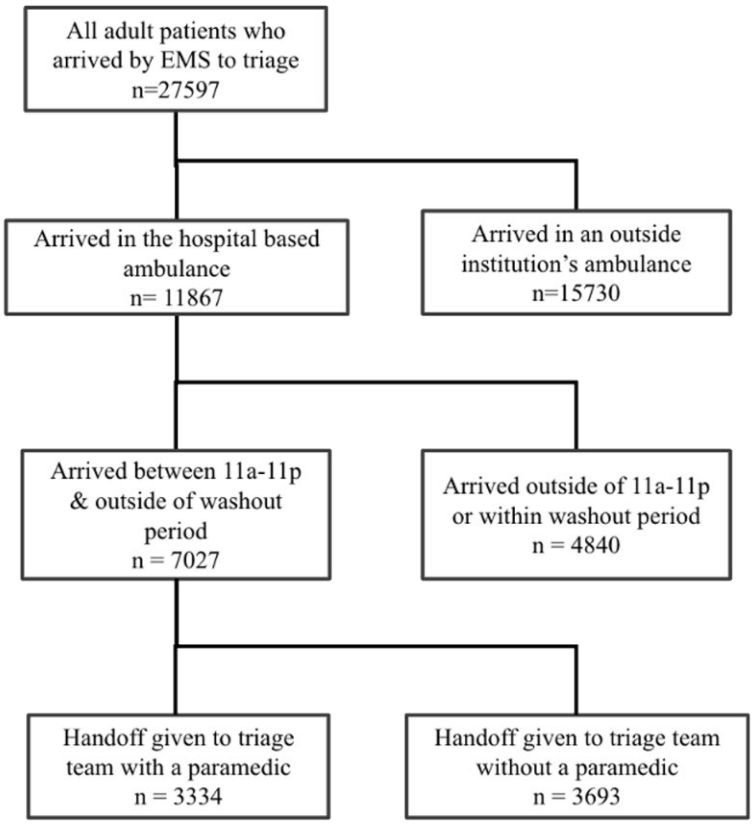

Figure 1. Flowchart of Inclusion and Exclusion of Ambulance Arrived Patient.

Ethical Considerations

This study was approved by the Institutional Review Board at Maimonides Medical Center, and all authors disclose that they are employees at Maimonides Medical Center, the institution hosting the study.

RESULTS

During the study period, 11,867 patients were transported by the hospital-based ambulance service. Patients who arrived outside of the 11a-11p time frame and in the washout period were excluded. This resulted in 3,693 patients in the pre-paramedic group and 3,334 patients in the post-paramedic group (Figure 1).

To control for changes in the hospital or EMS system that may have confounded the delivery interval, baseline characteristics before and after implementation are shown (Table 1). Hospital factors included the mean number of triage RNs, paramedic staffing, ED bed spaces, and the mean number of triage physician staff. EMS factors included the number of hospital-based 911 ambulances in service and ambulance arrivals per hour during the specified study period. Staffing numbers of outside EMS agencies that offload patients in this urban ED could not be identified. The hospital was on diversion for 0.8% of the study period, guided by the EMS system following other states in moving away from a diversion model (Burke, 2010). These characteristics, except paramedic staffing, were similar in the pre-and post-paramedic implementation phases.

There were statistically significant time differences in delivery interval, recovery interval, and turnaround interval between the two cohorts. In particular, the delivery interval was decreased in the post-paramedic cohort to 14:04 minutes (95% CI [13:44, 14:25]) when compared to the pre-paramedic group of 15:48 minutes (95% CI [15:28, 16:09]), with a mean difference of 01:44 minutes (p<0.0001; 95% CI [01:15, 02:13]). Interestingly, the recovery interval period was longer in the post-paramedic cohort at 22:00 minutes (95% CI [21:34, 22:26]) compared to the pre-paramedic group of 19:33 minutes (95% CI [19:11, 19:55]), with a mean difference of 02:27 minutes (p<0.0001; 95% CI [01:53, 03:01]). Overall, the turnaround interval was marginally longer in the post-paramedic

Characteristics	Pre-Paramedics	Post-Paramedics
ED Triage Factors		
RN staffing	2.3	2.2
Paramedic staffing 11a-11p	0	1
ED beds	68	68
Triage MD staffing	1	1
EMS Factors		
Mean # of hospital-based EMS units	14	14
Ambulance patients per hour 11a-11p	6.2	6.3

Table 1. Comparison of ED Triage Factors and EMS Factors Pre- and Post-Implementation.

Interval	Delivery		Recovery		Total Turnaround	
	Pre	Post	Pre	Post	Pre	Post
Time +/- Standard Dev	15:48 +/- 10:35	14:04 +/- 9:33	19:33 +/- 11:23	22:00 +/- 12:12	35:21 +/- 10:44	36:04 +/- 11:40
95% CI	15:28, 16:09	13:44, 14:25	19:11, 19:55	21:34, 22:26	35:01, 35:42	35:40, 36:29
Mean difference	-1:44		+2:27		+00:43	
95% CI	1:15, 2:13		1:53, 3:01		00:11, 01:16	
p-value	<0.0001		<0.0001		<0.01	

Table 2. Delivery, Recovery, and Turnaround Intervals Pre- and Post-Paramedic Intervention.

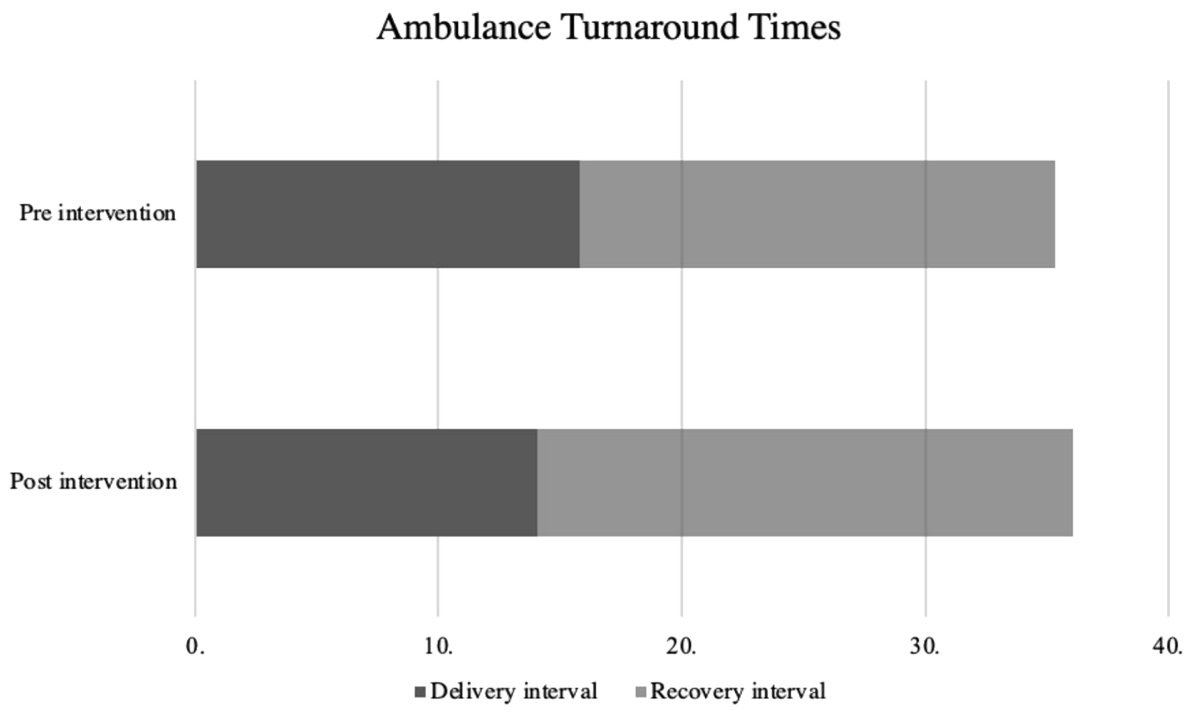

Figure 2. Delivery Interval, Recovery Interval, and Ambulance Turnaround Times Pre- and Post-Intervention.

group at 36:04 minutes (95% CI [35:40, 36:29]) compared to the pre-paramedic group at 35:21 minutes (95% CI [35:01, 35:42]) with a mean difference of 00:43 seconds ($p<0.01$; 95% CI [00:11, 01:16]) (Table 2 & Figure 2).

DISCUSSION

Few studies examine the effects of employing paramedics in the hospital (Li, 2019). To date, even fewer studies assess the role of paramedics in the ED triage setting. This study differs from Silvestri et al. (2014), in which paramedics received EMS hand-offs and also staffed hallway care spaces. This study demonstrates that having one additional paramedic staffing the triage area reduced delivery intervals by 1 minute and 44 seconds. Although it did not decrease overall turnaround times, the delivery interval is still an important metric to track as patients can receive a higher level of care earlier in the healthcare process (Crilly, 2015). This model has also been found outside the United States in Britain and Canada. In Britain, paramedics were successfully used in ED triage staffing, and many participants felt that their prehospital training transitioned well to the diagnostic reasoning skills needed for triage. In Nova Scotia, Canada, paramedics incorporated into the ED improved the quality of handoff and the collaborative interprofessional dynamic between EMS and in-hospital staff (Whalen 2018).

Though not objectively captured in the results, this paramedic intervention had positive feedback from our ED and EMS staff. ED personnel reported being "thankful for the extra set of hands" to offload certain patient care duties, especially during the peak patient arrival hours that this study captured. This allowed ED patients to initiate their evaluation and management sooner, which may have changed patient outcomes (Dawson,

2022). While we did not find a clear benefit in ambulance turnaround times, the paramedics did appear to improve patient care in the ED by offloading tasks from nursing and other ancillary medical staff (Greaves, 2017). Furthermore, 911 EMS personnel commented how the patient handoff process was "streamlined thanks to having a familiar colleague." Additionally, having a paramedic in triage may have prevented the need to up-staff nursing personnel to maintain ambulance turnaround times, who were already short-staffed and continuing to face hiring shortages (Pourmand, 2023).

The recovery and turnaround intervals were longer in the post-paramedic intervention with a mean difference of 2 minutes 27 seconds, and 43 seconds, respectively. This finding contrasted with Silvestri et al. (2014), which found an overall reduction in turnaround intervals after three paramedics were introduced to help with patient care after EMS hand-off. This could be explained by the number of paramedics employed in that study and the further responsibilities given to them. Our study employed one paramedic explicitly staffed in the ED triage area and showed how modifying this single variable decreased delivery interval times. Other factors involved in the turnaround interval are different from those in the delivery interval. This program did not modify the recovery interval, which makes up half of the turnaround interval and involves a progression of steps to prepare the ambulance for the next assignment. Improving training for EMS personnel before involvement in triage targeting delays in the recovery interval could have successfully translated to decreased total turnaround times.

We noticed that limited available hospital stretchers prevented EMS paramedics from transitioning into the recovery interval. Even though patient care was transferred over, paramedics could not bring the EMS stretcher back to the ambulance for their next assignment as it remained occupied. This period was also negatively impacted by supply shortages in the ED, which prevented restocking and further increased the recovery interval. If the decrease in delivery interval had been translated into the total turnaround interval for every ambulance arrival, it would be roughly 800 ambulance hours saved. However, maintaining turnaround intervals steady during this period of high staff turnover and logistical shortages is still an operationally important outcome. This initiative could also lead to cost-saving benefits without compromising patient care. For example, in this system, the cost of adding a paramedic to triage is 30% lower than adding a nursing staff to ED triage.

LIMITATIONS

We attempted to consider some baseline factors that could have confounded this intervention, including ED staffing, ED bed space, ED triage physician staffing, and ED triage nurse staffing. Even though the means of ED ambulance arrivals were unchanged, this likely disguised a certain amount of variability in the peaks and troughs of patient arrivals during the COVID-19 pandemic (Baugh, 2020). ED staffing, although unchanged numerically, was constantly reshuffled intra-shift. Many nurses and ancillary staff also left during this period and were replaced with new staff who may have been inexperienced with the hospital system and ambulance triage workflow. There could have been an even more dramatic effect in the decrease in delivery interval if staff turnover and patient presentation rates were in line with a pre-pandemic period.

One outcome we were interested in but did not examine was if earlier patient handoff affected ED patient length of stay. Additional research can also look into this intervention's effect on time to be seen by a physician or time to treatment initiation for ambulance-arrived patients. We also did not subdivide delivery interval and turnaround time based on patient characteristics, such as specific chief complaints or comorbidities. For example, one could imagine chest pain patients who arrived by BLS ambulance may be through triage more quickly because the triage paramedic could obtain an EKG more rapidly.

This study took place at a single, urban hospital with its own hospital-based EMS service. It may not be generalizable to other centers where EMS providers may not also be hospital employees. Diverting paramedics from the 911 system when there is a nationwide staffing shortage may not be an option for many systems (Quaile, 2015; Cash, 2022). We did not find as significant of a reduction in delivery interval times as in Silvestri et al. (2014). However, in their study, EMS routinely had turnaround times close to an hour that fell to 38 minutes. The mean turnaround time in our study pre-implementation was only 35 minutes, which was shorter than the post-implementation times in Silvestri et al. (2014). This intervention may be more effective in areas with longer offload delays. Another limitation of this study was that we only captured data from the hospital-affiliated EMS agencies transporting to the receiving ED. We are curious to know if these conclusions would still hold if all external EMS agency data had been captured.

Traditionally, interventions to improve ED flow often involve multiple measures at once to move the needle of one outcome in one direction (Bodnar, 2022). One of our outcomes was achieved with the single intervention of adding a paramedic to triage. A more effective strategy to decrease total turnaround times likely involves intervening in the recovery and delivery interval. Besides the positive operational impact, the financial impact in this system of adding a paramedic to ED triage is 30% lower than adding a nursing staff to ED triage. This also frees finite nursing staff resources to be placed in other roles.

CONCLUSION & FUTURE DIRECTION

This study showed that paramedics working in ED triage decreases the delivery interval, which allows the patient to begin their hospital-based care earlier. While there was a reduction in delivery time, we do not know if this difference impacted patient outcomes. Further research is needed to determine if the decrease in delivery interval improved patient outcomes and ways to translate the time saved in the delivery interval to total turnaround times. Potential solutions to decreasing the recovery interval include removing ambulance restocking bottlenecks, increasing stretcher availability, easier access to ambulance cleaning supplies, and staff incentives.

The program could also be expanded to include more roles for the ED paramedic. Burns et al. (2022) showed that a transportation destination officer who works to reduce simultaneous arrivals could reduce offload time, so expanding the role of a paramedic in triage to organize inbound ambulance arrivals deserves further study. This strategy, along with process improvement monitoring and fines for increased wall time, may yield better results. Lastly, the quality of ED handoffs between EMS and ED paramedics and finally to the triage nurse must also be investigated to ensure the decrease in delivery interval did not result in loss of important patient care information.

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RESEARCH REPORT

ASSESSING THE ACCURACY OF ECG CHEST ELECTRODE PLACEMENT BY EMS AND CLINICAL PERSONNEL USING TWO EVALUATION METHODS

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ABSTRACT

Background and purpose: A valid 12-lead electrocardiogram (ECG) depends on correct acquisition technique, particularly on the accurate location of precordial (chest) electrodes. The emergency medical services (EMS) segment of the care continuum is under-represented in previous clinically oriented studies of electrode placement. This study sought to assess the accuracy of chest electrode placement by EMS and clinical personnel in one geographic area, to identify patterns of misplacement to inform future training and continuing education, and to compare two methods of assessing electrode placement.

Methods: This prospective observational study recruited a convenience sample of EMS and clinical personnel. Participants placed simulated electrodes on a CPR-style manikin and completed a questionnaire about their training and experience. A subset also marked electrode locations on a printed diagram of the ribcage. Digitized placement data and questionnaire responses were analysed statistically.

Results: Findings from 149 participants showed misplacement patterns consistent with prior studies, with 41.6% rated as "acceptable" and 34.2% placing ≤ 3 electrodes acceptably. Correctness of electrode placement was comparable between EMS and clinical participants. More correct electrode placement correlated with classroom vs. on-the-job training, frequent vs. infrequent practice, and greater self-confidence. The diagram data collection method proved not equivalent to, and probably less reliable than, the hands-on manikin method for assessing placement skills.

Conclusions: Significant variation in ECG chest electrode placement by EMS personnel was comparable to that previously reported for clinical personnel, suggesting that existing concerns about placement errors by clinical personnel may apply equally to EMS personnel. More frequent practice and classroom-based initial ECG training were associated with significantly greater placement accuracy. Participants used diverse strategies to identify electrode locations. Further research is warranted to clarify optimal strategies for placing chest electrodes, especially on diverse body types. Sound initial ECG training and continuing education are necessary to reinforce high-quality ECG skills.

INTRODUCTION

The 12-lead electrocardiogram (ECG) is firmly established as a valuable and widely used diagnostic test (Bickerton & Pooler, 2019; Kligfield et al., 2007). National (U.S.) surveys estimate that nearly 27 million ECGs were acquired in ambulatory care visits to physicians' offices in 2018 and nearly 34 million ECGs in emergency departments (ED) in 2019 (Cairns & Kang, 2019; Santo & Okeyode, 2018). Corresponding inpatient hospital estimates are not available, but it is possible to assume that the annual volume of inpatient ECGs is comparable to either of the outpatient estimates or to both combined. In 2022, emergency medical service (EMS) personnel in the U.S. acquired more than 6.5 million ECGs (12-, 15-, and 18-lead) outside of healthcare facilities (National Emergency Medical Services Information System, n.d.). Thus, approximately 95-129 million ECGs are acquired in the U.S. each year, more or less one for every three inhabitants (U.S. Census Bureau, n.d.).

Potentially life-changing treatment decisions may be made on the basis of an ECG tracing. Thus, every ECG must reflect the patient's condition as accurately as possible. Validity of the 12-lead ECG depends on the correct acquisition technique and particularly on the accurate placement of precordial (chest) electrodes. Small deviations in electrode placement can significantly alter the waveforms recorded, potentially impacting the provider's interpretation of the ECG (Bond et al., 2012; Harrigan et al., 2012; Kania et al., 2014; Rosen et al., 2014; Rudiger et al., 2006). Misplaced electrodes can lead to false-positive interpretations that can generate needless anxiety, inconvenience, exposure to procedural risk, and expense (Abobaker & Rana, 2021; Drew, 2008; Ilg & Lehman, 2012; Rehman & Rehman, 2020; Toosi & Sochanski, 2008; Walsh, 2018). Less commonly, but more concerning, they also can mask pathological signals, potentially allowing serious conditions to go undetected and untreated (Derkenne et al., 2017). Conflicting results due to inconsistent ECG acquisition technique can create confusion and increase the risk of error when a patient moves between or within care settings (Drew, 2007). Acquiring 12-lead ECGs with precision across the continuum of care, supported by sound initial training and continuing education, is essential to safe and effective patient care (Hoffman, 2008).

Several studies have assessed 12-lead ECG chest electrode placement among physicians, registered nurses (RNs), and technicians in clinical settings (Aydemir, 2021; Medani et al., 2018; Rajaganeshan et al., 2008), and one recent study has focused on EMS personnel (Gregory et al., 2021). Results are concerning, suggesting that a large share of 12-lead ECGs are acquired incorrectly and thus are potentially misleading. The present study sought to assess the accuracy of chest electrode placement among EMS and clinical practitioners in the authors' geographic area; to inform future training and continuing education by identifying patterns of misplacement; and to compare two methods of assessing electrode placement.

MATERIALS AND METHODS

A convenience sample was recruited from EMS services after obtaining ethical approval for this prospective observational study from the Institutional Review Board (IRB #1471953-1). A cohort of clinical personnel was also enrolled for comparison. EMS personnel were paramedics and advanced emergency medical technicians (EMT-A). Clinical personnel were RNs and patient care technicians whose duties included the acquisition

of 12-lead ECGs. Physicians were not included in this study because they rarely are personally involved in acquiring 12-lead ECGs in the United States. We focused on the standard 12-lead ECG using chest leads V_1-V_6. Extended-lead ECGs were beyond the scope of this study.

Data collection was conducted privately for each participant. After obtaining informed consent, the researcher (ELC) asked every second participant to mark electrode locations on a printed diagram of the ribcage (Figure 1). This method was included to compare results with prior studies using that methodology. Then, each participant was asked to place six simulated electrodes on a plastic transparency taped to the chest of a CPR-style manikin (Figure 2). This method is substantially similar to the method validated by Medani et al. (2018), modified to facilitate quick data collection and to preserve original data for further analysis. Two conditions precluded employing a live human model, extended data collection over many months and data collection at numerous sites.

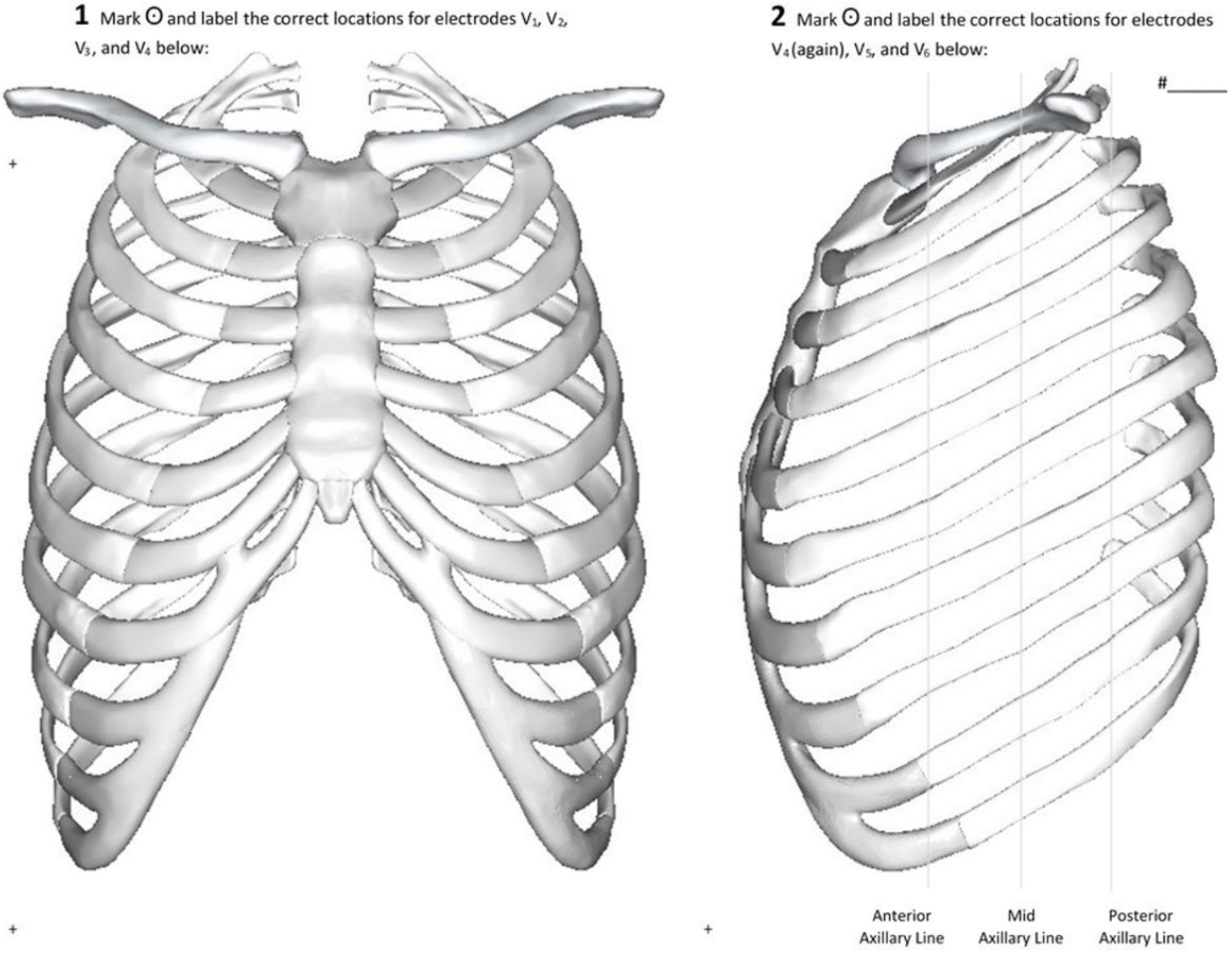

Figure 1. Printed diagram of the ribcage used for diagram data collection. Created using Anatomography, https://lifesciencedb.jp/bp3d.

After each participant finished placing electrodes, the locations of three registration points on the chest were marked on the transparency to establish standard axes for plotting the (x,y) coordinates of the electrodes. Following electrode placement, all partic-

ipants completed a questionnaire (Appendix A). One final question was posed orally, and the response was summarized and encoded by the researcher on the questionnaire sheet: "We are interested in how people find the starting point for locating the chest electrodes. What physical landmark do you locate first?"

The rib diagrams and the transparencies were scanned, the (x,y) coordinates of electrode locations were digitized using *Graph Grabber* v2.0.2 (Quintessa Software Ltd., Henley-on-Thames, UK, https://www.quintessa.org), and the data were uploaded into Excel®. Questionnaire responses also were entered into Excel®.

Data collection began in November 2019 and concluded in December 2021, with a hiatus from March 2020 to June 2021 due to the COVID-19 pandemic. All participants used the same manikin and identical materials. The first author (ELC) collected and reduced the data.

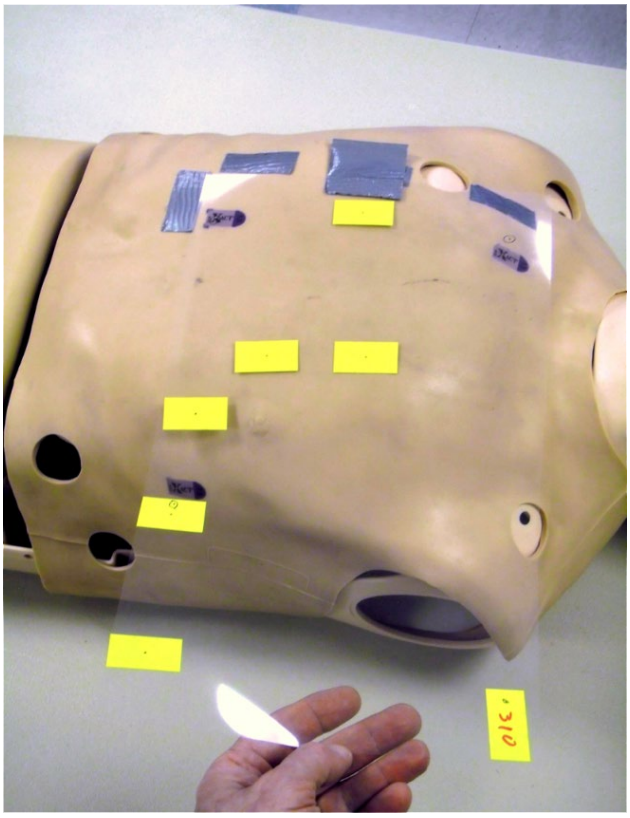

Figure 2. The manikin with a completed transparency showing simulated electrodes placed by a study participant.

DATA ANALYSIS

Ideal electrode locations were determined following AHA guidelines (Kligfield et al., 2007). To assess placement accuracy, a tolerance radius centered on the ideal location of each electrode was established for the two data collection methods (Table 1). Tolerances were based on the detailed assessment of the effects of electrode misplacement on ECG waveform morphology by Kania et al. (2014). A placement was considered acceptable if it lay within the tolerance radius for that electrode. Distances from ideal locations were calculated individually for each electrode, and aggregate error distances were calculated for electrode groups V_1-V_4 and V_1-V_6 (V_{all}). In addition, each participant's overall performance was coded as "acceptable" or "unacceptable" based on whether three or more of the electrodes V_1-V_4 lay within their respective tolerance radii. We concentrated on electrodes V_1-V_4 because the accuracy of the ECG depends most sensitively on correct placement of those four electrodes (Bond et al., 2012; Kania et al., 2014; Rudiger et al., 2007).

Method	V_1	V_2	V_3	V_4	V_5	V_6
Diagram	13	13	13	17	22	22
Manikin	30	30	30	40	60	60

Table 1. Tolerance radius (mm) for each electrode.

Descriptive and non-parametric statistics were calculated in Excel®, and mean aggregate electrode placement errors were analysed for variance with respect to questionnaire responses (ANOVA with Tukey comparisons) using *R* (R Foundation for Statistical Computing, Vienna, Austria, https://www.R-project.org).

RESULTS

A total of 149 participants completed the study. EMS data (n = 99) were collected during 27 visits to 14 sites representing six municipal fire departments, two hospital-affiliated EMS services, and one independent community EMS service located in one northeastern US state. Clinical data (n = 50) were gathered during 10 data collection sessions at the two campuses of the first author's hospital organization, a 150-bed medical and surgical hospital and a 40-bed inpatient mental health and outpatient surgical hospital, each location having a comprehensive ED. The study questionnaire and tabulated responses (Appendices A and B) describe the study participants.

Two-thirds of the study sample worked in EMS roles and one-third in clinical roles: RNs, certified nursing assistants (CNA), ED technicians, respiratory technicians, and inpatient psychiatric technicians. Half of the participants were paramedics; the other half were EMT-As, RNs, and clinical technicians. Nearly all ECGs are acquired by CNAs and ED technicians at the studied hospitals; very few full-time ECG technicians are employed, and none participated in the study.

See table 2 for ANOVA analysis of electrode placement errors for selected electrode groups. Only variables for which significant interactions were found are shown in the table.

Significant interactions appeared between questionnaire responses and placement errors, most often with electrodes V_4 and V_6 and least often with electrodes V_1, V_2, and V_5. Table 2 presents ANOVA results that achieved statistical significance for electrode groups V_1-V_4 and V_{all}.

Figures 3 and 4, respectively, present scatterplots of the placements of chest electrodes on the printed diagram of the ribcage (n = 67) and on the manikin (n = 149). Crosses in the figures indicate the ideal locations of the electrodes, and in Figure 4, solid circles mark the mean placements of the electrodes. The proportions

Variables	Mean Aggregate Errors	
	Electrodes V_1-V_4	All Electrodes
Frequency of Practice	≥ 5x/wk (113) > < 5x/mo (161) **p = 0.008**	≥ 5x/wk (180) > < 5x/mo (252) **p = 0.0009** ≥ 5x/wk (204) > < 5x/mo (252) p = 0.027
Initial Training: Where?	Academic (109) > Hospital (145) p = 0.013 Academic (109) > Fire Department (160) **p = 0.003**	Academic (185) > Fire Department (247) **p = 0.004**
Initial Training Format?	Classroom (146) > OJT (119) p = 0.047	[n.s.]
Recent Refresher: None	Too new (103) > Never (167) **p = 0.002**	Too new (161) > Never (262) **p = 0.002**
How Confident?	Very (118) > Somewhat (147) **p = 0.009**	[n.s.]
The mean aggregate error in mm (see text) for each participant group appears in parentheses. The notation " 5x/wk (180) > < 5x/wk (252)" indicates participants who reported acquiring five or more ECGs per week on average performed better (i.e., had a smaller mean aggregate placement error) than those reporting fewer than five ECGs per month. Bold font indicates p 0.01. n.s., no significant differences were found. OJT, on-the-job training.		

Table 2. ANOVA analysis of electrode placement errors for selected electrode groups.

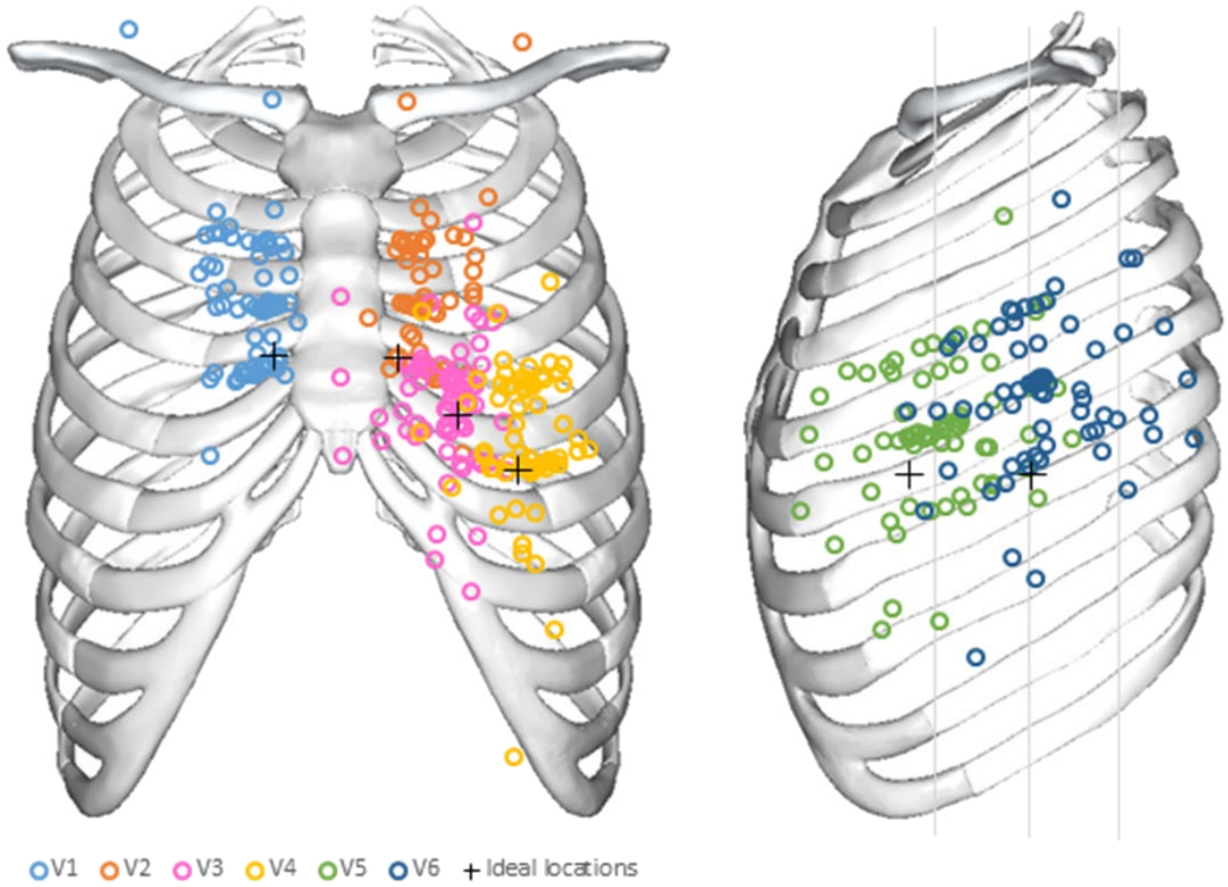

Figure 3. Scatterplot of diagram electrode placements superimposed on the diagram used by participants (n = 69). Crosses mark ideal locations of V_1-V_6 (left-right). Vertical lines on the lateral view mark the anterior, mid-, and posterior axillary lines (left-right).

of the two scatterplots differ because of differences between the printed diagram and the 3-dimensional manikin.

Overall, 41.6% of participants (n = 62) met the above-described acceptability criterion on the manikin; 21.5% (n = 32) placed five or more electrodes within tolerance; and 34.2% (n = 51) placed three or fewer electrodes within tolerance. The ANOVA analysis revealed no consistent differences in mean aggregate placement error related to the level of training, work role, or length of experience. The mean aggregate placement error for EMS practitioners was smaller than that for clinical practitioners in leads V_1-V_4 (127 mm vs. 144 mm, p = 0.092), and it and was approximately equal across all leads (207 mm vs. 205 mm, p = 0.8529). Nearly all (95%) placed electrodes V_1 and V_2 either both correctly or both incorrectly.

More than two-thirds of participants reported acquiring an average of at least five ECGs per month, or more than one per week (Appendix B). Almost one-third reported infrequent practice, fewer than once per week on average. Participants who reported acquiring five or more ECGs per week (V_1-V_4, p = 0.008; V_{all}, p = 0.0009) and those reporting five or more ECGs per month (V_{all}, p = 0.027) performed significantly better than those who reported fewer than five per month (Table 2).

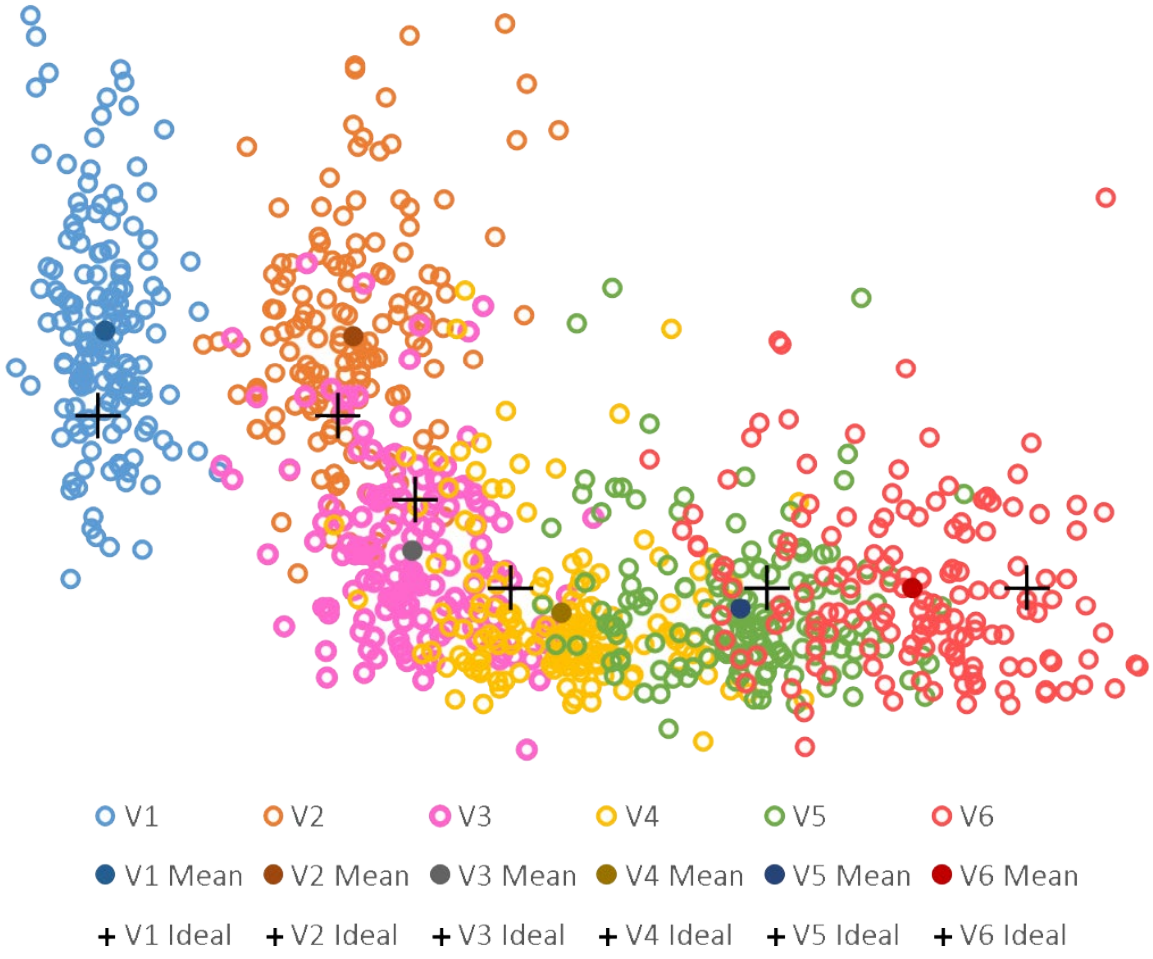

Figure 4. Scatterplot of manikin electrode placements (n = 149). Crosses mark ideal locations of V_1-V_6 (left-right), and solid circles mark the mean electrode placements.

Approximately 40% reported receiving initial ECG training from an academic organization (i.e., university, college, community college, or technical school) (Appendix B). Those participants performed significantly better than individuals trained in hospital (V_1-V_4, $p = 0.013$) or fire department (V_1-V_4, $p = 0.003$, V_{all}, $p = 0.004$) settings. This source of initial training was the most widespread difference we observed, achieving significance on all electrodes and groups but one. Similarly, those who reported classroom-based initial training performed significantly better (V_1-V_4, $p = 0.047$) than participants who reported on-the-job training (Table 2).

More than 90% of participants reported receiving their most recent refresher training through their workplaces (Appendix B). Differences in source, timing, and format of refresher training were not reflected in participants' electrode placement performance. However, among those who reported having received no refresher training, respondents whose initial training was within the past six months (i.e., too recently to require refresher training) performed significantly better (V_1-V_4, $p = 0.002$) than those with more experience but no refresher training.

According to our survey, participants who reported being "very confident" of their electrode placement skills performed significantly better than those who were "somewhat confident" (V_1-V_4, $p = 0.009$). No significant difference in performance appeared between those who did and those who did not report being responsible for training others on ECG technique. However, the self-identified instructors were more confident of their skills than non-instructors (66% vs. 45% indicated "very confident", Mann-Whitney test, $p = 0.050$) and reported somewhat more frequent practice (45% vs. 29% indicated ≥ 5 ECGs/week, $p = 0.080$). Instructors and non-instructors claimed approximately equivalent years of experience (both groups, median time since initial training = 5 to 10 years, $p = 0.739$).

The clavicle (44% of responses) and the nipple line (14%) were the physical landmarks cited most frequently as primary reference points for placing the chest electrodes (Appendix B). The first rib and the sternal notch were each cited by 7%. No significant difference in performance was associated with the choice of landmark.

Acceptability results for the two data collection methods were concordant (i.e., characterized as either "acceptable" or "unacceptable" by both methods) for 60% of the participants who used both methods (n = 67). Cohen's kappa for the two methods was $\kappa = 0.308$.

DISCUSSION

Classroom vs. on-the-job training and frequent vs. infrequent practice were associated with significantly smaller errors in electrode placement. The latter finding is consistent with the observation by McManus et al. (2004) that firefighter-paramedics assigned to busier stations performed better on ECG rhythm interpretation; together, they suggest that thresholds may exist below which practice becomes too infrequent to establish or maintain skills. The connection between greater self-confidence in placement skills and smaller placement errors seems to reflect participants' objective self-awareness of skills.

No specialized ECG technicians participated in this study. We would anticipate smaller error rates among specialized personnel for whom acquiring ECGs is a primary focus of their training and work, as found by Rajeganeshan et al. (2008). The fact remains, however, that specialist personnel are not available in all clinical settings — and rarely if ever in the EMS setting — so non-specialists necessarily acquire, and will continue to acquire, an unknown but probably large number of clinical ECGs as part of their overall duties.

Placement Accuracy and Patterns of Electrode Placement Error

The mean aggregate placement error among EMS personnel on the more sensitive leads V_1-V_4 was somewhat smaller than that for clinical personnel in this study. However, the standard deviation in the EMS group was greater, which suggests that while most EMS personnel placed the electrodes slightly more accurately than their clinical counterparts, some placed electrodes farther outside the acceptable range. The difference was not statistically significant (127 mm vs. 144 mm, $p = 0.092$), indicating that EMS personnel performed approximately equivalently to the clinical personnel we studied. Therefore, concerns that have been expressed here and elsewhere (Aydemir, 2021; Bickerton & Pooler, 2019; Garcia, 2015; García-Niebla et al., 2009; Kligfield et al., 2007; Medani et al., 2018; Rajaganeshan et al., 2008) regarding ECG electrode placement errors by clinical personnel appear to apply equally to the EMS personnel we studied. Gregory et al. (2021)

reached a similar conclusion regarding EMS personnel in the United Kingdom.

The scatterplots (Figures 3 and 4) indicate that mean electrode placements were generally close to acceptable, mostly within approximately one intercostal distance. However, the individual placements varied widely, with many lying far outside their acceptable ranges. Thus, the validity of ECGs acquired using those placements would be questionable.

Wide dispersion of electrode placements around approximately correct means suggested that there were few consistent patterns of directional displacement (i.e., significant individual placement errors in all directions mostly cancelled one another). A conspicuous exception is that V_1 and V_2 tended to be placed approximately one intercostal space (ICS) above their standard locations, which is consistent with previous findings (Aydemir, 2021; Gregory et al., 2021; Kligfield et al., 2007; Medani et al., 2018; Rajaganeshan et al., 2008). Contrary to earlier results, mean placements of electrodes V_3-V_6 in this study were either close to (manikin) or above (diagram) standard locations. In our study, placements of V_1 and V_2 were more dispersed vertically than laterally and were concentrated near the sternum, implying a good understanding of correct placement at the sternal border but less satisfactory identification of the correct (4th) ICS. These electrodes were misplaced equally often by all groups. Participants tended to associate the placement of electrodes V_1 and V_2 closely with one another, locating them either both correctly, or more often both incorrectly, in 95% of cases.

Linear groupings coinciding with ICSs in the diagram data implied a general understanding that certain electrodes are to be placed in ICSs. Most participants (46 of 67, 69% by visual inspection) placed electrodes V_4-V_6 along the 5th (or another) ICS on the diagram, but corresponding placements on the manikin tended to be anatomically horizontal (33 of 149, 22%, followed an ICS). That difference suggests that participants may have been misled by the ICSs on the graphic image, but that in practice they place electrodes more in line with AHA guidelines that V_5 and V_6 be placed in the horizontal plane defined by V_4 (Kligfield et al., 2007).

The absence of linear groupings in the manikin data also could have arisen from difficulty in palpating ribs on the manikin. However, many participants placed V_1, V_2, and V_4 in the wrong ICSs on the diagram where the correct ICSs could readily be located by sight. Figures 3 and 4 show that placements on the diagram are dispersed at least as widely as those on the manikin. Thus, general uncertainty about correct electrode locations apparently played a greater role in the broad dispersion of electrode placements observed in the manikin data than did difficulty identifying specific physical landmarks on the manikin.

Comparison of Data Collection Methods

Clear differences exist in electrode placements between the diagram and manikin data collection methods (Figures 3 and 4). Rajaganeshan et al. (2008) did not report whether they validated their diagram-based data collection method by having a cohort of participants also place electrodes on a live human model as Medani et al. (2018) did for their manikin-based data collection method. In the present study, several participants indicated informally that they were more comfortable working with the manikin than with the diagram because the manikin provided a more realistic and more familiar approximation of real-life practice. Visual inspection found that performance on eight of the 67 dia-

grams was very erratic, some to the point of being difficult to interpret, yet the manikin placements by seven of the same eight participants were at least close to acceptable.

In characterizing participants' overall performance as either "acceptable" or "unacceptable", the two methods were concordant (i.e., either "acceptable" or "unacceptable" according to both methods) for 60% of the 67 participants who used both methods. Cohen's kappa, $\kappa = 0.308$, indicated fair to minimal agreement between the two methods, depending on one's interpretation of the kappa statistic (McHugh, 2012). Because our manikin data collection method was substantially similar to the method validated by Medani et al. (2018), we regard it as preferable to the diagram method evaluated in this study.

Preferred Physical Reference Landmarks

Responses to the question about the primary reference point for placing chest electrodes were enlightening. They ranged from systematic placement strategies leading to textbook-correct results, to equally methodical approaches leading to incorrect results, to "I know I'm supposed to count ribs, but I usually just eyeball it." Some attributed their use of short-cut methods to time pressures inherent in EMS practice that are less prevalent in clinical settings. A few reported using separate strategies for female vs. male or obese vs. non-obese patients. After having made significant placement errors on the manikin, several used correct terminology (e.g., "4th intercostal space", "mid-clavicular line") and even described the placement process flawlessly. This suggests a disconnect between training and practice as reported by Gianetta et al. (2020) and Aydemir (2021) and underscores the importance of substantive follow-up to initial training.

In our study, the most commonly reported landmark was the clavicle (44% of participants). Only 6% cited the sternal angle (i.e., the angle of Louis) as a reference point for locating V_1 and V_2, as recommended by numerous textbooks and peer-reviewed articles (García-Niebla et al., 2009; Garcia, 2015; Goldberger et al., 2023; Brady et al., 2019; Campbell et al., 2017; Longo et al., 2017; Rautaharju, 2008). We concur with this recommendation, as the sternal angle unambiguously guides the practitioner to the second rib and thus to the second ICS, from which the fourth ICS can readily be located.

Interestingly, we found no significant differences in mean placement errors among participants employing various physical landmarks as their primary reference points, but these results raised one thought-provoking question. Participants referring to the nipple line, generally regarded as an unreliable reference point (e.g., García-Niebla, 2009; Goldberger et al., 2023; Crawford & Doherty, 2010), demonstrated the smallest mean and median placement errors across all electrodes but one and across all electrode groups. Perhaps these participants had developed an intuitive sense of correct electrode placement through long experience (e.g., one articulated this landmark as "where the nipple line ought to be"). However, their median time since initial ECG training equaled that of the overall study sample. This observation lacked statistical significance, but it increased our curiosity regarding strategies for identifying correct electrode locations.

Training Considerations

The diverse placement strategies and outcomes reported here and elsewhere in the literature indicate a need for more uniform initial training and continuing education in ECG technique for both EMS and clinical personnel (Bickerton & Pooler, 2019; Gregory et al.,

2021). Wolff et al. (2012) and Rautaharju (2008) found that sources of ECG training, supervision, and quality assurance for non-specialist clinical personnel who acquired ECGs in clinical settings were informal and unclear. Hayden and Barney (2018) wrote that no minimum standard exists for ECG competency for EMS practitioners. EMS curriculum guidelines give considerable curricular autonomy to individual training programs and EMS services (National Highway Traffic Safety Administration, 2021), with responsibility for the content of ECG training borne by the physician medical directors of individual programs and services. Given this study's findings, we agree with Hayden and Barney's proposal that instruction in the mechanics of ECG acquisition and in recognition of a few key ECG findings constitute "an obvious starting point" toward establishing a minimum ECG skills competency standard for EMS practitioners.

Today, the Internet provides easy access to resources of diverse quality and reliability. Bond et al. (2014) evaluated 42 diagrams illustrating ECG electrode placement obtained from online sources. They found that the accuracy and the overall utility of the diagrams were not suitable to guide clinicians in correctly acquiring 12-lead ECGs. In 2017, Walsh et al. reported that expert reviewers judged 13 of 22 chest electrode placement illustrations obtained from online sources to be too inaccurate for instructional use. Furthermore, Hoffman (2007) noted significant electrode placement errors in a diagram printed on an ECG electrode package. These observations highlight the importance of critically assessing potential learning and performance evaluation resources obtained from online sources by ECG instructors and practitioners alike.

Although 41% of participants in the present study reported receiving their initial ECG training through an academic institution, 90% stated fire departments, hospitals, or EMS services provided their most recent refresher training. A similar rate of electrode placement errors by self-identified instructors and non-instructors suggests that incorrect practices are being perpetuated through formal training and informal on-the-job coaching. We agree with the literature that proper ECG practice requires sound initial training and substantive continuing education with frequent reference to and reinforcement of established practice standards. Workplace administrators should ensure that their educators have sufficient time and access to resources to prepare and provide high-quality continuing education. Medani et al. (2018) is an interesting example of a study that not only identified this need but acted to address it with a peer-led education program that demonstrated promising improvements in ECG electrode placement among clinical staff.

LIMITATIONS

Eligible ECG practitioners in our sample were self-selected, which could have introduced unknown bias into the findings. A systematic, stratified sampling technique, though more challenging to achieve, would have provided a more objective cross-sectional assessment. Likewise, sources and formats of training were self-reported, and the terms were not defined on the questionnaire and might not have been understood consistently. Therefore, our findings regarding training should be interpreted with this in mind.

The sample size in this study is a limitation, but it still exceeds those in previous studies (Aydemir, 2021; Gregory et al., 2021; Medani et al., 2018; Rajeganeshan et al., 2008). A larger sample of up to 400 subjects was projected in our initial IRB proposal. However, the COVID-19 pandemic suspended data collection for 16 months. After data collection

resumed, some interested EMS services were still unable to participate due to ongoing safety policies that prevented the researcher from visiting their facilities.

The study focused on EMS services in one predominantly rural and small-city geographic area and on clinical personnel in a single hospital organization. We believe that the studied samples are broadly representative of corresponding populations elsewhere. However, scopes of practice (which define the categories of personnel who acquire ECGs) and policies, traditions, and available training resources can be expected to vary among regions and organizations, potentially affecting the applicability of our findings.

The manikin used in this study was not ideal, as indicated when participants were asked, "Did the hands-on electrode placement task allow you to demonstrate accurately where you would have placed the electrodes on a living patient?" (Appendix A). Slightly more than half (58%) responded "yes, completely"; thus, 42% were less than completely satisfied that this approach would accurately reflect their performance. Of those responding other than "yes, completely," 44% commented that the manikin differed significantly from a living patient, and a further 37% reported difficulty locating physical landmarks such as ribs and clavicles on the manikin. We acknowledge that this limitation may account for some of the variation observed in electrode placement. However, we did not find a statistically significant relationship between responses to this question and the accuracy of electrode placement. As noted above, V_1, V_2, and V_4 placements were dispersed at least as widely on the diagram as on the manikin. We believe that difficulty identifying physical landmarks on the manikin was not the primary source of the observed dispersion of electrode placements.

Several participants noted that the manikin did not reflect the variety of body types (e.g., obese patients and female patients) that they encountered in practice, and some commented that their ECG technique varied according to the physical characteristics of the patient. Others took exception to the choice of a default male body type for the study. While physical variability constitutes an acknowledged challenge in maintaining consistency in ECG practice (Bickerton & Pooler, 2019; Harrigan et al., 2012; Kligfield et al., 2007; Macfarlane et al., 2003; McCann et al., 2007; Walsh, 2018), the goal of this study was to assess electrode placement performance on a standardized model. While it is of great practical and clinical impact, addressing the effect of varied body types on the accuracy of ECG electrode placement was beyond the scope of this study and constitutes an important opportunity for further research.

CONCLUSIONS

We observed significant variability in the accuracy of chest electrode placement for 12-lead ECG by EMS personnel, comparable to that observed in previous studies and within this study among clinical personnel. Existing concerns regarding ECG electrode placement by clinical personnel and the subsequent risk of error as patients move along the continuum of care appear to apply equally to EMS personnel.

Initial ECG training from academic organizations vs. workplace-based training was associated with more accurate electrode placement. More frequent practice was also associated with better accuracy, as was greater confidence in the practitioner's own skills. The rate of placement errors among participants identifying as ECG instructors or trainers was comparable to the overall error rate, raising concerns about the quality of instruction

they provide. A paper diagram data collection method proved not to be concordant with, and probably less reliable than, a hands-on manikin method for assessing placement skills. Further research is warranted to clarify optimal strategies for locating chest electrodes, especially on diverse body types. Our findings indicate that there is an urgent need for sound initial ECG training and continuing education with careful attention to established practice guidelines.

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APPENDIX A. QUESTIONNAIRE

ECG Electrode Placement Survey

Survey #_____

1. Did the hands-on electrode placement task allow you to demonstrate accurately where you would have placed the electrodes on a living patient?

   ☐ Yes, completely
   ☐ Yes, but only partly (why?_____)
   ☐ Yes, mostly (why?_____)
   ☐ No (why?_____)

2. What is your most advanced level of training in health care?

   ☐ PA/NP
   ☐ Registered Nurse
   ☐ Paramedic
   ☐ Advanced EMT
   ☐ Basic EMT
   ☐ Medical Assistant/LPN/CNA/ED Technician
   ☐ Dedicated ECG Technician

3. In what capacity do you most often acquire 12-lead EGSs?

   ☐ PA/NP
   ☐ Registered Nurse
   ☐ Paramedic
   ☐ Advanced EMT
   ☐ Medical Assistant/LPN/CNA/ED Technician
   ☐ Dedicated ECG Technician

4. On average, how frequently do you personally acquire 12-lead ECGs?

   ☐ 5 or more per week
   ☐ 5 or more per month
   ☐ fewer than 5 per month
   ☐ fewer than 1 per month
   ☐ fewer than 1 per year

5. In what setting do you most often acquire 12-lead EGSs?

   ☐ hospital (inpatient, emergency department, ambulatory surgery, etc.)
   ☐ clinic or other outpatient medical facility
   ☐ EMS
   ☐ other _____

6. Your ***initial*** 12-lead ECG training ***(mark one in each column)***:

Where:	***When:***	***Format:***
☐ military service	☐ 6 months ago or less	☐ classroom course for academic credit
☐ hospital or other health care institution	☐ more than 6 months ago	☐ classroom training program for certification or licensure, but not for academic credit
☐ university, college, community college, technical school	☐ more than 1 year ago	☐ on-the-job training
☐ fire department	☐ more than 5 years ago	
☐ non-fire department EMS	☐ more than 10 years ago	

7. Your ***most recent*** 12-lead ECG training or review:

☐ none since initial training; OR ***(mark one in each column)***:

Where:	***When:***	***Format:***
☐ military service	☐ 6 months ago or less	☐ classroom course for academic credit
☐ hospital or other health care institution	☐ more than 6 months ago	☐ classroom training, not for academic credit
☐ university, college, community college, technical school	☐ more than 1 year ago	☐ skills fair or formal on-the-job review session
☐ fire department	☐ more than 5 years ago	
☐ non-fire department EMS	☐ more than 10 years ago	

8. Are you responsible for instructing or training others in 12-lead ECG technique? ***Mark all that apply.***

☐ yes: classroom course for academic credit
☐ yes: training program for certification or licensure, but not for academic credit
☐ yes: formal on-the-job training
☐ no

9. How confident are you that you acquire 12-lead ECGs correctly?

☐ very confident
☐ somewhat confident
☐ not very confident

Thank you for participating

SN C SA FR O X NL D Rev.9/14

APPENDIX B. QUESTIONNAIRE RESPONSES

Variables	All		EMS		Clinical	
	n	%	n	%	n	%
Level of Training						
RN	26	17%	2	2%	24	48%
EMT-P	74	50%	74	76%	0	0%
EMT-A	24	16%	22	22%	2	4%
EMT-B	1	1%	0	0%	1	2%
ED Technician	23	15%	0	0%	23	46%
Other (PhD)	1	1%	0	0%	1	2%
Role						
RN	24	16%	1	1%	23	47%
EMT-P	77	52%	77	77%	-	---
EMT-A	22	15%	22	22%	-	---
ED Technician	26	17%	-	---	26	53%
Frequency ECG Practice						
5 / week	50	34%	31	32%	19	37%
< 5 / week	54	36%	43	44%	11	22%
< 5 / month	27	18%	17	17%	10	20%
< 1 / month	11	7%	5	5%	6	12%
< 1 / year	7	5%	2	2%	5	10%
Setting of Practice						
EMS	98	66%	-	---	-	---
Clinical	51	34%	-	---	-	---
Initial ECG Training: Where?						
Military	2	1%	1	2%	1	1%
Hospital or similar	40	27%	3	7%	37	39%
Academic institution	61	41%	7	15%	54	57%
Fire department	21	14%	20	43%	1	1%
Non-fire department EMS	17	11%	15	33%	2	2%
Initial ECG Training: When?						
≤ 6 months ago	11	7%	2	2%	9	19%
6 months – 1 year	6	4%	1	1%	5	10%
1 year – 5 years	38	26%	22	22%	16	33%
5 years – 10 years	27	18%	23	23%	4	8%
≥ 10 years	64	43%	50	51%	14	29%
Initial ECG Training: Format?						
Classroom, academic credit	27	18%	22	24%	5	11%
Classroom, not for credit	62	42%	57	63%	5	11%
On the job training	48	32%	12	13%	36	78%
Latest ECG refresher: Where?						
Military	2	2%	1	1%	1	3%
Hospital or similar	38	32%	7	8%	31	94%
Academic institution	11	9%	11	13%	0	0%
Fire department	57	48%	57	66%	0	0%
Non-fire department EMS	12	10%	11	13%	1	3%

Variables	All		EMS		Clinical	
	n	%	n	%	n	%
Latest ECG refresher: When?						
Too new	12	8%	2	2%	10	20%
Never	13	9%	6	6%	7	14%
≤ 6 months ago	45	30%	34	36%	11	22%
6 months – 1 year	27	18%	19	20%	8	16%
1 year – 5 years	37	25%	25	27%	12	24%
5 years – 10 years	7	5%	5	5%	2	4%
≥ 10 years	4	3%	3	3%	1	2%
Latest ECG refresher: Format?						
Classroom, academic credit	23	15%	18	24%	5	13%
Classroom, not for credit	38	26%	29	39%	9	24%
On the job training	51	34%	27	36%	24	63%
Train others in ECG technique?						
Yes	44	30%	23	23%	21	41%
No	105	70%	75	77%	30	59%
How confident in ECG skills?						
Very confident	76	51%	57	58%	19	38%
Somewhat confident	68	46%	39	40%	29	58%
Not very confident	4	3%	2	2%	2	4%
Reference point for placing chest electrodes						
Sternal notch	7	7%	4	10%	3	7%
Clavicle	47	44%	17	43%	30	70%
Sternal angle	6	6%	3	8%	3	7%
First rib	8	8%	7	18%	1	2%
Nipple line	15	14%	9	23%	6	14%
Other	22	21%	15	38%	7	16%
None	1	1%	1	3%	0	0%

Abbreviations: RN, registered nurse; EMT, Emergency Medical Technician; EMT-P, paramedic; EMT-A, advanced EMT; EMT-B, basic EMT; ED, emergency department.

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RESEARCH REPORT

EXAMINING COGNITIVE AID USE IN EMERGENCY MEDICAL SERVICES: A CROSS-SECTIONAL SURVEY

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ABSTRACT

Background: Emergency Medical Service (EMS) clinicians render care in less-than-ideal environments, and errors occur at high rates. Some cognitive aids have been shown to reduce errors and improve adherence to evidence-based practices. This study focuses on the frequency of cognitive aids used by EMS clinicians.

Methods: A cross-sectional online survey was developed using a modified Delphi method with items examining demographic information and the frequency that 15 selected cognitive aids are used during patient care using a five-point Likert scale. A survey link was emailed to 136,093 EMS clinicians across six states (TX, ME, MI, LA, SC, and AR). Descriptive statistics were used to describe frequencies. Kruskal-Wallis was used to assess if use differed among demographic or employment groups, and Spearman correlation was used to examine the relationship between clinician age and cognitive aid use.

Results: A total of 2,251 respondents were included in the study after meeting the inclusion criteria. Of the 15 cognitive aids examined, the length-based tape was the most used (Med= 3.0, IQR: 1.0-4.0). Overall cognitive aid use was limited, with a median score of 1.67 (IQR: 1.07-2.27). The following groups reported more frequent use of cognitive aids: females (Med= 1.87, IQR: 1.27-2.47), Hispanics (Med= 1.93, IQR: 1.33-2.67), Black/African Americans (Med= 2.00, IQR: 1.20-2.53), air medical clinicians (Med= 2.00, IQR: 1.60-2.40) and clinicians working in military settings (Med= 2.23, IQR: 1.80-2.80).

Conclusions: Overall, cognitive aid use in EMS is limited. More effort is needed to increase their use in EMS. This data may provide insight to better target areas of need, improve design, and improve implementation of cognitive aids in EMS.

INTRODUCTION

Emergency Medical Service (EMS) clinicians render care in challenging environments. This fast-paced, high-risk setting creates an environment for higher rates of medical errors to occur. During an emergency situation, memory retrieval in humans is negatively impacted and cognitive workload increases (Kuhlmann, 2005; Thomas et al., 2017). Research has indicated that life threatening errors occur at high rates in EMS (Bigham et al., 2012; Walker et al., 2022). Some aspects of EMS, such as pediatric

care, are associated with abnormally higher rates of error (Hoyle et al., 2020; R. Lammers et al., 2012; R. L. Lammers et al., 2009).

Cognitive aids are support tools designed to reduce the cognitive burden that comes with completing certain tasks, improving the user's efficiency. They include items like checklists, reference tools, calculators, and mnemonic devices (Keebler, 2017). Numerous cognitive aids have been found to reduce error and improve patient outcomes in medicine (Arriaga et al., 2013; Hall et al., 2020; Haynes et al., 2009). Additionally, using a cognitive aid during emergencies can improve the comfort level of EMS clinicians rendering care for pediatric patients (Woods et al., 2019).

Some EMS medical oversight agencies promote the use of cognitive aids for specific interventions. The Michigan statewide EMS protocols require the use of the MI-MEDIC pediatric dosing reference during pediatric medication administration (Michigan Department of Health and Human Services Bureau of EMS, 2018). In 2020, a joint policy statement was published by the National Association of EMS Physicians (NAEMSP) regarding equipment for ambulances, which recommended stocking cognitive aids like a length-based tape (LBT) for estimating weight in pediatrics, and other pediatric reference material (Cicero et al., 2021). In 2022, the NAEMSP included cognitive aid recommendations in a different position statement for prehospital airway management. In this statement, they recommend the use of cognitive aids in some airway procedures but further stated that clinicians should train with these aids and implementation should be closely monitored (Counts et al., 2022).

Research examining the use of cognitive aids during patient care in EMS is limited. Several developed cognitive aids for EMS have been adopted in EMS systems, but their frequency of use during patient care has not been fully studied (Hoyle et al., 2020; Rappaport et al., 2022). Additionally, clinicians in EMS can acquire some cognitive aids by downloading them as mobile applications through app stores (G‡lvez et al., 2017; Kalz et al., 2014; Thygerson et al., 2013), or by purchasing pocket guides and flowcharts (Derr et al., 2021; Ward, 2017). This makes it difficult to identify what cognitive aids are being used during patient care and how frequently. The unknown type and frequency of cognitive aid use in EMS makes it difficult to determine the impact they may have on patient care. Furthermore, understanding clinicians' use of cognitive aids can provide insight into what aspects of patient care clinicians are seeking help with, and can help developers of these tools design aids targeted at areas of need.

This study aimed to examine cognitive aid use during patient care in EMS. The primary objective was to examine the type and frequency that cognitive aids are being used during patient care in EMS. The secondary objective was to examine the frequency of cognitive aid use among various demographic and employment groups.

METHODS

Study Population and Design

An online cross-sectional survey was developed. EMS departments in six states (Texas, Michigan, Arkansas, South Carolina, Maine and Louisiana) agreed to participate in the study. A link to the survey was sent to all licensed or certified EMS clinicians in these states. The link was received by 136,093 EMS clinicians. Clinicians less than 18 years of

age, those who do not work in the United States, and those not actively working as an EMS clinician in an emergency response capacity were excluded.

Protection of Human Subjects

This study was approved by the Western Michigan University Institutional Review Board (reference number: 21-08-05) under exempt status. The research team adhered to all ethical and legal guidelines. At the beginning of the survey, participants were informed of the purpose of the study and their right to withdraw from the study at any time. Informed consent was required prior to the participant being able to continue with the survey. No personal identifiable information was collected from the participants and responses were imported directly into the SurveyMonkey database file. After all responses were collected, data was downloaded to a separate password protected server.

Instrument Development and Administration

The survey was developed using a 6-round modified Delphi method with 6 subject matter experts (SMEs). Experts included two emergency physicians board certified in Emergency Medical Services, three paramedics (including a certified flight paramedic and a certified tactical paramedic), and an emergency medical technician. Each SME had over 20 years of experience in their respective position.

Pilot Testing

The pilot survey examined 21 cognitive aids and contained 129 items. Participants were asked how often they used each cognitive aid when they performed the skill or encountered the patient the aid was intended to be used for. The survey was distributed through Survey Monkey (SurveyMonkey Inc., Menlo Park, CA) and pilot tested on social media pages dedicated to EMS. Eighty-seven participants meeting inclusion criteria completed the pilot survey. Cognitive debriefing was conducted with six of these participants. After analysis, six cognitive aids were removed from the list due to no participants reporting use and those who participated in cognitive debriefing reported they were not familiar with them. No other significant changes were made.

Final Survey

The final survey contained 80 items that focused on the use of the 15 cognitive aids listed in Table 1. A link to the survey, via Survey Monkey, was distributed to EMS clinicians in the six participating states. State EMS departments in Arkansas, South Carolina, and Louisiana emailed the link to all licensed or certified EMS clinicians in their states. Texas and Maine provided the research team a contact list of all EMS clinicians in their states, who emailed the link to those clinicians. Michigan included the link in an emailed weekly EMS newsletter. The survey was open from January 3, 2022, to January 16, 2022.

Measures

Demographic and Employment Data

This survey included items assessing demographic information (age, gender, race/ethnicity, clinician level, years of EMS experience, highest level of education) and, employment information (primary work location-first response agency, private ambulance, fire-based

ambulance), employment type (full-time, part-time, volunteer), state or territory where the participant works, and community type where they work (e.g., rural, urban, suburban).

Cognitive Aid Frequency

Each of the 15 cognitive aids were listed with a specific skill or patient encounter type. Using a five-point Likert scale, participants were asked if they used the aid always, often, sometimes, rarely, or never. Table 1 provides a description of each cognitive aid and the associated skill/patient encounter.

Analysis

Data was exported to Stata IC 15.1 (StataCorp LP, College Station, TX). Descriptive statistics were used to describe the frequency of cognitive aid use. We specifically used medians and interquartile ranges (IQRs) to describe the results due to the nonparametric nature of the data. An overall median score for frequency of use for each cognitive aid included in the questionnaire was calculated and had a range of 0-4, where 0=never and 4=always. To assess whether the overall use of aids during patient care differed among demographic and employment groups, Kruskal-Wallis tests were performed due to its nonparametric approach to determine the differences between medians of three or more independent groups. Post-hoc analyses were conducted to further investigate demographic differences.

	Median	IQR	Associated Frequency
Phone or tablet application, specifically designed to calculate medications for adult medication calculation	1.0	0.0 – 2.0	Rarely
Phone or tablet application, specifically designed to calculate medications for pediatric medication calculation	2.0	0.0 – 3.0	Sometimes
Calculator (handheld calculator device or a calculator on a phone or tablet) for adult medication administration	1.0	0.0 – 2.0	Rarely
Calculator (handheld calculator device or a calculator on a phone or tablet) for pediatric medication administration	2.0	0.0 – 3.0	Sometimes
Pocket guides to reference treatment algorithms when managing patients in cardiac arrest.	1.0	0.0 – 2.0	Rarely
Color-metric length-based tape (e.g., Broselow tape) when treating pediatric emergencies	3.0	1.0 – 4.0	Often
Color-based medication reference cards when treating pediatric emergencies	2.0	0.0 – 3.0	Sometimes
Checklist (paper or digital) when performing procedures (e.g., endotracheal intubation, supraglottic airway placement, medication administration)	1.0	0.0 – 2.0	Rarely
Checklist (paper or digital) for managing patients in cardiac arrest (e.g., CPR checklists, defibrillation checklists)	1.0	0.0 – 2.0	Rarely
Protocol referencing (paper or digital) when treating patients (any condition or age)	2.0	1.0 – 3.0	Sometimes
Paper templates for note taking when treating patients (any condition or age)	1.0	0.0 – 3.0	Rarely
Medication recording feature on a cardiac monitor when administering medications (adult or pediatric)	2.0	0.0 – 3.0	Sometimes
Trauma score template (paper or electronic) when managing critical trauma patients.	2.0	0.0 – 3.0	Sometimes
GCS scoring template (paper or electronic) when treating patients (any condition or age).	2.0	1.0 – 4.0	Sometimes
Mnemonic (paper or electronic) for communication when performing a patient handoff	1.0	0.0 – 3.0	Rarely

Table 1. Frequency of Cognitive Aid Use During Associated Skill or Patient Encounter.

	Excluded		Final Study Sample		*p*
	N	%	N	%	
Gender					**.85**
Male	517	71.7	1,620	72.7	
Female†	200	27.7	594	26.7	
Non-binary, transgender, other	4	0.5	13	0.6	
Race/Ethnicity					**.03**
White	600	82.8	1,930	86.4	
Hispanic, Latinx, or Spanish origin†	48	6.6	111	5.0	
Black or African American†	31	4.3	61	2.7	
Two or more races	18	2.5	69	3.1	
Other*†	28	3.9	63	2.8	
Current EMS clinician level					**< .001**
Emergency Medical Responder / Medical† First Responder (EMR)	33	4.5	40	1.8	
Emergency Medical Technician (EMT)†	365	50.1	720	32.1	
Advanced Emergency Medical Technician (AEMT)	46	6.3	143	6.4	
Paramedic	285	39.1	1,339	59.7	
Highest Level of Education Completed					**< .001**
Less than a high school diploma or GED equivalent†	9	1.2	7	0.3	
High school diploma or GED equivalent†	330	45.2	879	39.1	
Associate degree	233	31.9	688	30.6	
Bachelor degree	124	17.0	532	23.7	
Master degree	28	3.8	112	5.0	
Doctorate	6	0.8	27	1.2	
Primary Work Location					**.01**
First response agency (non-transport)†	137	18.7	402	17.9	
Fire-based ambulance service	138	18.9	423	18.8	
Government ambulance service	161	22.0	573	24.5	
Private ambulance (for-profit or not-for-profit)†	238	32.6	657	29.2	
Air medical	17	2.3	102	4.5	
Military	3	0.4	10	0.4	
Tribal†	2	0.3	0	0.0	
Other	35	4.8	83	3.7	
EMS Employment Type					**.22**
Full-time	604	82.8	1,831	81.4	
Part-time†	83	11.4	239	10.6	
Volunteer response	34	4.7	153	6.8	
Other	8	1.1	26	1.2	
Type of Community					**< .001**
Rural	160	22.0	639	28.4	
Suburban†	93	12.8	228	10.1	
Urban†	135	18.5	278	12.4	
Combination of community types	340	46.7	1,104	49.1	
	Mean (SD)	**95% CI**	**Mean (SD)**	**95% CI**	***p***
Age (in years)	37.5 (12.5)	36.6 – 38.7	41.4 (12.4)	40.9 – 41.9	< .001
Years of Experience	12.6 (10.9)	11.8 – 13.4	16.5 (11.5)	16.0 – 17.0	< .001

*Includes Asian, Native American or Alaskan Native, Hawaiian Native or Pacific Islander, and other.
†Indicates demographic and employment groups that were excluded at significantly higher rates.

Table 2. Comparison of Demographic and Employment Characteristics between Study Sample and Excluded Participants.

RESULTS

Responses

A total of 3,929 responses were collected from the estimated 136,415 EMS clinicians who were emailed the survey (response rate of 2.88%). A total of 1678 (42.7%) were excluded. Seven hundred fifty-one (19.1%) were excluded for incomplete surveys, 614 (15.6%) were excluded for not currently working as an EMS clinician in the U.S. or being less than 18 years old, 306 (7.8%) were excluded for not consenting, and 7 (0.2%) were removed because of concerns over the validity of data (e.g., years of experience was greater than age). The final sample size was 2,251. Demographic and employment characteristics did vary significantly between responses that were included and those that were excluded (Table 2).

Demographics

A Kruskal-Wallis test was used to compare continuous variables (e.g., age and experience), and a Pearson chi-square was used for categorical variables (e.g., gender, race, clinician level). The majority of respondents were male (n=1620, 72.0%), white (n=1930, 85.7%), and working as an EMS clinician on a full-time basis (n=1831, 81.3%). Over half of participants were currently working as paramedics (n=1339, 59.5%) while one-third were EMTs (n=720, 32.0%). Most participants had at least a high school diploma but less than a master's degree (n=2099, 93.2%). First response clinicians (non-transport) and clinicians working for ambulance services comprised the majority of respondents (n=2055, 91.3%) and almost half of the study sample reported working in a mixed community of urban, suburban, and rural areas (n=1104, 49.0%).

Frequency of Cognitive Aid Use

The frequency of use for each cognitive aid can be found in Table 1. The most frequently used cognitive aid during the associated skills or patient encounters was the LBT for pediatric emergencies (Med= 3.0, IQR: 1.0-4.0), which was associated with a response of "Often." A total of 7 other cognitive aids had a median response of "Sometimes" and another 7 resulted in a median response of "Rarely." The most infrequently used cognitive aids were a calculator for adult medication administration, algorithm pocket guides for managing cardiac arrest, checklist when performing airway procedures, checklist (paper or digital) for managing patients in cardiac arrest, paper templates for note taking when treating patients (any condition or age), and mnemonic (paper or electronic) for patient handoff communication.

Cognitive aids used for pediatric care were used significantly more than those for adults (Table 3). The median of the medians was 2.0 (IQR: 1.0 - 3.0) for pediatrics and 1.5 (IQR: 0.5 - 2.0) for adults ($W = 27.26$, $p < .000$).

The median score for all cognitive aid use was 1.67 (IQR: 1.07-2.27), associated with a response of "Rarely" to "Sometimes."

Demographic and Employment Characteristics

Eight demographic and employment characteristics showed a significant association with frequency of cognitive aid use. Increasing age demonstrated a small, negative

	Median	IQR	*p*
Cognitive Aid Use			**< .000**
Cognitive aids used for pediatric emergencies (n=4)	2.0	1.0-3.0	
Cognitive aids used for adult emergencies (n=2)	1.5	0.5-2.0	

Table 3. Comparison of Cognitive Aids Used for Pediatric Care and Cognitive Aids Used for Adult Care. Wilcoxon sign-rank test used in this analysis.

	Median	IQR	*p*
Gender			**< .001**
Male	1.60	0.93 – 2.13	
Female†	1.87	1.27 – 2.47	
Race/Ethnicity			**< .001**
White	1.67	1.07 – 2.20	
Hispanic, Latinx, or Spanish origin†	1.93	1.33 – 2.67	
Black or African American†	2.00	1.20 – 2.53	
Two or more races	1.50	0.80 – 2.13	
Other*	1.47	0.87 – 2.13	
Current EMS clinician level			**< .001**
Emergency Medical Responder / Medical First Responder (EMR)	1.30	0.23 – 2.23	
Emergency Medical Technician (EMT)	1.47	0.73 – 2.07	
Advanced Emergency Medical Technician (AEMT) †	1.73	1.13 – 2.33	
Paramedic†	1.73	1.20 – 2.27	
Highest Level of Education Completed			**.01**
Less than a high school diploma or GED equivalent	0.60	0.00 – 3.00	
High school diploma or GED equivalent	1.73	1.07 – 2.33	
Associate degree	1.73	1.07 – 2.27	
Bachelor degree	1.67	1.00 – 2.20	
Master degree	1.67	1.07 – 2.00	
Doctorate	0.87	0.47 – 2.00	
Primary Work Location			**< .001**
First response agency (non-transport)	1.27	0.53 – 2.00	
Fire-based ambulance service	1.60	0.93 – 2.13	
Government ambulance service	1.80	1.27 – 2.40	
Private ambulance (for-profit or not-for-profit)	1.71	1.13 – 2.33	
Air medical†	2.00	1.60 – 2.40	
Military†	2.23	1.80 – 2.80	
Other	1.80	1.13 – 2.60	
EMS Employment Type			**< .001**
Full-time	1.73	1.07 – 2.27	
Part-time	1.50	0.93 – 2.20	
Volunteer response	1.33	0.53 – 2.00	
Other	1.40	0.87 – 2.60	
Type of Community			**< .001**
Rural	1.73	1.00 – 2.33	
Suburban	1.53	0.83 – 2.07	
Urban	1.47	0.87 – 2.00	
Combination of community types	1.73	1.14 – 2.27	
†Indicates demographic or employment groups reporting significantly higher rates of cognitive aid use than their counterparts as discovered in post-hoc analysis.			

Table 4. Cognitive Aid Use in EMS by Demographic and Employment Characteristics.

correlation with the overall use of cognitive aids (? = -0.06, p = .005). Furthermore, the following groups reported significantly more frequent use of cognitive aids than their counterparts: participants of Hispanic, Latinx, or Spanish origin, Black/African Americans, women, Advanced EMTs, paramedics, those working in air medical services, and those working in military environments (Table 4). Participants working with a first response agency (non-transport), those who volunteer as EMS clinicians, and those working in suburban and urban settings reported significantly less frequent use of these same aids. The only demographic or employment characteristic that did not show a significant association with the overall frequency of cognitive aid use during associated skills in patient care was years of experience (? = 0.01, p = .59).

A subgroup analysis was conducted (Figure 1) comparing the use of each aid between basic life support clinicians (i.e., Emergency Medical Responders and Emergency Medical Technicians) and advanced life support clinicians (i.e., Advanced Emergency Medical Technicians and Paramedics). The most used aid by basic life support clinicians was the Glasgow Coma Scale scoring template (n=553, 73.0%, p = < 0.01). The most used aid by advanced life support clinicians was the color-metric length-based tape (n= 1251, 84.5%, p = < 0.01), which had the most significant difference in use between the two groups (n= 778, 22.2%).

DISCUSSION

Frequency of Cognitive Aid Use

Although cognitive aids are readily available to EMS clinicians and are sometimes provided to them by employers, our study found that widespread use of cognitive aids in EMS was limited. This is similar to what was found in other studies. Follmann et al.,

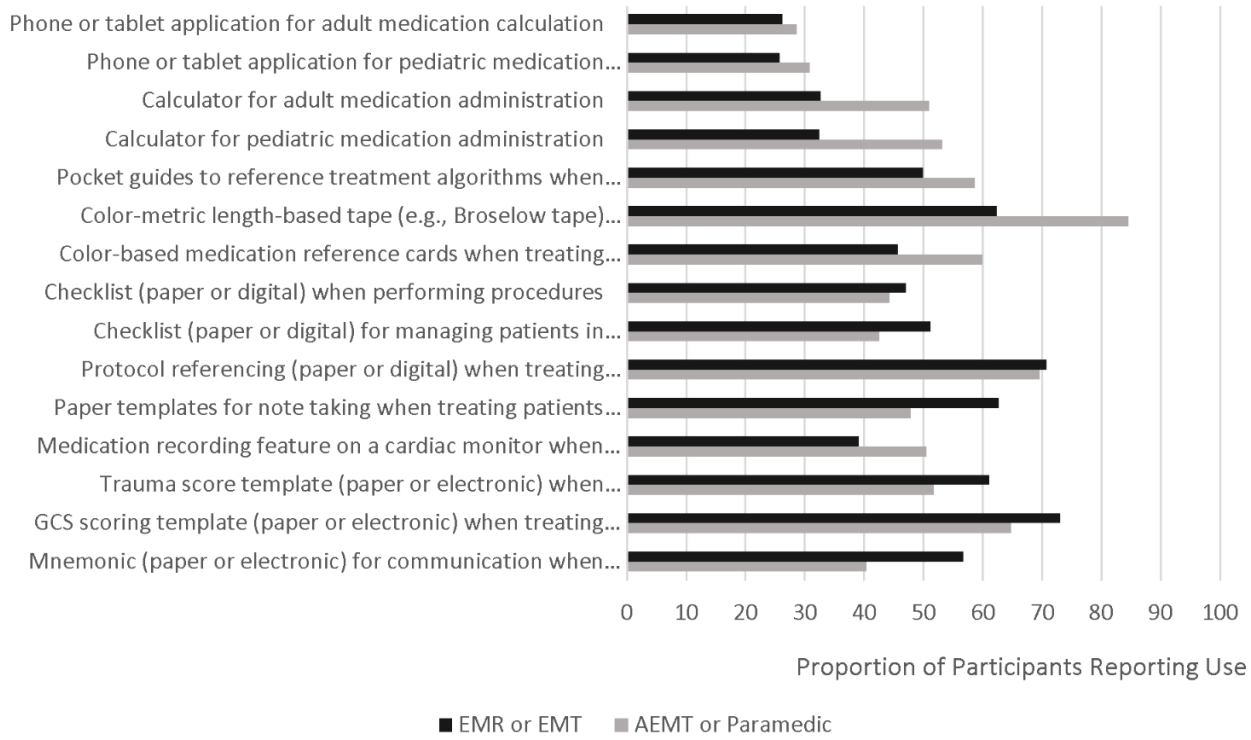

Figure 1. Comparison of Cognitive Aid Use in Education Programs Between EMS Clinician Levels.

(2019) examined the use of smart glasses in mass casualty incident triage comparing three groups: a group using a triage algorithm displayed in the smart glasses, a group using telemedical contact through the smart glasses, and a group provided with a printed triage algorithm card. No participants in the printed card group chose to use the cognitive aid. Instead, they engaged in triage without the use of any aid, resulting in only 58% accuracy. This reluctance to use cognitive aids could be the result of EMS culture and resistance by some EMS groups. Furthermore, clinicians may not be aware that many aids exist for EMS or implementation strategies may be missing, such as instituting policies requiring their use.

Among the least frequently used aids were checklists. During initial studies conducted by the World Health Organization on the adoption of their surgical safety checklist, they faced significant resistance among some groups using the cognitive aid. However, much of this was overcome through a strategic implementation campaign (Barimani et al., 2020). The National Association of EMS Officials National Model EMS Clinical Guidelines recommends using checklists for tasks like CPR and endotracheal intubation (National Association ofÊState EMS Officials, 2022). However, state EMS protocols across several states rarely mention cognitive aids (Paramedic Protocol Provider, n.d.).

Higher Use of Pediatric Aids

Our study demonstrated that pediatric cognitive aids were more commonly used than those for adults. The LBT was the most commonly used aid of all those examined in this study. Challenges with pediatric care in EMS have long been cited. Hoyle et al. (2012) identified that pediatric medication errors occur at a rate of 34.7% in EMS. Since this study, some cognitive aids have been designed to specifically address this issue (Hoyle et al., 2020; Rappaport et al., 2016, 2022), and are listed in some protocols to be used during pediatric medication administration (Brevard County Fire Rescue, 2018; Michigan Department of Health and Human Services Bureau of EMS, 2018). The availability of these aids and their promotion for use in EMS may influence the clinician's choice to use them.

Another factor influencing clinicians' use of cognitive aids during pediatric care could be the clinicians' lack of confidence in managing these patients. Fowler et al. (2018) conducted a scoping review of studies regarding the effectiveness of educational interventions in improving perceptions of pediatric care in EMS. The study noted that paramedics feel uncomfortable treating pediatric patients and wanted more help in better caring for them. Although this article cites the clinicians' desire for more training, pediatric cognitive aids may be perceived as another form of assistance in improving care. Since high cognitive load can increase stress (Brachten et al., 2020), the cognitive offloading these aids offer may decrease stress associated with pediatric care. This is supported by Woods et al. (2019), which found that using a specifically developed cognitive aid for pediatric emergencies improved paramedic comfort levels in managing pediatric patients.

Differences in Demographic and Employment Cognitive Aid Use

The results of our study found several demographic and employment differences associated with using cognitive aids. Advanced EMTs and Paramedics were significantly more likely to use cognitive aids than other EMS clinicians. Emergency Medical Technicians reported more frequent use of cognitive aids than emergency medical responders. These results were expected as this supports that the higher the scope of practice, the more

likely EMS clinicians were to use cognitive aids. Furthermore, many of these aids are designed and promoted for use in advanced life support care (e.g., medication administration and advanced airway procedures).

Clinicians working in some EMS work settings reported more frequent cognitive aid use. Those working in air medical and military settings were significantly more likely to use cognitive aids than other work settings. This is similar to higher rates of cognitive aid use found among high reliability organizations (Thomassen et al., 2011). This indicates that clinicians may be more open to the use of cognitive aids in emergency medical care due to their use in other aspects of their work setting, policies, or targeted training that may exist in these organizations, influencing their use.

A small negative correlation was found with age, with older clinicians less likely to use cognitive aids. Although it may seem that older clinicians were more experienced and had less of a need for cognitive aids, we found no correlation with experience level. Women, participants of Hispanic, Latinx, or Spanish origin or Black/African Americans, were significantly more likely to use cognitive aids than their counterparts. Some research has found that females are more likely to seek assistance than men with various tasks (Johnson et al., 2009). Research exploring the use of cognitive aids among certain demographic groups is limited. Further investigation is needed to examine why certain groups use cognitive aids more than others. Identifying such factors may result in improved cognitive aid design and more effective implementation strategies.

LIMITATIONS

The primary limitation of this study was the low response rate to the survey. The results from individuals who chose to take the survey may not generalize to other EMS clinicians. Additionally, using a survey to examine cognitive aid use requires clinicians to reflect on care they previously provided and recall how often they use these cognitive aids. Some of the listed cognitive aids are designed for care that is rarely performed. For instance, evidence has shown in some systems that up to 71.5% of paramedics did not administer any medications to pediatric patients over the previous 12 months (Hoyle et al., 2012). Due to some infrequent encounters like this, recall bias may be present in many of the responses noted in this study. Self-reporting of cognitive aid use may introduce other types of response bias, such as self-selection bias.

Although our study discovered several demographic and employment associations, the interaction effect was not able to be ruled out in circumstances where a theoretical foundation supports that it may exist. This was primarily due to a low sample size with those specific groups. For instance, there are higher percentages of some minority populations in the military (Department of Defense, 2017). However, only 10 participants responded from military EMS settings and we were unable to further examine this effect. Theoretical foundations are lacking for other demographic groups and settings.

Lastly, four of the six states (Texas, Arkansas, Louisiana and South Carolina) that participated in the study are located in the south. EMS system cultures may be similar between these states and may result in data that is not generalizable in other areas. Additionally, South Carolina had a significantly higher response rate than all other states. Of the 2,251 responses used in the analysis, 899 (39%) came from South Carolina. However, an exam-

ination of data from South Carolina was reviewed, and no significant differences were noted when compared to other states.

CONCLUSIONS

Although this survey discovered that overall cognitive aid use in EMS was limited, participants reported that some aids were used significantly more than others. This includes cognitive aids used for pediatric emergency care. Cognitive aid use was more frequent among several demographic and employment groups. Women, participants of Hispanic, Latinx, or Spanish origin, Black/African Americans, Advanced EMTs, Paramedics, and those working in air medical and military settings were all more likely to use cognitive aids during patient care. Lastly, decreased cognitive aid use was noted with increasing age.

More research is needed to better understand the reason some cognitive aids are being used more than others, and why some demographic and employment groups report higher use. Additionally, researchers should investigate the aspects of EMS care that would benefit from cognitive aids and determine design features that maximize usability. Any developed aid should be examined to determine its efficacy prior to implementing it in practice. Effective implementation strategies should be identified to increase their use during patient care.

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RESEARCH REPORT

THE RELATIONSHIP BETWEEN EMOTIONAL INTELLIGENCE, SELF-COMPASSION AND WELLBEING IN AMBULANCE STAFF

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Abstract

Objective - Ambulance staff are at increased risk of negative wellbeing outcomes, though there is a lack of research into their wellbeing. This study explores the relationship between emotional intelligence and self-compassion, two factors related to positive wellbeing in other populations, and the professional quality of life and psychological wellbeing of ambulance staff.

Methods - A within-participants cross-sectional survey was completed with UK ambulance staff. Data were collected via an anonymous online survey on participants' demographics, emotional intelligence, self-compassion (separated into the subscales of self-coldness and self-kindness), compassion fatigue and compassion satisfaction, and psychological wellbeing. The relationships between variables were first explored using Pearson's r correlational analyses. Then, three hierarchical multiple regressions were used to explore what predicted the outcome variables of compassion fatigue, compassion satisfaction, and psychological wellbeing.

Results - 146 ambulance staff completed the survey. Emotional intelligence and self-kindness correlated negatively with compassion fatigue, while self-coldness correlated positively with compassion fatigue; emotional intelligence and self-kindness correlated positively with both compassion satisfaction and psychological wellbeing, and self-coldness correlated negatively with compassion satisfaction and psychological wellbeing. In hierarchical multiple regression analyses, compassion fatigue was significantly predicted by greater self-coldness and years of experience; compassion satisfaction was predicted by greater emotional intelligence and fewer years of experience; and psychological wellbeing was predicted by greater emotional intelligence and lower self-coldness.

Conclusions - The findings indicated that emotional intelligence and self-coldness can predict aspects of professional and psychological wellbeing in ambulance staff. Self-kindness does not predict wellbeing in models with age, years of experience, emotional intelligence, and self-coldness. This suggests that enhancing emotional intelligence and reducing self-coldness could be targets in interventions to support ambulance staff wellbeing.

INTRODUCTION

Emergency ambulance work has been described as "inherently intense" (Granter et al., 2019), with regular exposure to traumatic events such as others' distress, death and treating acute illness (Davis et al., 2019; Lawn et al., 2020), and occupational stressors including workplace violence (Setlack, 2019), perceived high

expectations from the public (Nelson et al., 2020; Wankhade, 2016), and perceived lack of respect from other services (Beldon et al., 2022; Nelson et al., 2020). A wider healthcare context is also important; for example in the UK, pressures are heightened by increased demands on services, lack of funding, and staff shortages (NHS Providers, 2019), which can lead to longer hours, concern about the impact of demands on patients, high workload, and few breaks (Beldon et al., 2022; Clompus & Albarran, 2016; Wankhade, 2016).

These factors have a cumulative negative impact on wellbeing. Ambulance staff report higher rates of depression, anxiety, post-traumatic stress disorder (PTSD), and distress (Bennett et al., 2005; Davis et al., 2019) than the general population (Petrie et al., 2018; Wagner et al., 2020) and other emergency service personnel (Berger et al., 2012), while male UK paramedics (the senior ambulance staff) are 75% more likely to complete suicide than other health care workers (Office for National Statistics, 2017). They also experience high rates of burnout - a response to chronic occupational stress characterized by emotional exhaustion, feelings of disconnection or cynicism regarding work, and lack of occupational efficacy (Maslach et al., 2001); and compassion fatigue (CF; Beldon et al., 2022; Dehghannezhad et al., 2020; Koohsari et al., 2022; Zaidi et al., 2017) Ð the negative emotional effects of caring for distressed individuals, such as low mood, trauma responses and feeling overwhelmed (Figley, 1995; Sorenson et al., 2016). This reflects the increased risk of negative wellbeing outcomes for ambulance staff.

Ambulance staff wellbeing has implications for ambulance service organizations. Poorer ambulance staff wellbeing is associated with lower job satisfaction and greater turnover intention (Wankhade, 2016) and can lead to increased sickness absence, with ambulance staff consistently having the highest sickness absence rates of any professional group in the UK National Health Service (NHS; NHS Digital, 2022a). This is costly to services and can increase pressure on other staff members.

Despite exposure to highly stressful experiences and increased risk of negative wellbeing outcomes, research into ambulance staff wellbeing is lacking (Clark et al., 2021; Wagner et al., 2020). Research exploring potential psychological mechanisms involved in ambulance staff wellbeing could thus facilitate strategies to protect and improve their wellbeing.

Emotional intelligence (EI) is one factor associated with wellbeing in other populations. EI is a broad intelligence incorporating the ability to perceive, understand, and reason about emotions, manage ones' own and others' emotions, and use emotions to facilitate thought (Mayer & Salovey, 1997). Greater EI is related to better wellbeing in healthcare workers, predicting lower depression, stress, and anxiety (Landa et al., 2008; Ng et al., 2014), greater life satisfaction, psychological wellbeing, self-esteem, and self-efficacy (Montes-Berges & Augusto-Landa, 2014; Pérez-Fuentes et al., 2019) and associated with lower burnout (Görgens-Ekermans & Brand, 2012; Markiewicz, 2019; Unal, 2014; Weng et al., 2011; Zeidner et al., 2013) and greater compassion satisfaction (CS) - the positive feelings experienced due to helping others (Zeidner & Hadar, 2014).

The few EI studies, including ambulance staff suggest a positive relationship between EI and wellbeing. Greater EI was related to lower emotional exhaustion and greater job satisfaction in 207 EMTs (Nauman et al., 2019), fewer PTSD symptoms in 55 EMTs and firefighters (Rinker, 2016), and better sleep quality and lower fatigue in 400 healthcare

students, including paramedicine students (Abdali et al., 2019). Further, 100 paramedicine students reported improved stress management skills following an EI intervention (Sellakumar, 2017), suggesting that EI could improve wellbeing. However, as studies have often been on paramedic students or mixed professional groups, further research is needed to clarify this relationship in ambulance staff.

Self-compassion is another factor that is positively associated with wellbeing. Neff (2003a) defined self-compassion as a way of relating to oneself when experiencing suffering, from uncompassionate "self-coldness" to compassionate "self-kindness" (Neff, 2022). This includes three aspects: self-kindness - approaching oneself with understanding and comfort, versus self-judgment; common humanity - viewing one's suffering as part of the human condition versus feeling isolated; and mindfulness - accepting experiences versus over-identifying with them. Greater self-compassion was associated with lower burnout and CF and greater CS in healthcare workers (Buceta et al., 2019; Duarte & Pinto-Gouveia, 2017; Duarte et al., 2016; Hashem & Zeinoun, 2020) and predicted lower burnout and stress in 1700 doctors, nurses, and medical residents (Dev et al., 2020). Intervention studies have found that increases in self-compassion predicted decreases in burnout, mental health symptoms, and stress (Delaney, 2018; Duarte & Pinto-Gouveia, 2017; Neff et al., 2020) and increases in life satisfaction (Duarte & Pinto-Gouveia, 2017) among healthcare workers. Thus, self-compassion may protect health care workers' wellbeing.

There need to be more research on self-compassion and wellbeing in ambulance staff. Two studies found greater self-compassion was related to greater psychological wellbeing and lower PTSD, mental health symptoms, and burnout in ambulance staff (Davis, 2017; Setlack, 2019). Research on related concepts found that self-acceptance (the tendency not to be self-critical) predicted increased resilience (Bilsker et al., 2019), and fewer stress-related symptoms, while greater self-criticism was related to greater stress, mental and physical health symptoms, and lower job satisfaction (Rojas et al., 2022). This indicates that a compassionate, rather than self-critical, approach to oneself may be related to better wellbeing in ambulance staff. However, Mitmansgruber et al. (2008) unexpectedly found that greater contempt and "tough control" regarding one's emotions predicted better psychological wellbeing in paramedics, suggesting that self-compassion was unrelated to better wellbeing. While Mitmansgruber et al. (2008) measured meta-emotions (emotional reactions to one's emotions, such as anger about feeling anxious) rather than self-compassion, this suggests that self-compassion may have a different relationship with wellbeing in ambulance staff than other healthcare workers.

While current research suggests that EI and self-compassion may relate to better wellbeing in ambulance staff, the lack of research solely on ambulance staff and mixed evidence regarding self-compassion limits the conclusions that can be drawn. This study, therefore, aims to explore the relationships between EI, the self-coldness and self-kindness aspects of self-compassion, and wellbeing outcomes in ambulance staff. Wellbeing outcomes will include professional quality of life (CF and CS). As wellbeing includes positive aspects, rather than just the absence of difficulties (Seligman, 2018), psychological wellbeing will also be explored as a positive outcome.

It is hypothesized that:

- H1: Greater EI will be associated with greater perceived psychological wellbeing and CS and lower CF.
- H2: Greater self-kindness will be associated with greater perceived psychological wellbeing and CS and lower CF.
- H3: Greater self-coldness will be associated with lower perceived psychological wellbeing and CS and higher CF.
- H4: When combined in one model, EI, self-kindness, and self-coldness will contribute unique variance to predicting psychological wellbeing, CS, and CF.

METHODS

Participants

The inclusion criteria were that the participants:

- Were staff members who worked on NHS emergency ambulances.
- Had patient contact in their role.
- Were working-age adults, aged 18 and over.

A sample size of at least 92 to 98 was sought, based on a regression model including five to six predictor variables, with a medium effect size, power of 0.8, and alpha level of $p = .05$. A medium effect size (0.15) was chosen as previous research on the relationships between wellbeing and both EI (de Looff et al., 2019; Gong et al., 2020) and self-compassion (Buceta et al., 2019; Dev et al., 2020) in health care workers has found medium effect sizes. The final sample size of 146 met this criterion.

Study Design

This quantitative study used a within-participants, cross-sectional design to explore relationships between EI, self-compassion, and wellbeing in ambulance staff. Data were collected via a one-off anonymous online survey and analyzed using Pearson's r correlational analyses and hierarchical multiple regressions. Research paramedics and ambulance staff were consulted on the study design and participant documents and piloted the questionnaires to check their acceptability, ease, and time for completion.

Materials

Participants provided demographic information, including gender, ethnicity, age, job role, and years of experience working on emergency ambulances.

Self-Report Emotional Intelligence Test (SREIT)

EI ability was measured using the SREIT (Schutte et al., 1998). This 33-item measure scores responses from 1 (Strongly disagree) to 5 (Strongly agree). Higher scores indicate higher EI. The SREIT has good internal reliability in healthcare workers ($\alpha = .84$ to .92; Ng et al., 2014; Zeidner & Hadar, 2014). Scores of 33-110 can be categorized as "unusually low" EI, 111-137 as "average," and 138-165 as "unusually high" (Schutte et al., 1998). A pro-

posed four-factor structure was not supported in prior research (Brackett & Mayer, 2003; Craparo et al., 2014; Musonda et al., 2020); therefore, total EI score was used.

Self-Compassion Scale (SCS)

Self-compassion was measured using the SCS (Neff, 2003b). This 26-item questionnaire scores responses from 1 (Almost never) to 5 (Almost always). A two-factor structure was used, as recommended by previous research (Brenner et al., 2017; Brenner et al., 2018; Costa et al., 2016; López et al., 2015); "self-kindness" incorporates the compassionate subscales of self-kindness, mindfulness, and common humanity; "self-coldness", combines the uncompassionate subscales of self-judgement, over-identification, and isolation. Higher scores indicate higher self-coldness or self-kindness. Average scores of 1-2.49 indicate low levels, 2.5-3.49 moderate levels, and 3.5-5.0 high levels (Neff, 2003a).

The SCS has good reliability and validity with healthcare workers (Buceta et al., 2019). Good internal reliability was found for self-kindness (α = .86 to .91) and self-coldness (α = .89 to .94) factors (Brenner et al., 2017; Costa et al., 2016; López et al., 2015).

Professional Quality of Life Scale (ProQOL)

The ProQOL-21 measures CF and CS (Heritage et al., 2018). This is an alternative method of scoring the 30-item ProQOL-5 to address construct validity issues (Stamm, 2010) to give two scores: CS, measured with ten items, and CF, using eleven items. Responses are scored from 1 (Never) to 5 (Very often). Higher scores indicate higher CS and CF. The ProQOL-5 has been used extensively with people in helping professions, and the ProQOL-21 scales have good internal reliability (α = .90 for CF, α = .92 for CS; Heritage et al., 2018). Recommended cut-off scores are 21 and 30 for low and high CS and 16 and 25 for low and high CF (Stamm, 2010).

Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS)

The WEMWBS (Tennant et al., 2007) is a 14-item scale of subjective psychological wellbeing. Responses are scored from 1 (None of the time) to 5 (All of the time), to provide an overall score. Higher scores indicate greater psychological wellbeing. The WEMWBS has good internal reliability with healthcare workers (α = .93; Oates et al., 2017).

Procedure

Two NHS ambulance services and the College of Paramedics advertised the study through internal staff communications. Participants could also share the survey link with colleagues and on social media. Recruitment occurred between 22nd April and 30th September 2022. Participants accessed the online survey on the Qualtrics website via the link. The survey began with the participant information sheet, which provided details about the study and the use of their data. This included a consent statement to confirm that participants fully understood the information, consented for their data to be used in the research, and met the inclusion criteria. They were then presented with the survey questionnaires, and finally, a debrief sheet. The survey was estimated to take 20-30 minutes to complete.

Ethical Approval

The Lancaster University Faculty of Health and Medicine Research Ethics Committee granted ethical approval (FHMREC21002). Research governance approval was obtained through the UK Health Research Authority (HRA) Integrated Research Application System (Project ID: 303396). Research and development approval was obtained from participating NHS Trusts.

Data Analysis

Data analysis was completed using SPSS version 27. Chi-squared goodness-of-fit tests and an independent samples t-test analysed differences in the demographics and SREIT of those who completed the full survey and those who did not. Descriptive statistics for demographics and study variables were explored. Cronbach's alphas for study variables were calculated to assess internal consistency.

For correlation analyses, data were checked for outliers and normality of distribution by visually inspecting histograms and Q-Q plots and examining skew and kurtosis. These were within acceptable parameters thus Pearson's r correlational analyses were used. Sensitivity analyses excluded one participant with an outlying SREIT score, but this did not significantly affect the results, so they were included in the analyses.

Three hierarchical multiple regressions explored relationships between predictor variables and three outcome variables: CF, CS, and psychological wellbeing. Data were checked and met assumptions, including independence of residuals, no evidence of multicollinearity, homoscedasticity, and normally distributed residuals. Following previous research, demographic variables significantly correlating with at least one outcome variable were entered in the first block. As prior research suggests a stronger role for EI than self-compassion in ambulance staff wellbeing, EI was entered in the next block, with self-compassion variables entered last. Self-kindness and self-coldness were entered separately to explore the predictive value of each.

	N	%
Gender		
Male	54	37.0
Female	91	62.3
Non-binary	1	0.7
Age		
18-24 years	18	12.3
25-34 years	54	37.0
35-44 years	30	20.5
45-54 years	32	21.9
55-64 years	11	7.5
Over 65 years	1	0.7
Ethnicity		
White British	137	93.8
Any other white background	5	3.4
Multiple ethnic backgrounds	3	2.1
Asian	1	0.7
Job Role		
Paramedic (including specialist paramedics)	82	56.2
Emergency Medical Technician	32	21.9
Student paramedic	3	2.1
Ambulance support staff	25	17.1
Call handler	4	2.7
Years of experience as ambulance staff		
0-1	11	7.5
2-5	60	41.1
6-10	35	24.0
11-15	17	11.6
16-20	7	4.8
21-25	7	4.8
26-30	5	3.4
30+	4	2.7

Table 1. Participant Demographic Characteristics.

RESULTS

One hundred sixty-nine participants consented to participate and began the survey. One hundred forty-six surveys were completed in full, while 11 participants completed demographics questions only, and a further 12 completed demographics questions and SREIT. There were no statistically significant differences between those who completed the survey and those who did not on demographic variables ($p > .05$) or EI scores ($t(156) = -1.140$, $p = .256$). Therefore, only the data of the 146 survey participants were included in further analyses.

Sample Characteristics

The sample demographic characteristics are presented in Table 1.

Descriptive Statistics

Descriptive statistics and Cronbach's α coefficients are provided in Table 2. All measures demonstrated high internal consistency, with Cronbach's α over 0.8.

	M(SD)	α	1.	2.	3.	4.	5.	6.	7.	8.
1. Age		-	-	.595**	.117	.291**	-.418**	.132	-.090	.202*
2. Years of experience		-		-	.004	.045	-.155	-.091	.169*	-.039
3. EI		11.623 (13.86)	.89		-	.618**	-.459**	.540**	-.224**	.526**
4. Self-kindness		33.64 (11.06)	.93			-	-.698**	.414**	-.251**	.607**
5. Self-coldness		42.65 (12.10)	.93				-	-.378**	.368**	-.654**
6. CS		36.75 (7.53)	.93					-	-.510**	.628**
7. CF	29.18 (9.42)	.91							-	-.594**
8. Psychological wellbeing	43.05 (10.00)	.94								-
Note. EI = emotional intelligence; CS = compassion satisfaction; CF = compassion fatigue. * p <.05, ** p<.01										

Table 2. Descriptive Statistics, Cronbach's Alphas and Correlation Coefficients for Study Variables.

The mean EI score was at the lower end of "average" EI (Schutte et al., 1998), slightly lower than studies with other healthcare workers (Kaur et al., 2015; Zeidner & Hadar, 2014) and first responders (Markert-Green, 2021; Romosiou et al., 2019; Wagner et al., 2016), though similar to police officers in Malaysia (Kamri et al., 2019).

The mean self-kindness score was at the low end of "moderate" self-kindness, slightly lower than studies with EMTs (Davis, 2017), firefighters (Kaurin et al., 2018), and police (Çetin et al., 2008). The mean self-coldness score indicates "high" self-coldness (Neff, 2003a), similar to scores reported by EMTs (Davis, 2017), but higher than firefighters (Kaurin et al., 2018) and other health care workers (Buceta et al., 2019; Hashem & Zeinoun, 2020).

The ProQOL scores indicate high CS and CF. CS and CF scores vary in the literature, with the current mean CS similar to ambulance staff and first responders in some studies (Dehghannezhad et al., 2020; Zaidi et al., 2017) but higher CF than ambulance staff in other studies (Crampton, 2014; Dehghannezhad et al., 2020; Ondrejková & Halamová,

2022). In some previous research, the mean WEMWBS score was similar to ambulance staff and first responders (Davis, 2017; Jackman et al., 2020; Keech et al., 2020).

Correlational Analyses

Pearson's r correlations between variables are shown in Table 2. All psychological variables were significantly correlated in the expected directions. CF had small negative correlations with EI (r = -.224, p <.01) and self-kindness (r = -.251, p <.01), a moderate positive correlation with self-coldness (r = .368, p <.01), a small positive correlation with years of experience (r = .169, p <.05), and did not correlate significantly with age. CS had a strong positive correlation with EI (r = .540, p <.01), a moderate positive correlation with self-kindness (r = .414, p <.01), a moderate negative correlation with self-coldness (r = -.378, p <.01), and did not significantly correlate with age or years of experience. Psychological wellbeing had strong positive correlations with EI (r = .526, p <.01) and self-kindness (r = .607, p <.01), a strong negative correlation with self-coldness (r = -.654, p <.01), a small positive correlation with age (r = .202, p <.05), and did not correlate significantly with years of experience.

Hierarchical Multiple Regression Analyses

Three hierarchical multiple regressions examined the variance in CF, CS, and psychological wellbeing explained by predictor variables. Independent samples t-tests found no significant differences between males and females on the outcome variables (p >.05); therefore, gender was not included. As age and years of experience significantly correlated with at least one outcome variable, they were included in all models for consistency. Predictor variables were entered in three blocks: (a) demographic variables (age, years of experience); (b) EI score; (c) self-compassion scores (self-kindness, self-coldness).

Compassion Fatigue

The overall model was significant (F (5, 140) = 7.011, p < .001), explaining 17.2% of the variance in CF scores (R2 = .200, adjusted R2 = .172). In the final model, self-coldness (β = .392, p = .001) and years of experience (β = .295, p = .002) positively predicted CF. Age (β = -.118, p = .254), EI (β = -.094, p = .331) and self-kindness were not significant predictors (β = .102, p = .339). The results are summarised in Table 3.

	B	SE	Beta	t	p	R^2	Adj R^2	R^2 Change	F Change
Step 1						.083	.071	.083	6.502**
Age	-2.304	.788	-.290	-2.924	.004				
Years of experience	1.948	.568	.340	3.428	.001				
Step 2						.121	.102	.037	6.035*
Age	-2.032	.782	-.255	-2.597	.010				
Years of experience	1.837	.560	.320	3.278	.001				
EI	-.133	.054	-.195	-2.457	.015				
Step 3						.200	.172	.080	6.962**
Age	-.940	.821	-.118	-1.145	.254				
Years of experience	1.693	.544	2.95	3.111	.002				
EI	-.064	.066	-.094	-.975	.331				
Self-kindness	.087	.102	.102	.846	.339				
Self-coldness	.305	.087	.392	3.515	.001				
Note. EI = emotional intelligence * p <.05, ** p<.01									

Table 3. Results of Hierarchical Multiple Regression for Compassion Fatigue.

Compassion Satisfaction

The overall model was significant (F (5, 140) = 14.248, p < .001), explaining 31.4% of the variance in CS scores (R2 = .337, adjusted R2 = .314). In the final model, greater EI (β = .460, p < .001) and fewer years of experience (β = -.193, p = .027) significantly predicted higher CS. Age (β = .133, p = .161), self-kindness (β = .003, p = .979) and self-coldness (β = -.140, p = .171) did not predict CS. The results are summarised in Table 4.

	B	SE	Beta	t	p	R^2	Adj R^2	R^2 Change	F Change
Step 1						.061	.048	.061	4.650*
Age	1.807	.637	.284	2.835	.005				
Years of experience	-1.185	.460	-.259	-2.579	.011				
Step 2						.324	.310	.263	55.320**
Age	1.228	.548	.193	2.241	.027				
Years of experience	-.950	.393	-.207	-2.419	.017				
EI	.282	.038	.518	7.438	<.001				
Step 3						.337	.314	.013	1.367
Age	.842	.597	.133	1.410	.161				
Years of experience	-.884	.396	-.193	-2.234	.027				
EI	.250	.048	.460	5.215	<.001				
Self-kindness	.002	.075	.003	.026	.979				
Self-coldness	-.087	.063	-.140	-1.377	.171				
Note. EI = emotional intelligence * p <.05, ** p<.01									

Table 4. Results of Hierarchical Multiple Regression for Compassion Satisfaction.

Psychological Wellbeing

The model was significant (F (5, 140) = 29.996, p < .001), explaining 50.0% of the variance in psychological wellbeing (R2 = .517, adjusted R2 = .500). In the final model, greater EI (β = .219, p = .004) and lower self-coldness (β = -.462, p < .001) predicted greater psychological wellbeing. Age (β = .014, p = .886), years of experience (β = -.127, p = .088) and self-kindness (β = .151, p = .109) were not significant predictors. The results are summarised in Table 5.

	B	SE	Beta	t	p	R^2	Adj R^2	R^2 Change	F Change
Step 1						.079	.066	.079	6.135**
Age	2.907	.838	.344	3.469	.001				
Years of experience	-1.474	.604	-.242	-2.439	.016				
Step 2						.320	.306	.241	50.418**
Age	2.172	.730	.257	2.976	.003				
Years of experience	-1.174	.523	-.193	-2.246	.026				
EI	.358	.050	.496	7.101	<.001				
Step 3						.517	.500	.197	28.544**
Age	.115	.677	.014	.170	.866				
Years of experience	-.771	.449	-.127	-1.719	.088				
EI	.158	.054	.219	2.916	.004				
Self-kindness	.136	.084	.151	1.614	.109				
Self-coldness	-.382	.072	-.462	-5.336	<.001				
Note. EI = emotional intelligence * p <.05, ** p<.01									

Table 5. Results of Hierarchical Multiple Regression for Psychological Wellbeing.

DISCUSSION

The study aimed to explore the relationships between EI and self-compassion and the professional quality of life and psychological wellbeing of ambulance staff. The hypotheses that greater EI and self-kindness and lower self-coldness would be associated with greater psychological wellbeing and CS and lower CF were supported, with all variables significantly correlated in the expected directions. The hypothesis that EI, self-kindness, and self-coldness would each significantly independently predict psychological wellbeing, CS, and CF was not fully supported. Each regression model was significant, but for CF, only years of experience and self-coldness were significant predictors; for CS, only years of experience and EI were significant predictors; and for psychological wellbeing only EI and self-coldness were significant predictors. This suggests that EI, self-kindness, and self-coldness have differential importance to the ambulance staff's professional and psychological wellbeing.

High CF was indicated in the sample. This may be due to data collection occurring during the COVID-19 pandemic, as healthcare workers reported increased CF during this time (Lluch et al., 2022), and years of experience and self-coldness positively predicted CF, with self-coldness as the best predictor. This supports previous research, which found that self-coldness predicted CF in palliative care staff (Galiana et al., 2022), aspects of self-coldness predicted CF in healthcare workers (Yu et al., 2021), and that self-criticism predicted CF while total self-compassion did not in people in helping professions (Ondrejková & Halamová, 2022). Self-coldness may predict greater CF as it amplifies pain and distress when faced with others' suffering (Neff, 2003a), overwhelming the individual's ability to cope with distress over time (Coetzee & Klopper, 2010).

In this study, while EI negatively correlated with CF, it did not significantly predict CF in a model with self-coldness. Maillet & Read (2021) found that only the perception and utilization of emotional aspects of EI predicted lower CF in healthcare workers. Zeidner et al. (2013) found that EI and emotion management skills together only predicted 8% of the variance in health care workers' CF. Thus, EI may have a small effect on CF, but self-coldness may be more relevant when both are included in a model.

The final model only accounted for 17.2% of the variance in CF, suggesting that important predictors were omitted. Workplace factors, including long hours, violence, traumatic events, high workload, and lack of support and autonomy (Dehghannezhad et al., 2020; Ericsson et al., 2021; Lluch et al., 2022; Maillet & Read, 2021; Turgoose & Maddox, 2017; Yu et al., 2021), and psychological factors including negative affect, psychological inflexibility, and PTSD symptoms (Duarte & Pinto-Gouveia, 2017; Koohsari et al., 2022; Turgoose & Maddox, 2017; Yu et al., 2021; Zeidner et al., 2013) are related to greater CF in health care workers and ambulance staff. Therefore, including a broader range of occupational and psychological variables in future research.

EI predicted by CS, indicating that staff with greater EI tend to be more satisfied with their caring role. This supports studies that found greater EI to be related to CS in healthcare workers (Maillet & Read, 2021; Zeidner & Hadar, 2014) and is consistent with the theory that EI allows for more effective emotion regulation, leading to positive mental health outcomes (Mayer & Salovey, 1997). Neither self-kindness nor self-coldness predicted CS. Previous research with healthcare workers found self-coldness to make a very

small contribution (Buceta et al., 2019) or not predict CS (Yu et al., 2021), when accounting for variables such as sense of vocation (Buceta et al., 2019), empathy, and work engagement (Yu et al., 2021). This suggests self-coldness may not affect CS as much as empathy for others and job satisfaction. This may be because CS can be achieved by focusing on others and alleviating patient suffering (Stamm, 2010); thus, it may be less influenced by staff members' approach towards themselves (Yu et al., 2021).

EI predicted psychological wellbeing, consistent with previous research in health care workers (Noshili et al., 2022) and supporting theoretical understandings that EI benefits overall wellbeing (Bar-On et al., 2012; Mayer & Salovey, 1997). Self-coldness negatively predicted psychological wellbeing, aligned with literature which found self-coldness to be inversely related to positive wellbeing outcomes, including life satisfaction, positive affect, optimism, self-esteem, self-acceptance, and self-efficacy (Baer et al., 2012; Brenner et al., 2018; Neff et al., 2018). This suggests that approaching one's experiences with coldness can exacerbate the negative effects of unpleasant experiences, leading to difficulty accepting and regulating emotions, thus to poorer wellbeing (Neff, 2003a).

Surprising, despite significant correlations, self-kindness did not predict CF, CS, or psychological wellbeing in the models with EI and self-coldness. This may reflect the nature of ambulance work. Mitmansgruber et al. (2008) found that "tough control" and contempt for emotions predicted greater psychological wellbeing in paramedics, while compassion for emotions predicted lower wellbeing. It was suggested that "tough control" supports short-term wellbeing by allowing staff to put their feelings aside and help distressed others, whereas compassionately engaging in the moment could reduce wellbeing. However, the long-term effects of this are unclear and the study did not include CF or CS. Further, much of the research on self-compassion and wellbeing (Duarte & Pinto-Gouveia, 2017; MacBeth & Gumley, 2012; Ondrejková & Halamová, 2022; Upton, 2018; Zessin et al., 2015) only used total self-compassion scores and thus cannot determine the relative contribution of self-kindness and self-coldness (Muris & Otgaar, 2020). Research that has separated these aspects found that self-coldness has a stronger relationship with negative wellbeing outcomes than self-kindness (Brenner et al., 2018; López et al., 2015; Muris & Petrocchi, 2017; Neff et al., 2018), and that self-kindness and self-coldness are often similarly predictive of positive wellbeing outcomes (Brenner et al., 2018; López et al., 2015; Neff et al., 2018). This indicates that vulnerability to negative wellbeing outcomes arising from the tendency towards self-coldness may be more important in predicting wellbeing than a protective effect of self-kindness and may explain why self-kindness did not predict wellbeing in this study.

Clinical Implications

The findings have potential implications for ambulance services in supporting staff wellbeing. Self-coldness may be promoted by a "blame culture" reported in ambulance services (Granter et al., 2019). A more compassionate culture may support staff wellbeing by reducing self-judgement engendered by a perceived lack of compassion from management (Beldon et al., 2022; NHS England, 2022), and isolation stemming from a perceived discouragement from expressing emotions or seeking support (Mind, 2019; Nelson et al., 2020), thus decreasing self-coldness. Compassionate leadership is related to better ambulance staff wellbeing and better patient outcomes (Eaton-Williams & Williams, 2022; Kline, 2019; Petrie et al., 2018; West et al., 2017). Individual leaders and services could

contribute by, for example, creating space for staff to share in decision-making, listening with curiosity to their difficulties (Kline, 2019), and taking a non-judgemental approach to staff engagement (Eaton-Williams & Williams, 2022; Lawn et al., 2020).

Further, services may promote wellbeing by facilitating increased EI. Ambulance staff report that lack of support or reflection time following potentially traumatic calls increased distress and a tendency to suppress emotions (Beldon et al., 2022; Lawn et al., 2020; Nelson et al., 2020). Therefore, the provision of reflective spaces post-incident and ensuring teams have space to reflect together on the impact of the work (West et al., 2017) may allow staff to gain insight and awareness into their emotions.

Self-kindness did not predict wellbeing. Thus, interventions just focusing on increasing self-kindness may not be as relevant to ambulance staff wellbeing. There is inconsistent access to psychological support (Billings et al., 2021), despite staff's expressed desire for such support (Beldon et al., 2022; Lawn et al., 2020). Therefore, interventions and coping strategies that focus on the particular needs of ambulance staff could be developed. Support could involve strategies to enhance EI, for example, training on responding to others' distress (Nelson et al., 2020) and recognizing and managing one's own distress (Lawn et al., 2020). It could also involve reducing self-coldness, for example, reducing stigma around help-seeking (Lawn et al., 2020) and reducing isolation by enabling the sharing of experiences (Clompus & Albarran, 2016). Further research could then explore the effects of these service changes and interventions on ambulance staff wellbeing.

Limitations and Future Research

First are limitations regarding the sample. Only actively employed staff who may experience better wellbeing than those on sick leave or who have left the profession were included, which may bias the results. In the sample, people under 35 were over-represented compared to the UK ambulance staff population (NHS Digital, 2022b). As age affected some variables, the higher proportion of younger people could mean the results are not generalised to other UK ambulance populations. Further, data collection occurred during a pandemic, which may have negatively influenced staff perceptions of their wellbeing due to increased stressors. Therefore, it may be beneficial to replicate the study to explore whether these relationships are consistent over time and to compare findings with staff who have retired, left the profession, or are on long-term sick leave. More purposive sampling may also ensure that the sample is representative of the ambulance staff population.

Second, data were self-reported and collected anonymously. Thus, it was impossible to calculate how many people chose not to participate or explore reasons for non-completion. Self-report measures could introduce bias if individuals have little awareness of their EI and self-compassion or are unable to disclose lower wellbeing due to stigma (Nelson et al., 2020). The anonymous design was utilized to ameliorate the latter problem. Additionally, as the study was cross-sectional, causation cannot be determined. For example, rather than EI and self-compassion leading to better wellbeing, ambulance staff with greater wellbeing may be more able to recognize and manage their emotions and approach their experiences compassionately. Thus, longitudinal research exploring the relationships between EI, self-compassion, and wellbeing would help clarify these relationships' directions.

Finally, the number of variables was limited to reduce participant burden. However, the small variance explained by the CF regression model suggests that important factors were not included. Future research could include a broader range of factors hypothesized to be important in ambulance staff wellbeing, such as occupational stressors and traumatic experiences (Dehghannezhad et al., 2020; Renkiewicz et al., 2021).

A further avenue for research may be the relationship between EI and self-compassion in ambulance staff and other healthcare workers. Neff (2003a) proposed that self-compassion should be positively related to EI, as both involve observeing one's emotions and using this to effectively inform thoughts and behaviours. One study found a positive relationship between EI and self-compassion in nurses (Senyuva et al., 2014). Further research may help determine the effects of on staff wellbeing.

CONCLUSION

This study examined the relationships between EI, self-compassion, and wellbeing in ambulance staff and found that greater EI and self-kindness, and lower self-coldness, are related to better professional quality of life and psychological wellbeing. Hierarchical multiple regressions found that CF was predicted by greater self-coldness and years of experience, CS was predicted by greater EI and fewer years of experience, and greater EI and lower self-coldness predicted psychological wellbeing. Despite limitations, this study is the first to consider both EI and self-compassion concerning the professional and psychological wellbeing of ambulance staff. It highlights the positive relationship EI and aspects of self-compassion have with wellbeing. This may have implications for the leadership of ambulance services and interventions developed to support staff wellbeing. Further research would be beneficial in determining the longitudinal relationships between these variables, their relationships in ambulance staff not in active employment, and other occupational and psychological variables that may influence ambulance staff wellbeing.

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RESEARCH REPORT

FACTORS ASSOCIATED WITH CAREGIVER DECISION NOT TO TRANSPORT PEDIATRIC PATIENTS ASSESSED BY EMERGENCY MEDICAL SERVICES

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ABSTRACT

Objectives: Almost one third of pediatric 9-1-1 calls result in non-transport by Emergency Medical Services (EMS). It is unknown to what extent these decisions are driven by caregivers' decisions to decline transport versus EMS advice that transport is unnecessary. Further, it is unknown whether demographic, economic, encounter, or agency factors are associated with caregivers declining transport.

Methods: We conducted a retrospective cross-sectional study with data from the national 2019 ESO Data Collaborative. We included 9-1-1 responses for children <18 years. The primary outcome was caregiver decision not to transport patient (per EMS documentation) compared to EMS-initiated non-transport. Bivariable and multivariable logistic regression identified factors associated with caregiver decision not to transport.

Results: Of 313,903 pediatric 9-1-1 activations, 37.2% resulted in non-transport, with 80.0% of pediatric non-transports attributable to caregiver decision. Specific reasons for caregiver refusal included plans to seek care by private vehicle and not feeling the injury/illness required emergent transport. The patient and encounter characteristics for children not transported by EMS were similar, regardless of whether the caregiver or EMS clinician made the decision not to transport. There was wide inter-agency variation in both the rate of non-transport per EMS agency (median 0.37, interquartile range (IQR) 0.25-0.48) and the proportion of these encounters attributable to a caregiver decision (median 0.82, IQR 0.68-0.94).

Conclusions: In this large national dataset, pediatric non-transport by EMS was common, and in most cases was attributed to caregiver decision in documentation. The proportion of non-transport and caregiver decision varied significantly between EMS agencies. Further research is needed to understand pediatric patient outcomes after non-transport and to identify why the proportion of encounters resulting in caregiver refusal per EMS agency varies so widely. Developing standardized, evidence-based non-transport protocols for children may help reduce this potentially unwarranted clinical variation.

BACKGROUND

In 2021, there were 2.4 million pediatric 9-1-1 activations in the United States (US) (NEMSIS-End-of-Year-Report-2021.pdf n.d.). Almost one-third of these pediatric Emergency Medical Services

(EMS) encounters resulted in non-transport (Gerlacher, Sirbaugh, & Macias 2001; Kannikeswaran et al. 2007; Ramgopal, Owusu-Ansah, & Martin-Gill 2018; C. Ward et al. 2022). In some cases, EMS clinicians advise that transport to a healthcare facility is not indicated, also known as EMS-initiated non-transport (Jaslow et al. 1998; Knapp et al. 2009; Millin, Brown, & Schwartz 2011a). In others, caregivers may decline transport, in some cases against the medical advice of EMS clinicians (Seltzer et al. 2001).

Developing and disseminating alternative EMS disposition programs, including EMS-initiated non-transport for low-acuity patients, is a national priority (Munjal & Carr 2013). Almost one-third of children transported to the hospital by EMS have no urgent or emergent medical needs (C. E. Ward et al. 2023). This use of the EMS system for non-emergent complaints can be inefficient and unsafe, leading to delays in care for other patients with more acute needs (Alpert et al. 2013; Mell et al. 2017). Several initiatives have attempted to address this issue. The Emergency Triage, Treat, and Transport (ET3) program was a voluntary, five-year payment model funded by the Centers for Medicare and Medicaid Services (CMS) to try and realign these incentives (Goldman et al. 2020). The results of this program have not yet been shared publicly, though the program was ended two years ahead of schedule with CMS noting that the number of interventions was lower than expected (Centers for Medicare and Medicaid, 2021). Some EMS agencies have recently implemented protocols allowing EMS-initiated non-transport of children. While initial results appear promising, these protocols have not been widely disseminated or tested for safety (Coster et al. 2019; Oulasvirta et al. 2019a; Yeung et al. 2019).

Despite the significant rate of pediatric non-transport, little is known about what proportion of pediatric non-transport is currently due solely to caregiver decision to decline transport, EMS recommendation that transport is unnecessary, established protocols, or shared decision-making between EMS and caregiver. It is unknown how pediatric non-transport practices vary between EMS agencies. Furthermore, no pediatric studies have investigated demographic or clinical factors associated with caregiver decision to decline transport. The primary objective of this study was to determine the prevalence of and factors associated with caregiver decision to decline transport for children assessed by EMS. The secondary objective was to determine the variability of the per-EMS agency proportions of non-transport and caregiver refusals.

METHODS

Study Design and Data Source

We performed a retrospective study using the ESO Data Collaborative (Austin, TX) public release dataset for 2019 (C. Ward et al. 2022). ESO is an encounter-based EMS electronic health record that uses the National EMS Information System (NEMSIS) data standards (Kannikeswaran et al. 2007). Each record includes patient demographic information, agency-specific details, and information about clinical care, transportation, and disposition. The ESO Data Collaborative consists of EMS agencies that use the ESO software and have voluntarily agreed to share de-identified patient care records for research purposes. The 2019 data set includes data from 8,340,148 EMS encounters from 2,000 participating EMS agencies. The Institutional Review Board at Children's National Hospital approved this study.

Study Population

The study included all ESO records from January 1, 2019 to December 31, 2019, for patients aged 0 - 17 years with a 9-1-1 EMS scene response, and a final patient disposition of non-transport. The study excluded ESO records for interfacility medical transports, community assistance calls, calls that did not result in any patient contact, encounters where the patient was deceased upon arrival, and activations for a patient in police custody.

Primary Outcome

Consistent with previous studies, to identify non-transported patients, we utilized the EMS clinician documentation for "disposition" (NEMSIS v3.4 element eDisposition.12) coded as a dichotomous variable of "transport" versus "non-transport" (Gerlacher, Sirbaugh, & Macias 2001; Ramgopal, Owusu-Ansah, & Martin-Gill 2018). Disposition values for non-transported patients included: 1) No treatment, no transport; 2) Patient evaluated, no treatment/transport required; 3) Patient refused evaluation/care (without transport); 4) Patient treated, released (AMA); 5) Patient treated, released (per protocol); and 6) Treatment, no transport. For pediatric patients, #3 and #4 refer to the caregiver decision to refuse treatment.

The primary outcome was the entity who made the decision not to transport a child. We coded this as a dichotomous variable with values of "Caregiver Decision" versus "EMS Decision." This outcome variable was classified based on the EMS clinician response to "Disposition" (NEMSIS v3.4 element eDisposition.12) and the recorded "Reason for Refusal." The "Reason for Refusal" variable is specific to ESO and is not an element of the NEMSIS v3.4 data standards, with categories: 1) Against medical advice, 2) Patient does not feel injury/illness requires ambulance, 3) Patient to seek further care in POV, and 4) Other. "Disposition" and "Reason for Refusal" responses were used to determine whether the non-transport decision was attributable to "Caregiver Decision" or "EMS Decision" (Supplemental Figure 1). Records where the classification of entity making the non-transport decision was unclear, including those where the "Disposition" and "Reason for Refusal" appeared inconsistent, were excluded from the analysis (Supplemental Figure 1).

Secondary Outcomes

The secondary outcomes were the interquartile ranges (IQR) of the per-EMS agency proportions of 1) encounters that resulted in pediatric non-transport and 2) non-transport that was attributed to caregiver refusal.

Covariates

Covariates of interest were selected based on biologic and sociologic plausibility and have been identified as relevant to EMS transport decision-making in previous studies (Gerlacher, Sirbaugh, & Macias 2001; Jaslow et al. 1998; Knapp et al. 2009; Millin, Brown, & Schwartz 2011b; Ramgopal, Owusu-Ansah, & Martin-Gill 2018; C. E. Ward et al. 2023). Covariates included age, sex, race/ethnicity, U.S. Census geographic region (Midwest, Northeast, South, West), urbanicity per the Centers for Medicare and Medicaid Services (CMS) definitions (urban defined as areas with a population of 50,000 or more or clusters with at least 2,500 but fewer than 50,000 people; rural defined as the top three quartiles of non-urban areas; or super-rural defined as the lowest quartile of non-urban areas); pri-

ority level of EMS call (emergent versus non-emergent), originator of EMS call (patient, family, bystander, or health care provider/first responder), EMS unit level of care (ALS versus BLS), whether call occurred during standard medical office hours (8:00 a.m.-5:00 p.m., Monday-Friday), documentation of complete vital signs recorded (pulse, respiratory rate, and oxygen saturation), whether the patient was injured, whether the call was classified as medical, trauma or both, if the patient was pregnant, and if language barrier was present.

The race/ethnicity variable was constructed based upon the NEMSIS variable for race and the ESO variable for ethnicity. NEMSIS records patient or family's self-report of race as defined by the U.S. Office of Management and Budget (OMB), which includes the following categories: American Indian or Alaskan Native, Asian, Black or African American, Hispanic or Latino, Native Hawaiian or Other Pacific Islander, and White. Ethnicity is an ESO-specific dichotomous variable of whether patient self-reports as Hispanic or Latino, versus not Hispanic or Latino. We created a combined race/ethnicity variable (see Supplemental Table 1 for details).

	Caregiver Decision (N=81,176)	EMS Decision (N=20,309)	Total Non-Transported Patients (N=101,485)
Age (Years)			
Mean (SD)	8.69 (5.92)	8.42 (5.87)	8.64 (5.91)
Median [Min, Max]	9.00 [0, 17.0]	8.00 [0, 17.0]	9.00 [0, 17.0]
Sex			
Female	39,474 (48.6%)	9,360 (46.1%)	48,834 (48.1%)
Male	40,699 (50.1%)	10,222 (50.3%)	50,921 (50.2%)
Missing	1,003 (1.2%)	727 (3.6%)	1,730 (1.7%)
Race/Ethnicity			
American Indian or Alaskan Native	110 (0.1%)	33 (0.2%)	143 (0.1%)
Asian, Non-Hispanic	875 (1.1%)	244 (1.2%)	1,119 (1.1%)
Black, Non-Hispanic	18,298 (22.5%)	4,224 (20.8%)	22,522 (22.2%)
Hispanic or Latino	12,863 (15.8%)	2,488 (12.3%)	15,351 (15.1%)
Native Hawaiian or Other Pacific Islander	84 (0.1%)	29 (0.1%)	113 (0.1%)
Other or Unknown	1,425 (1.8%)	381 (1.9%)	1,806 (1.8%)
White, Non-Hispanic	36,119 (44.5%)	7,928 (39.0%)	44,047 (43.4%)
Missing	11,402 (14.0%)	4,982 (24.5%)	16,384 (16.1%)
EMS Requested By			
Patient	9,853 (12.1%)	2,036 (10.0%)	11,889 (11.7%)
Bystander	18,070 (22.3%)	3,866 (19.0%)	21,936 (21.6%)
Family	38,101 (46.9%)	9,699 (47.8%)	47,800 (47.1%)
First Responder or Health Professional	8,429 (10.4%)	2,154 (10.6%)	10,583 (10.4%)
Missing	6,723 (8.3%)	2,554 (12.6%)	9,277 (9.1%)

Table 1. Patient demographic and EMS agency characteristics for pediatric encounters resulting in non-transport, sorted by entity making non-transport decision.

	Caregiver Decision (N=81,176)	EMS Decision (N=20,309)	Total Non-Transported Patients (N=101,485)
Urbanicity			
Rural	13,395 (16.5%)	2,631 (13.0%)	16,026 (15.8%)
Urban	65,343 (80.5%)	17,192 (84.7%)	82,535 (81.3%)
Super Rural	2,397 (3.0%)	480 (2.4%)	2,877 (2.8%)
Missing	41 (0.1%)	6 (0.0%)	47 (0.0%)
Geographic Region			
Midwest	15,465 (19.1%)	4,708 (23.2%)	20,173 (19.9%)
Northeast	1,957 (2.4%)	663 (3.3%)	2,620 (2.6%)
South	54,423 (67.0%)	9,246 (45.5%)	63,669 (62.7%)
West	8,899 (11.0%)	5,613 (27.6%)	14,512 (14.3%)
Missing	432 (0.5%)	79 (0.4%)	511 (0.5%)
Priority			
Emergent	69,517 (85.6%)	17,091 (84.2%)	86,608 (85.3%)
Non-emergent	11,659 (14.4%)	3,218 (15.8%)	14,877 (14.7%)
Unit Level			
ALS	69,746 (85.9%)	14,428 (71.0%)	84,174 (82.9%)
BLS	6,201 (7.6%)	3,131 (15.4%)	9,332 (9.2%)
Missing	5,229 (6.4%)	2,750 (13.5%)	7,979 (7.9%)
Injury			
No injury	55,716 (68.6%)	12,947 (63.8%)	68,663 (67.7%)
Injury	23,075 (28.4%)	5,560 (27.4%)	28,635 (28.2%)
Missing	2,385 (2.9%)	1,802 (8.9%)	4,187 (4.1%)
Medical v. Trauma			
Medical	45,081 (55.5%)	11,813 (58.2%)	56,894 (56.1%)
Trauma	32,565 (40.1%)	7,058 (34.8%)	39,623 (39.0%)
Medical and Trauma	1,132 (1.4%)	308 (1.5%)	1,440 (1.4%)
Missing	2,398 (3.0%)	1,130 (5.6%)	3,528 (3.5%)
Pregnancy			
Not pregnant	81,038 (99.8%)	20,280 (99.9%)	101,318 (99.8%)
Pregnant	138 (0.2%)	29 (0.1%)	167 (0.2%)
Time of Day			
During office hours	32,671 (40.2%)	8,987 (44.3%)	41,658 (41.0%)
Outside office hours	48,505 (59.8%)	11,322 (55.7%)	59,827 (59.0%)
Vital Signs Obtained			
Incomplete	38,358 (47.3%)	10,698 (52.7%)	49,056 (48.3%)
Complete	42,818 (52.7%)	9,611 (47.3%)	52,429 (51.7%)
Language Barrier Present			
No language barrier	77,651 (95.7%)	18,045 (88.9%)	95,696 (94.3%)
Language barrier	690 (0.9%)	171 (0.8%)	861 (0.8%)
Missing	2,835 (3.5%)	2,093 (10.3%)	4,928 (4.9%)

Table 1 (continued). Patient demographic and EMS agency characteristics for pediatric encounters resulting in non-transport, sorted by entity making non-transport decision.

Statistical Analysis

We calculated the proportion of EMS activations resulting in non-transport and the proportion of these non-transport encounters attributable to "Caregiver Decision" versus "EMS Decision." We generated descriptive statistics to measure variability between EMS agencies. Data for covariates were missing for 0-32% (Supplemental Table 2). Data for pregnancy status was missing in 32% of records. It was assumed that these non-responses indicated a patient was not pregnant (due, in many cases, to the patient's age), so missing values for this variable were categorized as "not pregnant." As described above, data points were discarded when there was a discrepancy between the documented "Disposition" and "Reason for Refusal," i.e., when one variable indicated that non-transport was due to caregiver decision while another indicated that non-transport was per EMS decision (Supplemental Figure 1). After this transformation, only 0.3% of Decision for Non-transport was missing. Complete case analysis was used when measuring bivariable associations and constructing logistic regression model.

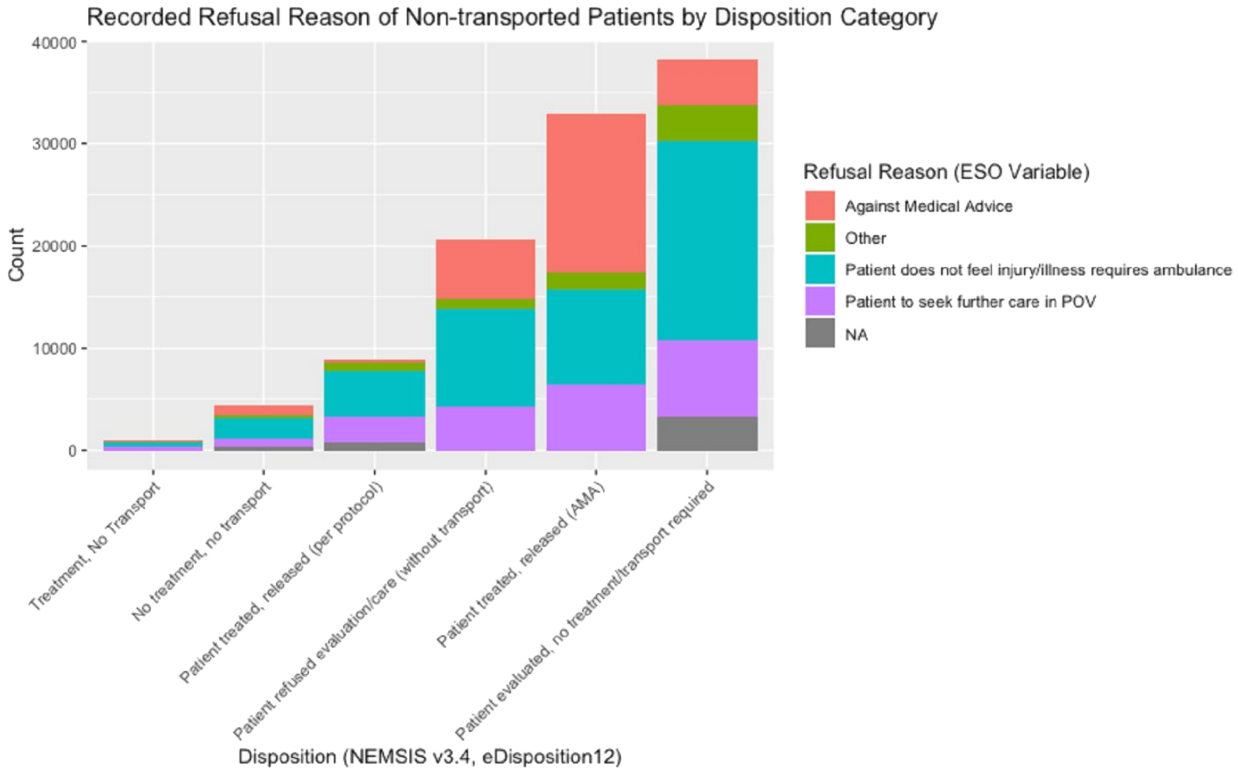

Figure 1. Reason for refusal (ESO specific variable) sorted by encounter disposition (NEMSIS variable) category.

We evaluated bivariable associations with the outcome of non-transport due to "Caregiver Decision" versus "EMS Decision," using odds ratios (OR) with 95% confidence intervals (95% CI). We constructed a multivariable logistic regression model to evaluate associations of covariates with this outcome, expressing results as adjusted odds ratios (aOR) with 95% CIs. Diagnostic plots of the logistic regression model plotted deviance versus

fitted values of the model. We assessed for multicollinearity by calculating variance inflation factors (VIF). All data analysis was performed using R (Studio Version 2022) (R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/. n.d.).

RESULTS

Of the 8,340,148 EMS encounters in the ESO dataset, 313,903 were 9-1-1 activations for patients aged <18 years, of which 106,173 (37.2%) resulted in non-transport. For 4,688 (4.4%) of these non-transports, the entity responsible for the non-transport decision could not be determined from the EMS documentation due to an inconsistency between the classification of the "Disposition" and "Reason for Refusal " variables. Of the remaining 101,485 encounters, 81,176 (80.0%) were attributable to caregiver decision, and 20,309 (20.0%) were EMS-initiated. The median age of non-transported patients was 9 years, and 50,921 (51.9%) were male. Most activations (82,535, 80.5%) originated in urban areas. Complete patient demographic and EMS agency characteristics for pediatric encounters resulting in non-transport are summarized in Table 1.

Figure 1 depicts the ESO-specific refusal reason by NEMSIS disposition category. Each disposition category contained the full range of refusal reasons, but "Patient does not feel injury/illness requires ambulance" was the most common refusal reason, representing 44-49% of refusal reasons in all disposition categories except Patient treated, released (AMA)." For "Patient treated, released (AMA)," the most common refusal reason was "Against Medical Advice" (47%). Notably, "Against Medical Advice" was a refusal reason in all disposition categories, including "Patient evaluated, no treatment/transport required," where it represented 12% of refusal reasons.

Unadjusted and adjusted odds ratios of the covariate association with the outcome of caregiver decision are summarized in Table 2. Based upon multivariable logistic regression, demographic factors associated with a modestly increased likelihood of caregiver decision for non-transport were patient female sex and Hispanic/Latino race/ethnicity identification. Black, Non-Hispanic, Asian, Non-Hispanic, and other or unknown race/ethnicity were associated with modest decreased likelihood of caregiver decision. Other demographic covariates, including age, were not significant. Community factors of rural or super-rural community, compared with urban community, and regions of Northeast, Midwest, and South compared to the West, were associated with increased likelihood of caregiver decision. Encounter factors associated with increased likelihood of caregiver decision included Advanced Life Support (ALS) designation of EMS unit, the absence of an injury, and the designation of trauma. 9-1-1 activations resulting from a caregiver or bystander call were associated with increased caregiver decision likelihood compared to healthcare workers placing the call. In addition, having complete vital signs recorded by EMS was associated with increased likelihood of caregiver decision, as was activation occurring outside of regular office hours. We did not find evidence of multicollinearity.

Among the 1,209 agencies for which data were available, the mean and median non-transport proportions for pediatric 9-1-1 encounters per agency were 0.38 and 0.37, respectively, with an interquartile range of 0.25-0.48 (Figure 2a). Across the 1140 agencies

for which refusal reason was available, the mean and median proportions of caregiver decision were 0.78 and 0.82, respectively, with an interquartile range of 0.68 - 0.94 (Figure 2b).

	Caregiver Decision (%)	EMS Decision (%)	OR (95% CI)	aOR (95% CI)
Sex				
Male	79.9	20.1	Reference	
Female	80.8	19.2	1.06 (1.03, 1.09)	1.05 (1.01, 1.10)
Race/Ethnicity				
White	82.0	18.0	Reference	
American Indian or Alaskan Native	76.9	23.1	0.73 (0.50, 1.08)	0.83 (0.54, 1.32)
Asian, Non-Hispanic	78.2	21.9	0.79 (0.68, 0.91)	0.83 (0.71, 0.98)
Black, Non-Hispanic	81.2	18.8	0.95 (0.91, 0.99)	0.83 (0.79, 0.87)
Hispanic or Latino	83.8	16.2	1.13 (1.08, 1.19)	1.09 (1.03, 1.15)
Native Hawaiian or Other Pacific Islander	74.3	25.7	0.64 (0.42, 0.97)	0.87 (0.54, 1.45)
Other or Unknown	78.9	21.1	0.82 (0.73, 0.92)	0.86 (0.75, 0.99)
Urbanicity				
Urban	79.2	20.8	Reference	
Rural	83.6	16.4	1.34 (1.28, 1.40)	1.09 (1.03, 1.16)
Super-rural	83.3	16.7	1.31 (1.19, 1.45)	1.35 (1.20, 1.53)
Region				
West	61.3	38.7	Reference	
Northeast	74.7	25.3	1.86 (1.69, 2.05)	1.99 (1.67, 2.38)
Midwest	76.7	23.3	2.07 (1.98, 2.17)	1.27 (1.18, 1.37)
South	85.5	14.5	3.71 (3.57, 3.86)	2.12 (1.99, 2.26)
Priority				
Non-emergency	78.4	21.6	Reference	
Emergency	80.3	19.7	1.12 (1.08, 1.17)	0.91 (0.86, 0.96)
Requested By				
Health Professional	79.6	20.4	Reference	
Family	79.7	20.3	1.00 (0.95, 1.06)	1.05 (0.98, 1.12)
Bystander	82.4	17.6	1.19 (1.13, 1.27)	1.11 (1.03, 1.19)
Patient	82.9	17.1	1.24 (1.16, 1.32)	1.24 (1.14, 1.35)
EMS Unit				
BLS	66.4	33.6	Reference	
ALS	82.9	17.1	2.44 (2.33, 2.56)	1.25 (1.16, 1.35)
Time of Dispatch				
During office hours	78.4	21.6	Reference	
Outside of office hours	81.1	18.9	1.18 (1.14, 1.22)	1.17 (1.12, 1.21)
Vital Signs				
Incomplete	78.2	21.8	Reference	
Complete	81.7	18.3	1.24 (1.20, 1.28)	1.24 (1.19, 1.29)

Table 2. Factors associated with caregiver decision for pediatric patients not transported by EMS.

	Caregiver Decision (%)	EMS Decision (%)	OR (95% CI)	aOR (95% CI)
Presence of Trauma				
Medical	78.6	21.4	Reference	
Trauma	79.2	20.8	1.21 (1.17, 1.25)	1.52 (1.44, 1.62)
Medical and Trauma	82.2	17.8	0.96 (0.85, 1.09)	1.17 (0.99, 1.38)
Presence of injury				
Injury	80.6	19.4	Reference	
No injury	81.1	18.9	1.04 (1.00, 1.07)	1.41 (1.33, 1.50)
Pregnancy				
No pregnancy	80.0	20.0	Reference	
Pregnancy	82.6	17.4	1.19 (0.80, 1.78)	0.85 (0.56, 1.37)
Language Barrier				
Language barrier	80.1	19.9	Reference	
No language barrier	81.1	18.9	0.94 (0.79, 1.10)	0.90 (0.73, 1.13)

Table 2 (continued). Factors associated with caregiver decision for pediatric patients not transported by EMS.

DISCUSSION

In this study, 38% of pediatric patients assessed by EMS were not transported, and in 80% of cases, documentation implied the caregiver was the entity determining non-transport. Several factors were significantly associated with caregiver versus EMS decision for non-transport. The magnitude of these effects was modest, with adjusted odds ratios ranging from 0.83-2.12. For important demographic and encounter factors such as age, sex, and race, the groups of non-transported children were similar regardless of whether EMS or caregivers made the decision not to transport. Finally, there was large variability in per-EMS agency proportions of encounters resulting in non-transport and non-transport attributable to caregiver decision. The interquartile range for the per-agency proportion of patients not transported was 0.25-0.48, and the interquartile range for proportion of per-agency caregiver decision as the recorded reason for non-transport was 0.68-0.94.

This analysis of a large national dataset of EMS encounters validates previous observations regarding pediatric non-transport and provides additional insights into the patient, clinical, and regional factors associated with non-transport decision making. The rate of non-transport of patients in this dataset is comparable to published literature on the topic, where pediatric non-transport rates range from 16-46% (Gerlacher, Sirbaugh, & Macias 2001; Hartka & Vaca 2020; Kannikeswaran et al. 2007; Lowery et al. 2023; Oulasvirta et al. 2019a; Ramgopal, Owusu-Ansah, & Martin-Gill 2018; Richard et al. 2006). The broad range of reported per-agency non-transport rates likely reflects heterogeneity in study settings, as urban EMS agencies have lower rates of non-transport than rural regions (C. Ward et al. 2022).

The rate of caregivers making non-transport decisions in our study (80%) is slightly higher than in the previously published literature. Two studies using the National EMS Information System (NEMSIS) dataset reported caregiver refusal rates of 66-67% for pediatric non-transport cases (Hartka & Vaca 2020; C. Ward et al. 2022). This difference may be explained by how we defined this variable. Our study used the NEMSIS "Dispo-

sition" variable and the ESO "Reason for Refusal" variable, providing additional important context. For a sizeable proportion of non-transported patients in the ESO database, the refusal reason was recorded as "Patient does not feel injury/illness requires transport," a descriptor that by itself does not indicate disagreement between the caregiver and EMS team about the disposition of the patient and cannot be reasonably categorized as a refusal of transport. In this dataset, for 19,450 non-transport encounters (20%), the combination of recorded disposition and refusal reason was "Patient evaluated, no treatment/transport required" and "Patient does not feel injury/illness requires transport." For this reason, the current study focused on whether EMS documentation indicated that the caregiver's perception and preferences were the primary reason for non-transport rather than a narrower definition of refusal, in contrast to an EMS-initiated decision.

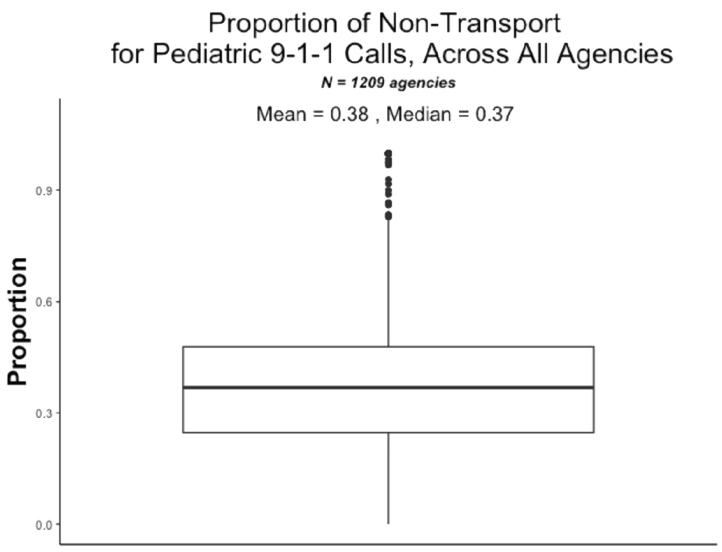

Figure 2a. Variation by EMS agency in the proportion of pediatric 9-1-1 calls that result in non-transport.

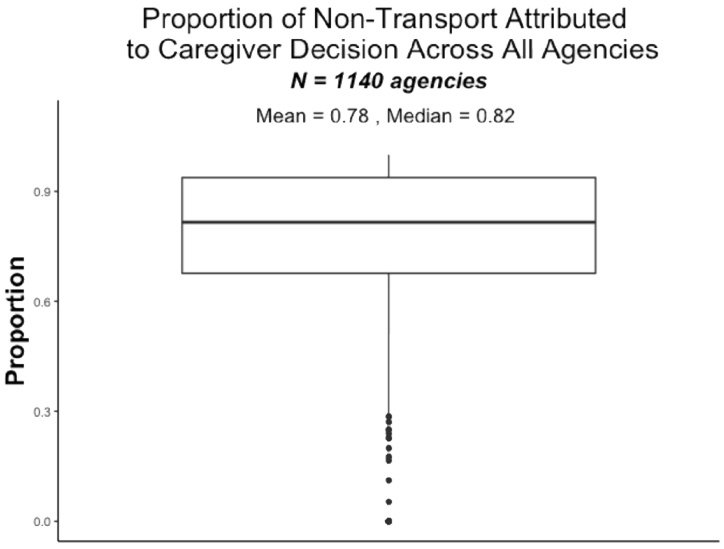

Figure 2b. Variation by EMS agency in the proportion of pediatric non-transport cases that are due to caregiver decision.

There are several important implications of our findings. This study adds to a growing body of literature showing that pediatric non-transport by EMS is common and occurs more often with children than adults, where non-transport rates are 10-20% (C. Ward et al. 2022). The reasons why non-transport rates differ significantly between adult and pediatric patients are not fully understood, although one may speculate that since an adult caregiver generally calls 9-1-1 on behalf of a child, there may be a lower threshold to seek a medical opinion on the severity of an acute illness for a child compared to an adult. This could result in 9-1-1 being called for lower severity illnesses for pediatric versus adult patients. However, while studies in Europe have assessed patient outcomes after non-transport, little is known about the patient outcomes for US children with non-transport after EMS evaluation (Coster et al. 2019; Oulasvirta et al. 2019b). Previous studies have been limited to small single-center analyses with

incomplete patient follow-up (Pringle et al. 2005; Seltzer et al. 2001). This is particularly concerning because EMS clinicians receive limited pediatric education and have documented deficiencies in pediatric assessment and management skills (Hansen et al. 2015; Jeruzal et al. 2019; Zaritsky et al. 1994). It is concerning that only half of patients with non-transport had complete vital signs recorded. Previous work has demonstrated that pediatric patients are less likely than adults to have vital signs documented by EMS, and the measurement and interpretation of pediatric vital signs may pose a challenge to EMS clinicians who do not regularly interact with pediatric patients (Hewes et al. 2016; Shinohara et al. 2022). The Pediatric Assessment Triangle (PAT) is a tool for rapid assessment of pediatric patients to identify critical illness and inform initial medical management, and its use may be especially important for pediatric patients for whom EMS is not able to obtain vital signs (Dieckmann, Brownstein, & Gausche-Hill 2010). There is a need for EMS agencies to develop initiatives to improve the rate of vital sign documentation for children not transported by EMS, or to use validated alternatives to assessing clinical status when vital signs cannot be obtained.

The discordance observed between the NEMSIS "Disposition" and ESO "Reason for Refusal" is both a limitation of our study and an important finding. This suggests that the current medical record documentation for non-transport cases may not adequately capture what clinical reasoning or decision-making transpired during an encounter. For example, the proportion of pediatric non-transports recorded as being "against medical advice" was 28% when looking at the ESO "Reason for Refusal" and 51% in the NEMSIS "Disposition" variable, with 36% of records having discordant responses. Furthermore, we found that while some NEMSIS disposition categories seem to clearly imply who made a non-transport decision, the ESO refusal reason provided further context and did not obviously align in some cases. For example, the NEMSIS disposition "Patient treated/released (per protocol)" is defined by the NEMSIS codebook to indicate that the patient met predefined EMS criteria for treat and release. However, in 3.2% of these cases, the ESO refusal reason was listed as AMA. This appears to be contradictory but may indicate that a caregiver advocated for non-transport, and the EMS clinicians used a non-transport protocol. Similarly, the disposition category "Patient evaluated, no treatment/transport required" was the most used NEMSIS disposition and does not provide enough information to determine how the non-transport decision was made. Our findings suggest that caution should be taken when using current disposition documentation to infer who has decided not to transport a child. This has implications for those engaged in medical oversight and research. In addition, current disposition categories do not explicitly account for instances of shared decision-making between caregivers and EMS teams. Revision to current disposition categories could address this issue by allowing EMS teams to be explicit when caregiver and EMS assessments of patients were aligned versus when they were at odds.

There are important economic implications of our findings. Current federal regulations categorize EMS services as a transportation benefit, meaning that transport to a qualifying destination (usually an ED) must occur for the agency to receive payment (Goldman et al. 2020; National EMS Advisory Council (NEMSAC) 2019). It is likely that these reimbursement regulations influence rates of non-transport. For example, private, non-hospital EMS agencies have lower rates of non-transport compared to government, non-fire and fire department-based agencies. This may be attributable to private agencies being

more reliant upon billable services (Déziel 2017; Eckstein 2013; C. Ward et al. 2022). It has also been shown that providing EMS flexibility in transporting low-acuity patients to alternative destinations, or to treat on scene, could save the federal government up to $560 million (Alpert et al. 2013). The National Association of EMS Physicians (NAEMSP) has advocated that EMS agencies be appropriately reimbursed for encounters resulting in non-transport (Millin, Brown, & Schwartz, 2011a). As initiatives to reimburse for alternative disposition and on-scene treatment develop, it will be increasingly vital to have more accurate documentation about how non-transport decisions are made, and by whom. At this time, many insurers will not provide reimbursement for care provided on scene when the patient refuses transport (National EMS Advisory Council (NEMSAC) 2019). Documentation suggesting that caregivers refused transport against medical advice has important financial ramifications for both patient families and EMS agencies.

Finally, we found that that the proportion of pediatric encounters resulting in non-transport and specifically caregiver refusals varied widely between EMS agencies. This may reflect variation between EMS agencies in how pediatric non-transport is managed and documented. This may be unwarranted clinical variation, with the practice being driven by local culture and norms rather than differences in the clinical needs of patients (Atsma, Elwyn, & Westert 2020). Further work is needed to understand why non-transport practices vary widely between EMS agencies. Understanding and developing initiatives to reduce unwarranted clinical variation, potentially with clinical decision support tools, has the potential to help improve patient safety and quality of care (Mitchell et al. 2014), healthcare efficiency (Lewkowicz, Wohlbrandt, & Boettinger 2020), and to address healthcare disparities (Vasey et al. 2021). A standardized, evidence-based clinical decision aid may help to reduce this clinical variability.

LIMITATIONS

There are several limitations to this study. First, while the ESO dataset captures a large volume of encounters from across the US, it is a convenience sample, and findings could be subject to a selection bias. Second, there are limitations related to medical record documentation. For some covariates, a proportion of records had missing data, including a sizeable number of the variable for pregnancy status. Imputation techniques were not used, and instead, complete case analysis was performed. A higher proportion of data were missing in the "EMS Decision" compared to "Caregiver Decision" group for all covariates with missing data except "Geographic Region." While we did not perform a statistical analysis of missing data, the fact that data may be missing not at random could introduce bias into this study. Additionally, this study had no way to verify with clinicians and caregivers who made a non-transport decision and whether both parties agreed with the EMS clinical documentation regarding this. There were also discrepancies in how the data used to construct our outcome variable (entity making the decision for non-transport) was recorded. In a subset of encounters, documentation describing the entity making the decision not to transport a child was ambiguous, and thus these records were excluded from the analysis. Finally, the study would be strengthened if there were the means to determine outcomes for non-transported patients, including subsequent 9-1-1 encounters, primary care follow-up, and hospitalizations.

CONCLUSION

In summary, consistent with previous research in other populations, this study demonstrated that in a large national dataset, 38% of pediatric patients for whom 9-1-1 was activated were not transported by EMS. Among these patients, caregiver decision was recorded to be the reason for non-transport 80% of the time. The patient and encounter characteristics for children not transported by EMS were broadly similar, regardless of whether EMS or the caregiver made the decision not to transport. However, there was wide inter-agency variation in both the rate of non-transport and the proportion of these encounters attributable to a caregiver decision. This suggests there may be unwarranted variation in pediatric non-transport practices between EMS agencies. Further research is needed to understand pediatric patient outcomes after non-transport and to identify the reasons for practice variability between EMS agencies. Developing standardized, evidence-based non-transport protocols for children may help reduce this potentially un-warranted clinical variation.

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RESEARCH REPORT

AUSTRALIAN PARAMEDICS' EXPERIENCES OF STRESSORS DURING THE COVID-19 PANDEMIC

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ABSTRACT

Objective: Paramedics are exposed to significant job-related stressors, which have been exacerbated by the pressures of the COVID-19 pandemic. Given the essential role that paramedics play in the health system, it is imperative that we understand how their health and wellbeing are affected by this range of stressors.

Methods: We conducted a mixed-methods, cross-sectional statewide survey of the Ambulance Victoria workforce between August and November 2021. A total of 690 paramedics (i.e., operational staff) answered a quantitative question about operational and organizational job stressors, while a subset (N=151) provided a response to a free-text qualitative question about stress related to COVID-19.

Results: Quantitative data revealed the four COVID-19-related stressors were more stressful than all other job-related factors at that time. The specific stressors were COVID-19-related changes to PPE (M=6.05, SD=2.43), workload (M=6.29, SD=2.36), COVID-19-related changes to working conditions (M=6.12, SD=2.74), and COVID-related changes to clinical practice guidelines (M=6.05, SD=2.53), where the midpoint of the rating scale was 4.5. In addition, paramedics reported moderate to high levels of stress for nearly three quarters of all stressors listed. Thematic analysis of the qualitative question showed that paramedics experienced: stress related to operational changes; personal protective equipment-related stress, the everyday life impacts of the COVID-19 pandemic, work-related conflicts and concerns, exposure to COVID-19, vaccine-related stress, and issues with management and communication.

Conclusions: Paramedics have been significantly affected by the unique stressors brought about by the COVID-19 pandemic, which have added strain onto an already stressful work environment. The stressors we have identified suggest that organizations should examine their internal practices and consider their impact on paramedics, along with offering mental health support to paramedics where appropriate.

INTRODUCTION

Paramedics undertake highly demanding and often stressful work, involving long hours and shift work, time-sensitive operations with critically ill individuals, and regular exposure to potentially traumatic events. These significant job-related stressors are directly related to poor mental health and wellbeing (Awais

et al., 2021). For example, research shows that paramedics are particularly vulnerable to the development of mental health concerns including suicidal ideation and posttraumatic stress disorder (PTSD), as well as high rates of burnout (Bentley et al., 2013; Kyron et al., 2022; Vigil et al., 2019).

The healthcare response to the COVID-19 pandemic has placed unprecedented pressure on paramedics, and exacerbated stress, by not only increasing workloads, but also increasing risk through exposure to the virus. While the long-term impacts of the pandemic on paramedics remain unknown, a recent meta-analysis shows that since March 2020 there has been a significant increase in the prevalence of depression, anxiety, and stress compared to the pre-COVID-19 pandemic period for paramedics worldwide (Huang et al., 2022). To adequately support the mental health and wellbeing of paramedics, a clear understanding of the stressors impacting mental health and wellbeing is needed. Paramedics are, however, under-represented in research on the impacts of COVID-19, and there is a particular paucity of Australian research. Two previous studies have explored experiences of COVID-19 amongst Australian paramedics and found that they experienced a range of challenges related to the pandemic (Petrie et al., 2022; Roberts et al., 2021). These studies, conducted early in the pandemic, indicated that the main challenges faced by paramedics were: the pervasiveness of COVID across all life domains; the challenges of widespread disruption at work; risk, uncertainty, and feeling unsafe at work; and the challenges of pandemic (un)preparedness across the health system. These early studies laid an important foundation for future pandemic management. There remains, however, limited evidence around the nature of stressors experienced by paramedics, as previous research tends to focus on combined samples of healthcare workers and paramedics. Understanding the nature of the stressors associated with the COVID-19 pandemic helps identify modifiable stressors and allows paramedic organizations to address these stressors for future pandemics.

This study was conducted with Ambulance Victoria paramedics in Australia in 2021 during the COVID-19 pandemic, and while the state of Victoria was in the midst of its sixth lockdown. The restrictions imposed during the sixth lockdown included limiting movement outside of home, requiring the use of masks outside the home, and limiting the distance that could be travelled. On the 4th of October 2021, the city of Melbourne in Victoria marked 245 days of lockdowns and became the city with the longest cumulative time in lockdown in the world. In this context, the aim of this study was to use a mixed methods approach to better understand the stressors faced by paramedics in this later stage of the pandemic. In addition, we sought to investigate how non-pandemic stressors compared to pandemic stressors.

METHOD

Participants and Procedure

The data examined in this paper were obtained as part of a larger online, anonymous survey of Ambulance Victoria employees and volunteers in Victoria, Australia. This survey is carried out every two years to evaluate the psychosocial wellbeing of the organization's staff.

Ambulance Victoria employees and volunteers (including both operational, i.e., paramedics, and corporate staff) were invited to participate via email. All current employees

and volunteers who were over the age of 18 were eligible to take part in the survey. Data was collected at a single time-point and each participant completed the survey once, between the 23rd of August and 6th of October 2021. Study information for participants was provided on the survey website, and all participants provided their informed consent to participate in the study online prior to commencing the survey. All data was collected anonymously. Individual responses were kept confidential, and only aggregated summary statistics were reported to Ambulance Victoria without any individually identifiable information. While the whole Ambulance Victoria workforce participated in the workforce survey that formed the basis of this paper, and the impacts of COVID-19 were felt across all employees and volunteers, this study focused on the paramedic subsample only (83% of those who completed the survey), excluding corporate staff. This was due to the two groups having different experiences of the COVID-19 pandemic with paramedics being affected by unique operational stressors. A total of 690 paramedics completed questions related to operational stressors, while a smaller subset responded to an additional open-ended question about stressors related to COVID-19 (21.88%, n = 151). The total workforce at the time numbered 5393 employees (including corporate employees), meaning that our paramedic sample constituted 12.79% of the total workforce.

The study received ethical approval from the University of Melbourne Human Research Ethics Committee (HREC) in August 2021 (project reference number 2021-22311-20868-4).

Measures

The online survey included demographic questions such as age, gender, marital status, education, and length of time working at the ambulance service. For the operational and organizational stressors, participants were given the instruction: "Below is a list of stressors you may have experienced. Please indicate the severity of the stress that each stressor has caused you in the past 6 months." They were presented with a list of 21 potential operational and organizational stressors and were asked to select a response option from a 9-point Likert scale ranging from 1 (no stress), 5 (average amount of stress), to 9 (high degree of stress) for each stressor. Participants also had the ability to select "not applicable" for each stressor. These stressor items were developed by the research team for the purpose of this research, in consultation with the Ambulance Victoria to ensure they related directly to the experience of Victorian paramedics. The survey included questions regarding COVID-19-related stressors, which were intended to determine the psychosocial needs of Ambulance Victoria employees and volunteers in the later stages of the pandemic and the post-pandemic recovery period. The operational and organizational scale is provided in Supplementary Materials (Table 3). An open-ended, free-text qualitative item was included asking participants about any other COVID-19-related stressors that they may have experienced.

Data Analysis

Demographics were summarized by descriptive statistics, including means and percentages. Mean ratings of stress severity were calculated for each operational stressor, with those rated above the midpoint of the scale (4.5) considered a more important stressor.

Analysis of qualitative open text responses adopted a thematic approach (Clarke & Braun, 2013) focusing on the types of COVID-19-related stressors experienced by participants. An inductive method was utilized to code the data, moving from descriptive

codes to interpretative codes, and finally to overarching themes. Participant responses were independently coded by one researcher (LFS) who developed preliminary codes. A second researcher (H-AA) discussed and reviewed preliminary codes. Emerging categories showed high consistency, and so a final coding framework was agreed upon to be applied to the full data set. Coding was subsequently completed by each team member, with codes and coding later reviewed and cross-checked collaboratively. Differences in coding were discussed until consensus was reached, and categories were revised where appropriate. Relevant statements were coded with ample context to avoid data fragmentation and de-contextualization. A selection of transcripts and quotes were reviewed collectively by all co-authors under each theme to ensure consensus (Clarke & Braun, 2013).

RESULTS

Demographics

Demographic and service characteristics of the total number of participants who answered questions about operational stressors (n=690) are presented in Table 1. Participants had a mean age of 41.87 years (SD = 12.16 years) and were predominantly female (51.2%). Most were married (49.8%), had a bachelor's or post-graduate degree (80.9%), and had worked at the ambulance service for more than six years (68.5%). The majority of participants were in a relationship with 49.7% married and 22.2% in a de facto relationship.

Demographic Categories		Frequency	Percentage
Gender	Male	319	46.2%
	Female	351	50.9%
	Non-binary/gender diverse/ prefer not to say	25	3.7%
Marital status	Single	142	20.6%
	Married	343	49.7%
	De facto	153	22.2%
	Separated/divorced/widowed	49	7.5%
Educational qualification	High school	15	2.2%
	Trade certificate	7	1.0%
	College certificate or diploma	107	15.5%
	University degree	380	55.1%
	Post-graduate degree	181	26.2%
Length of service at ambulance organization	Less than a year	36	5.2%
	1-2 years	59	8.6%
	3-5 years	122	17.7%
	6-10 years	144	20.9%
	11-19 years	178	25.8%
	20+ years	151	21.9%

Table 1. Demographic and service characteristics of paramedics (n = 646).

Quantitative Findings

Participants' ratings of the severity of stress associated with the 21 operational and organizational stressors are presented in Table 2. The top stressor was COVID-19-related changes to PPE, followed by workload, COVID-19-related changes to working conditions, and COVID-19-related changes to clinical practice guidelines. A total of 15 stressors were given a rating above the midpoint of the scale (4.5), indicating a moderate to high degree of stress. Five of these were organizational, nine were operational and one remaining stressor related to issues in paramedics' personal lives. Outside of the top four stressors, the remaining greatest sources of work stress were associated with shift work, organizational and welfare conditions, communication within the ambulance service, direct exposure to a potentially traumatic job with personal significance, training and accreditation requirements, and direct exposure to the death of a child patient.

Qualitative Findings

Of 690 participants, 151 provided a free-text response to the open-ended qualitative item about COVID-19 stressors. Some responses comprised one or two words (e.g., home schooling, lockdown, PPE), however the majority reported full sentences, multiple sentences, or a paragraph. There was also some variation between longer responses, with some focusing on a single issue while others covered multiple points.

From these, seven themes emerged in relation to COVID-19 stressors. These were operational changes, PPE-related stress, everyday life impacts of COVID-19, work-related conflicts and concerns, exposure to COVID-19, vaccine-related stress, and issues with management and communication. Illustrative quotes for the each of the seven themes are provided in the Supplementary Materials (Table 4).

	Mean (SD)
COVID-19-related changes to PPE*	**6.60 (2.43)**
Workload*	**6.29 (2.36)**
COVID-19-related changes to working conditions*	**6.12 (2.74)**
COVID-19-related changes to clinical practice guidelines*	**6.05 (2.53)**
Shift work*	**5.95 (2.39)**
Organizational and welfare conditions^	**5.93 (2.61)**
Communication within ambulance service^	**5.71 (2.58)**
Direct exposure to a potentially traumatic job that had personal significance* for any reason	**5.39 (3.16)**
Training and accreditation requirements^	**5.32 (2.38)**
Direct exposure to death of child patient*	**5.27 (3.86)**
Direct exposure to distressed family members/loved ones*	**5.17 (2.61)**
Direct exposure to a multi-casualty event*	**4.87 (3.40)**
Family and personal life	**4.84 (2.47)**
Indirect exposure to potentially traumatic events (critical incidents)*	**4.61 (2.90)**
Direct exposure to unsuccessful resuscitation of a patient*	4.57 (3.04)
Communication with other professionals and the public*	4.27 (2.36)
Threat to self*	4.07 (2.86)
Industrial relations^	4.03 (2.84)
Threat to colleague*	3.88 (2.91)
Driving*	3.79 (2.39)
Job security^	3.55 (2.81)

` PPE = personal protective equipment.
*Operational stressors.
^Organizational stressors.

Table 2. Mean scores for operational and organizational stressors (n = 646). **Bold font** indicates mean scores above the mid-point (4.5). Scores could range 1-9.

Theme 1: Operational Changes

Paramedics reported experiencing changes to work-related operations as a significant source of distress during COVID-19. Higher workloads were a commonly reported issue. Paramedics frequently reported feeling a sense of added expectation, urgency, and responsibility in addition to typical workloads. Increases in work demands were noted, such as extra reporting requirements and having to drive long distances to hospitals with capacity to treat COVID-19 patients. Paramedics also reported that when they reached hospitals, they had to deal with long wait times due to ambulance ramping. Compounding this, paramedics felt an inability to treat patients effectively during transport, which generated further distress as paramedics had to observe patients' conditions deteriorate. Higher workloads also reduced the number and quality of break times, with many paramedics reporting a lack of breaks or not being able to finish work on time, and when taking a break, paramedics often encountered a lack of appropriate restroom facilities or rest areas to eat, drink, and relax.

Theme 2: PPE-Related Stress

Wearing COVID-19-specific PPE was an extra operational requirement of working during the pandemic. It has been given its own section due to the frequency with which paramedics mentioned PPE as a stressor. Paramedics reported feeling distress over the policy mandating removal of facial hair to ensure masks adequately seal around the mouth and nose. Paramedics reported feeling targeted by this policy (implemented indefinitely) and felt distress about having to alter physical appearances. Paramedics experienced distress about low PPE supplies and feeling they were not being fully protected by adequate or best available PPE products. In addition, when available, paramedics reported that wearing extra protection for long durations often caused overheating. The physical barriers imposed by PPE made drinking water regularly difficult, leading to dry skin and headaches. In addition to this, paramedics reported experiencing pain due to constantly wearing PPE and that PPE was an impediment to their work due (impairing vision and communication).

Theme 3: Everyday Life

The impacts of COVID-19 extended into everyday life and caused difficulties and distress. Due to the closure of schools and childcare during the lockdown, paramedics expressed difficulties around managing home schooling and/or caregiving responsibilities alongside work. Paramedics also reported distress related to statewide lockdown mandates. This included distress surrounding the inability to go anywhere during leave, worries about family members' levels of stress during the lockdown, and feelings of isolation from not being able to see family, friends, and support networks.

Theme 4: Work-Related Interpersonal Conflicts and Concerns

Several work-related conflicts and concerns were reported by paramedics. Paramedics reported having arguments with hospital staff (e.g., in relation to long wait times), as well as workplace issues with colleagues. Conflict with colleagues manifested as complaints and confrontations in the workplace. COVID-19 restrictions also created separation between colleagues, lowering overall morale and camaraderie. Paramedics also reported feeling isolated and separated from their team members due to social distancing initiatives and a ban on food sharing. Paramedics were also challenged with public attitudes and behaviors toward COVID-19. Paramedics described feeling unappreciated when observing complacency, irresponsibility, and disregard for COVID-19 safety among the general public (e.g., lockdown protests, not wearing masks, etc.).

Theme 5: Exposure to COVID-19

Paramedics wrote extensively about exposure to COVID-19 as a source of stress. This included the ongoing threat of being exposed to the virus and becoming unwell through their treatment of COVID-19 patients. Further, a major concern of paramedics was the fear of dual site risks, where they may unknowingly carry or transmit the virus from work to home, putting family and friends at risk of exposure.

Theme 6: Vaccine-Related Stress

Paramedics also described experiencing stress in relation to the vaccine. This included a lack of timely access to vaccines while working closely with COVID-19 patients. Para-

medics reported that these issues around vaccine access made them feel unsupported by management. Compounding this, paramedics experienced stress caused by members of the community who were protesting vaccine mandates. Paramedics reported stress from constant reporting of anti-vaccine protests in the media, having arguments with people about vaccines (e.g., friends), and stress from colleagues who refuse to be vaccinated. In contrast, other paramedics reported experiencing stress due to the vaccine mandate, being forced to be vaccinated to continue working as a paramedic, and management not respecting their individual health choices and personal decision making.

Theme 7: Issues with Management and Communication

Various issues relating to the organization were commonly noted as sources of distress among paramedics. Paramedics reported poor communication from management regarding organization guidelines surrounding COVID-19. Paramedics felt stress around feeling responsible for keeping up to date with constantly changing guidelines, with no access to clear, reliable advice to follow. When information was delivered from the organization, paramedics felt that communication was poor and ineffective. Similarly, despite organizations providing educational material, paramedics reported experiencing stress due to a perceived lack of education, awareness, and training about COVID-19 (e.g., pathophysiology) and how to work safely and confidently in COVID-19 environments. Issues with HR and organizational management were also reported stressful, with paramedics citing poor or inconsistent communication from senior team members. Some paramedics noted a perceived lack of professional and emotional support from managers and other team members. Another source of stress was a lack of professional development opportunities. Paramedics noted having limited time to practice skills, lack of Continuing Professional Development (CPD) days, and for recent graduates, uncertainties around gaining on-road experience due to isolations and lockdowns.

DISCUSSION

This study examined the stressors that were faced by paramedics in the Australian state of Victoria at the height of the 2021 COVID-19 lockdowns. Unsurprisingly, three COVID-19-related stressors were ranked in the top four of 21 operational and organizational stressors, with workload being the other. While workload was not explicitly listed as a COVID-19-related stressor, qualitative reports from paramedics indicated that workloads significantly increased as a result of the pandemic, implying that all the top four stressors were directly or indirectly related to the impacts of COVID-19. This is in line with the findings of Roberts and colleagues (2021), who found that 76% of rural-based emergency services workers in Australia reported an increase in workload due to COVID-19, on top of an already high workload before the pandemic. Our results support previous research that working as a paramedic is inherently stressful (Lawn et al., 2020). Of the 21 stressors that were provided, paramedics scored 15 stressors as being in the moderately or highly stressful range. However, the findings from the qualitative component of the study leads us to suggest that most of these occupational and organizational stressors were directly or indirectly impacted by the COVID-19 pandemic and its consequences.

A salient finding was that COVID-19-related changes to PPE was one of the most stressful factors for paramedics during this period. Paramedics reported that PPE was often in

short supply or of an inferior quality, which was also reported in several studies as one of the biggest challenges facing paramedics in Australia and internationally during the pandemic (Hoernke et al., 2021; Li et al., 2021). Paramedics also reported that wearing PPE for long periods resulted in dehydration and physical pain, and that PPE impaired vision and communication, impacting their ability to deliver care to their patients. This is consistent with qualitative research involving patients who utilized emergency healthcare in Australia, which found that many patients, especially those who were deaf, with hearing difficulties, children, or older people, experienced communication challenges due to healthcare workers wearing PPE (Smith et al., 2021). This is a modifiable risk factor and access to high quality PPE is essential to minimize this stressor. Future research would be useful in PPE design that overcomes some of the difficulties paramedics experienced in communicating with patients with disabilities.

COVID-19 also significantly impacted paramedics' experience of the workplace. They reported that an increase in workload, changes to working conditions, and changes to clinical practice guidelines were among the most stressful things in their workday. Many paramedics reported experiencing stress related to operational changes, conflicts with colleagues and hospital staff, and a lack of support or communication from management. This is consistent with other recent research on Australian paramedics, which found that paramedics described feeling unsupported by management and receiving inconsistent information in the workplace (Petrie et al., 2022). This is also consistent with findings from a range of other workforces, with employees who worked from home during the pandemic reporting having limited communication with colleagues and managers, and that this was a barrier to productivity (Mustajab et al., 2020). Support from colleagues and managers, however, is an important protective factor for employee mental health, particularly healthcare workers in the context of a virus outbreak (Carmassi et al., 2020; Petrie et al., 2022). Paramedic organizations should design policy and practices that aim to maximize consistent communication strategies to future-proof these organizations against further waves of COVID-19 or other disasters.

It is well recognized that the COVID pandemic had an unparalleled impact on health care workers. Across the world, published research has shown that usual working conditions were challenged which in turn impacted wellbeing and mental health of health care and emergency services workers (Ardebili et al., 2021; Huang et al., 2022; Petrie et al., 2022; Roberts et al., 2021). Our results suggest that this was certainly the case for Australian paramedics. The impacts of the pandemic meant that usual operational and organizational procedures could not proceed as usual within Ambulance Victoria. Worldwide PPE shortages, hospital ramping, a rapid increase in patient numbers, and a sudden need for purpose-built facilities (e.g., separate rest and toilet facilities) all increased stress for Australian paramedics. Previous studies have indicated that these stressors could be ameliorated by a number of protective factors (Carmassi et al., 2020; Roberts et al., 2021). The findings from the current study showed that support from one's friends and family were helpful as well as support in the workplace. Other workplace factors included adequate training in pandemic response procedures, working in structured units, feeling that the workplace was safe and clear communication of guidelines. Finally, positive coping strategies were also protective. Teaching paramedics these types of coping strategies, along with ensuring thorough training and clear communication, could help to improve paramedics' experiences in future pandemics.

Paramedics were not only affected by COVID-19 in the workplace, but also described its ramifications in their homes and social lives. As was the case for many Victorians and people across the globe, paramedics were concerned about having to home school their children or find adequate care for them while the paramedics were at work during lockdowns. They also suffered from feelings of isolation and frustration about being unable to leave their homes when quarantined or during lockdowns. What was unique about the paramedic experience, however, were concerns about being exposed to COVID-19 at work and potentially taking the virus home to their families. They also had to contend with vaccine mandates during this phase of the pandemic, with some becoming distressed about public protest against vaccines, while others did not want to conform to the mandate. A prior study of Australian paramedics' experiences of the pandemic in 2020 echoed these findings, noting the pervasiveness of COVID-19-related stress in everyday life and a lack of social support due to lockdown-related isolation (Petrie et al., 2022). Similarly, in the international context, research has shown that healthcare providers faced a fear of transmitting the disease to family members, and anxiety and fear when isolating away from family members (Ardebili et al., 2021). These stressors may have been worse for paramedics as they struggled to balance a uniquely stressful work environment with broader stressors affecting the general population.

The results of this study indicate that the disruption of normal working practices and day-to-day life during the COVID-19 pandemic caused paramedics to experience considerable stress. Our findings support previous research that suggests that poor workplace mental health is largely caused by structural issues in the workplace such as excessive work demands, role overload, and insufficient support (Gilboa et al., 2008). A recent study of Canadian healthcare workers found that employees only rarely used formal mental health supports provided by the organization, preferring informal supports from peers or coping strategies such as exercise or hobbies (M nard et al., 2022). Historically there has been a tendency to focus on the individual worker with supports targeted at the individual. However, the findings of this study suggest that many of the stressors emanated from the workplace, and as such, interventions that target the organization may be useful. These includes unambiguous communication from management, increased training in pandemic response, consulting with staff about their needs and providing practical solutions where possible (in regards, for example, to access to toilets and rest breaks), and training managers in how to emotionally support their staff.

LIMITATIONS

This study used voluntary response sampling, so there may have been a bias for participants who held stronger opinions and were more motivated to be more likely to respond to this survey. Similarly, the sample made up a small proportion of the workforce at Ambulance Victoria, meaning that it may not be fully representative of the larger population. Nevertheless, the sample included a balanced representation of men and women (improving generalizability of findings), and the sample size was larger than similar qualitative studies (Ardebili et al., 2021; Hoernke et al., 2021; Petrie et al., 2022). The results are also consistent with those of previous studies (Ardebili et al., 2021; Petrie et al., 2022; Willis et al., 2021). An additional limitation of the study is that the qualitative responses were gathered via short text responses to a survey, and there was potential for bias in the selection of the illustrative quotes. Richer, more detailed answers could have been gained from an in-depth interview process. However, the study's strengths

are the combination of quantitative and qualitative survey data, and the ability to collect responses from a wider range of people with a larger sample size than may have been possible had the data collection had been limited to interview data. A future direction for research is to further develop and validate the operational and organizational stressor scale used in the current study.

CONCLUSION

Our study has demonstrated that the COVID-19 pandemic produced a number of new stressors for paramedics in Victoria, Australia, particularly in relation to COVID-19-related changes to PPE, workload, COVID-19-related changes to working conditions, and COVID-related changes to clinical practice guidelines. These new stressors were in addition to compounding preexisting occupational stressors. Prospective research can further these findings contrasting pandemic related stressors with typical occupational stressors of paramedicine to assess the differential impacts on mental health and well-being and exploring tailored ways to mitigate different stressor experiences. The current findings highlight the need to design organizational policies and practices that will minimize these stressors in future waves of the pandemic or other disasters. It is also important to offer individual targeting interventions for paramedics who are experiencing mental health difficulties. This could ensure that paramedics maintain their health and continue to provide a critical response to this ongoing pandemic, and that organizations are better placed to respond to the next pandemic.

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Instruction: Below is a list of stressors that you may have experienced. Please indicate the severity of the stress that each stressor has caused for you in the past 6 months										
Stressors	**1 (No Stress)**	**2**	**3**	**4**	**5 (Average amount of stress)**	**6**	**7**	**8**	**9 (High degree of stress)**	**N/A**
Shiftwork	○	○	○	○	○	○	○	○	○	○
Driving	○	○	○	○	○	○	○	○	○	○
Workload	○	○	○	○	○	○	○	○	○	○
Threat to self	○	○	○	○	○	○	○	○	○	○
Threat to colleague	○	○	○	○	○	○	○	○	○	○
Direct exposure to death of a child patient	○	○	○	○	○	○	○	○	○	○
Direct exposure to unsuccessful resuscitation of a patient	○	○	○	○	○	○	○	○	○	○
Direct exposure to a multi-casualty event	○	○	○	○	○	○	○	○	○	○
Direct exposure to distressed family members/loved ones	○	○	○	○	○	○	○	○	○	○
Direct exposure to a potentially traumatic job that had personal significance for any reason	○	○	○	○	○	○	○	○	○	○
Indirect exposure to potentially traumatic events (critical incidents)	○	○	○	○	○	○	○	○	○	○
Communication within ambulance service	○	○	○	○	○	○	○	○	○	○
Communication with other professionals and the public	○	○	○	○	○	○	○	○	○	○
Organisational and welfare conditions	○	○	○	○	○	○	○	○	○	○
Ongoing training and accreditation requirements	○	○	○	○	○	○	○	○	○	○
Job security	○	○	○	○	○	○	○	○	○	○
Industrial relations	○	○	○	○	○	○	○	○	○	○
Family and personal life	○	○	○	○	○	○	○	○	○	○
COVID-19 related changes to working conditions (e.g., working from home)	○	○	○	○	○	○	○	○	○	○
COVID-19 related changes to PPE	○	○	○	○	○	○	○	○	○	○
COVID-19 related changes to CPGs	○	○	○	○	○	○	○	○	○	○

Table 3. The operational stressors questions that paramedics answered as part of a larger survey regarding wellbeing and psychosocial factors. Abbreviations: COVID-19 = coronavirus disease 19, CPG = clinical practice guidelines, PPE = personal protective equipment.

Theme	Stressor	Illustrative Quotes
Operational changes	Higher workload	"Additional workload from COVID-19 related operational preparedness / response activities" "Increased workload leading to poor outcomes for other non-COVID patients" "Increased workload with sicker patients with limited resources. Unable to help them"
	Having to drive long distances to hospitals with capacity to treat COVID-19 patients	"Having to drive long distances (55km) for a hospital that has capacity for COVID positive patients"
	Long wait times at the hospital	"Increase demand on hospitals causing increases to ramping" "Also the ramping at the hospital as they also can't cope with the increase in caseload" "Waiting 6 plus hours for a bed whilst wearing Tyvek" "Exhausted, long wait times are draining and bad on body"
	Inability to treat patients	"Increase stress with patient management and lack of ability to treat patients" "Inability to provide life saving measures to patients (i.e. no nebuliser meds for adult asthma)" "Watching [respiratory] distress patients deteriorate during transport" "Restrictions on being able to provide treatment options to the full extent"
	Lack of breaks	"Also the lack of fatigue breaks following s/Covid jobs especially after a Covid clean in prolonged PPE is exhausting" "Not getting to have meal breaks or ever finish on time on most shifts" "No meal breaks"
	Lack of appropriate facilities	"Lack of facilities for paramedics at EDs is very stressful" "Limited access to toilets, rest areas, food/drink" "Lack of hand soap in some portaloos [portable toilet] is stressful- especially during menses"
	COVID-related changes to logistics	"Frequent changes and [delegated] responsibility [without] clarity" "Covid related changes to logistics"
PPE-related stress	Facial hair policy	"Being directly targeted by the facial hair policy" "Facial hair policy should be temporary only" "Not being able to have a beard, which directly impacts my self-esteem and pride in personal appearance"
	Availability of PPE	"Not enough PPE supplies" "Availability of appropriate PPE (surgical masks of decent quality)"
	Physical impacts of PPE	"Physical toll of wearing PPE (skin problems, dehydration, headaches)" "Constant dehydration, pain from wearing P2 masks constantly, overheating in PPE" "Wearing PPE for long duration in warm to hot weather. Wearing PPE levels higher than other health professionals" "Working in PPE is really difficult, it make it harder to see, and loss of peripheral vision due to PPE, along with increased difficulties communicating, and wearing mask and keeping hydrated"
Everyday life	Home schooling/caregiving	"Childcare issues due to family members not being available due to COVID" "Home schooling. Child care family not wanting us home after treating covid patients" "Organising child care when schools closed, holidays and access to family for help due to lockdown"
	Lockdown	"Being in lockdown during leave" "Not being able to see my adult daughter since 2019 as she is living in Brisbane" "Lockdown, isolation from family and support systems" "Lock downs don't allow me to access my self care regime (hiking)"
Work-related interpersonal conflicts and concerns	Arguments with hospital	"Arguments with [hospitals] about offloading after 20 minutes" "Dealing with hospitals"
	Public attitude and behaviour	"Feeling that public do not care enough about healthcare worker health to wear a mask so it covers both nose and mouth" "Public perception, complacency and disregard and it impact on our frontline"
	Social isolation at work	"That we cannot choose to share food (even wrapped) at work & now have to wear masks at our socially distanced desks. Morale is very low already, [introducing] these added measures further declines morale significantly" "The fact that masks have been introduced at our socially distanced desks and shared food is banned. How can you ban that, we're are adults and can make our own choices if we want to share the food or not" "Team separation, isolation"
	Workplace conflict with colleagues	"Horizontal violence" "Vexatious complaints from another employee"

Table 4. COVID-19 related qualitative themes, stressors and illustrative quotes.

Theme	Stressor	Illustrative Quotes
Exposure to COVID-19	Being exposed to COVID-19	"Ongoing threat of becoming unwell" "Exposure due to patients with extremely mild symptoms" "Being directly exposed to COVID19" "Might catch it"
	Transmitting COVID-19 to family or friends	"COVID-19 exposure at work then returning to home with family and friends" "Fear of taking Covid 19 home from the workplace" "Attending positive pts daily. Concerns with contracting and passing on to family" "Getting the virus at work and transmitting to family"
Vaccine-related stress	Lack of access to vaccines	"Lack of vaccination access" "No vaccination access"
	Vaccine mandate	"Mandatory vaccination no choice" "Upcoming mandate on covid 19 vaccine is causing me an unbearable amount of stress" "[Mandatory] vaccines unlawful breach on my human right" "Prospect of mandatory vaccinations when my vaccine of choice hasn't arrived in Australia yet"
	Antivaxxers	"Antivax protests and loss of friends hopefully temporarily due to their unwillingness to listen to evidence regarding vaccines and covid risks" "Stress from colleagues who refuse to be vaccinated/follow procedures" "COVID-19 and the talk of vaccinations in the media constantly. I am pro-vaccination and have found the protests and arguments against vaccination quite stressful"
Issues with management and communication	Poor communication of consistently changing COVID guidelines	"Constantly changing requirements for PPE; information spread across many platforms" "Fault seems to like with the individual paramedic if Covid updates weren't followed although updates are unclear and frequently changing" "Inconsistent communication, frequent changes and [delegated] responsibility without clarity" "Overwhelmed with COVID info from multiple sources & constantly changing" "Initial pandemic response characterised by daily changing info, CPG criteria, PPE requirements etc."
	Issues with management/HR	"Lack of senior [leadership] availability for compassionate conversation. "Poor communication and [leadership] care" "Lack of support from AV when managing patients with restricted skillset due to COVID concerns"
	Lack of education about COVID	"Lack of education on the pathophysiology of the disease itself." "Lack of structured training and education to allow me perform my role safely and with a high degree of confidence and competence."
	Lack of professional development opportunities	"Lack of CPD days and expecting there is downtime to complete them online" "Less time to practice skills at branch" "Isolation uncertainties and being able to gain enough on road experience as a grad"
	Poor communication from management (excessive or ineffective)	"Based upon workload and consistent guidelines changes with extremely poor communication from the service."

Table 4 (cont.). COVID-19 related qualitative themes, stressors and illustrative quotes.

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REVIEW

INCIDENCE AND OUTCOMES OF ADULT SYNCOPE PRESENTATIONS TO EMERGENCY MEDICAL SERVICES: A SYSTEMATIC REVIEW

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ABSTRACT

Objective: The objectives of this systematic review were to evaluate the incidence, patient demographics, and associated outcomes of adult syncope presentations to emergency medical services (EMS) within current literature.

Methods: Inclusion criteria were EMS contact, a provisional diagnosis of syncope, and epidemiological data regarding EMS contact with these patients. Exclusion criteria were all non-primary studies, patients given an alternative provisional diagnosis or who received life supporting interventions, studies that examined only presyncope presentations or were limited to paediatric patients, or that examined syncope within highly specific non-generalisable settings. Databases were searched on April 5th, 2022, and included Emcare, AMED, Medline, and CINAHL Plus. Quality assessment was conducted using the National Heart, Lung, and Blood Institute quality assessment tool. Data were manually extracted and collated with results synthesised using descriptive statistics and a narrative synthesis.

Results: Twelve studies were included in this review. Studies were primarily completed in Europe or the USA, and sample sizes ranged from 500 to 16 million. Most studies were rated as good to fair in quality. No studies specifically looked at the incidence or outcomes of syncope presentations to EMS. The reported incidence of syncope ranged between 0.09% and 24%.

Discussion: Most studies were generalised epidemiological studies looking at EMS presentations. There were no studies that specifically looked at the incidence and outcomes of syncope presentations to EMS together. Instead, they were either large scale epidemiological studies that lack detailed analysis or had small samples focusing only on certain patient characteristics or presentations. An improved understanding of the epidemiological features of syncope presentations within the prehospital setting and their associated outcomes are of critical importance for the determination of risk stratification that can help guide clinical decision making by EMS.

INTRODUCTION

Syncope is defined as a sudden transient loss of consciousness followed by spontaneous and complete recovery without intervention (Brignole et al., 2018; Thiruganasambandamoorthy et

al., 2022). It is caused by transient global cerebral hypoperfusion due to either decreased cardiac output, excessive vasodilation, or a combination of both (Thiruganasambandamoorthy et al., 2014; A. Ungar et al., 2010). Syncope can be broadly categorised as reflex syncope (including vasovagal syncope), orthostatic hypotension, or cardiac syncope (Sutton, Ricci, & Fedorowski, 2022). Causes of syncope range from benign conditions such as a vagal response to fear, to life threatening conditions such as lethal arrhythmias, structural heart defects, or an aortic dissection (Thiruganasambandamoorthy et al., 2014).

The incidence of syncope in the setting of the emergency department (ED) is generally reported to be between 1-3% and outcomes associated with ED presentations are well reported (Anand et al., 2018; Bernier, Tran, Sheldon, Kaul, & Sandhu, 2020; Long, Serrano, Cabanas, & Bellolio, 2016). However, the incidence of syncope in the prehospital setting remains largely unknown. Some studies suggest that more than 50% of presentations to ED for syncope arrive by emergency medical services (EMS) transport (Bernier et al., 2020; Long et al., 2016; Somani, Baranchuk, Guzman, & Morillo, 2012; V. Thiruganasambandamoorthy et al., 2013; Yau et al., 2019). Furthermore, Yau et al. (2019) showed that of the 70% of syncope patients to arrive by ambulance only 17% were admitted.

Historically, syncope has presented a significant health burden. The overall admission to hospital was disproportionately high, as clinicians sought to mitigate the risk of life-threatening conditions associated with syncope (Bernier et al., 2020; Long et al., 2016; Somani et al., 2012). An understanding of the epidemiology, risk factors and associated outcomes for syncope within the ED has been integral in the development of risk-stratification tools and guidelines that have helped reduce unneccesary hospitalisations by more than 40% (Anand et al., 2018). A similar understanding of the epidemiology, risk factors and associated outcomes related to EMS presentations specifically, could therefore help to reduce unnecesary ED transportations.

The primary objective of this systematic review was to evaluate the incidence of adult syncope presentations to EMS amongst the current literature. The secondary objective was to evaluate patient demographics and any outcomes relating to syncope presentations such as transportation rates, the incidence of adverse events, and any other commonly reported outcomes.

METHODS

This systematic review was guided by JBI's manual for evidence synthesis; systematic reviews of prevalence and incidence (Munn Z, 2020). It was reported in accordance with the updated 2020 guidelines for the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Page et al., 2021). It was prospectively registered with the International Prospective Register of Systematic Reviews (PROSPERO ID # 323284). The review was conducted with methodological support from Monash University.

Search Strategy and Information Sources

A search strategy using the PECO structure was performed as outlined in the protocol and Appendix 1. As all epidemiological outcomes were sought, there was no control required and specific outcomes were avoided to prevent exclusion of relevant results. A pre-established and validated paramedic filter was used to identify any prehospital

non-physician healthcare provider with any educational level or experience (Olaussen, Semple, Oteir, Todd, & Williams, 2017). To ensure that all possible papers were included, the paramedic filter with greater sensitivity (98.4%) was used (Olaussen et al., 2017). The search strategy was conducted in Emcare, AMED and Medline (R) via OVID, and CINAHL Plus via EBSCO Host, from their individual commencement dates until December 20th, 2022.

Eligibility Criteria and Screening

The results were uploaded into the automated screening and data extraction tool Covidence (2022), where duplicates were automatically removed. A title and abstract review of all articles was completed independently by MC, with a secondary review (by AD, MW-S and AO) against the inclusion/exclusion criteria. For inclusion, papers must have provided epidemiological data conducted in the prehospital setting on patients with a clinical impression or primary complaint of syncope. A full exclusion criterion is provided in Appendix 2. Conflicts were resolved via discussion among the three investigators where two out of four disagreed initially. A full text review was independently completed on all the remaining articles by MC, with a secondary review by either MW-S or AO, focusing on key exclusion criteria. Conflicts were resolved via discussion among the three investigators, where one out of the three disagreed. Interrater reliability was calculated using Cohen's kappa. A final forwards and backwards citation search was conducted on all included text using the automated process Citation chaser, with papers manually reviewed (N. R. Haddaway, Grainger, & Gray, 2021).

Data Extraction and Synthesis of Findings

Data were manually extracted and outcomes manually collated by a single investigator (MC). Data extracted for study characteristics included country of study, EMS qualifications, study design, study period, study population, and population characteristics, as well as whether syncope was reported as a primary complaint or clinical impression. The primary patient outcome extracted from the data was the incidence of syncope. The secondary patient outcomes were rates of transport, adverse events, mortality, and all other reported outcomes. Rates were manually calculated where required. Results were produced using a narrative synthesis to identify the primary and secondary objectives.

Assessment of Study Quality

The National Heart, Lung and Blood Institute quality assessment tool was used to conduct a quality assessment of each study (Health, 2013). This questionnaire allowed for the assessment of weakness and/or bias regarding study population and population characteristics, sample size justification and power, evaluation of exposures and outcomes, as well as consideration for confounding variables and blinding of outcome assessors. An overall assessment of quality was summarised as being good, fair or poor (Health, 2013). This questionnaire was uploaded into the data extraction tool Covidence, and each study was independently assessed by two investigators (MC and MW-S) (Innovation, 2022). Interrater reliability was calculated using Cohenss kappa. Conflicts were resolved by an independent review from a third investigator (AO).

RESULTS

Study Selection

The search yielded 3,913 papers, of which 919 were duplicated. A full text review of 62 papers resulted in 11 inclusions and 51 exclusions (Figure 1). The citation search yielded one additional study, resulting in 12 studies being included. Inter-rater reliability for study inclusion was 0.1 for MC and MWS (31% agreement) and 0.71 for MC and AO (66% agreement). All conflicts were resolved via group discussion.

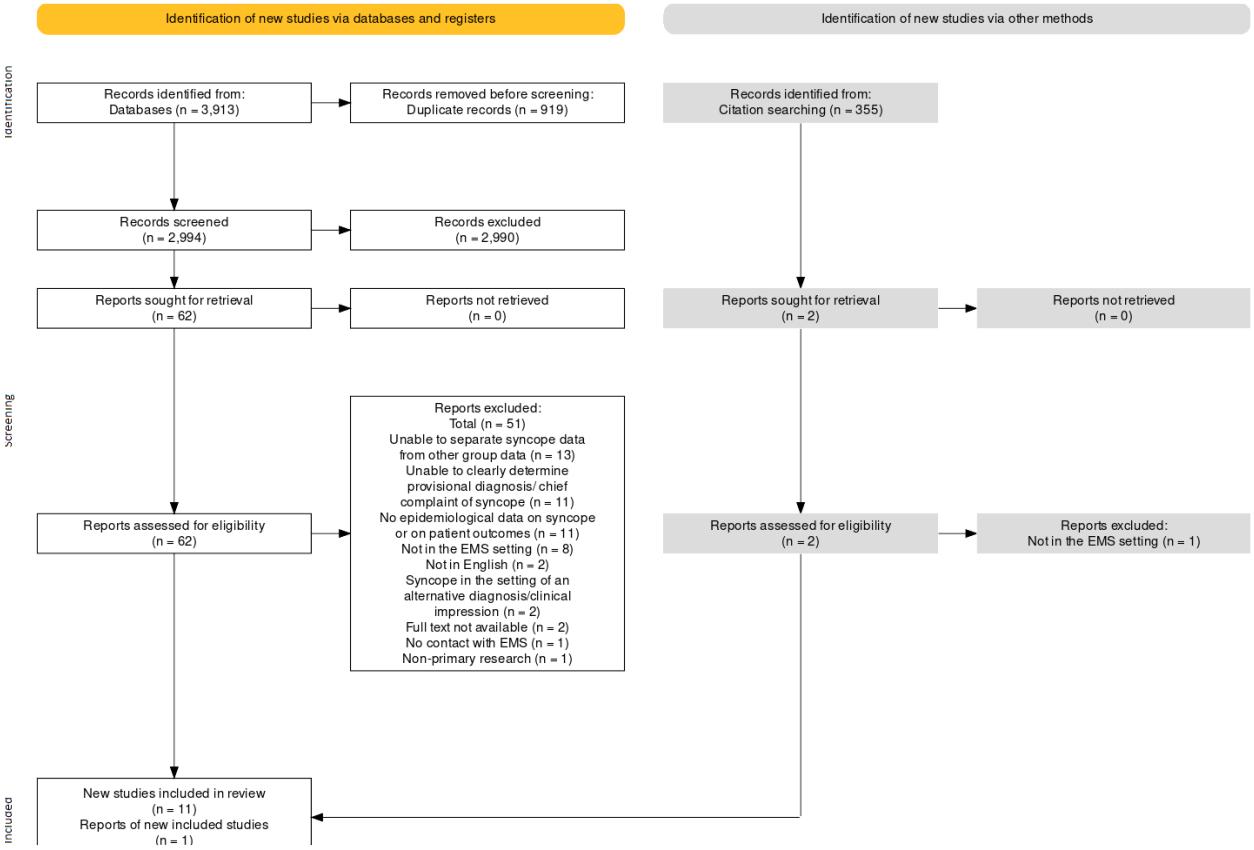

Figure 1. PRISMA flowchart (Neal R. Haddaway, Page, Pritchard, & McGuinness, 2022).

Study Characteristics

Studies were primarily completed in Europe or the USA between 1985 and 2020. EMS qualifications varied widely amongst the studies ranging from emergency physicians to emergency medical technicians, with paramedics being the most common qualification. Sample sizes ranged from 500 to 16 million patients (Table 1).

One study was a prospective cohort study and the remaining eleven were retrospective observational studies. Two studies looked at characteristics of prehospital electrocardiograms (ECGs) and two looked at the diagnostic agreement between prehospital and emergency department diagnosis. Four studies analysed the epidemiology of all EMS presentations, and two looked only at the epidemiology of EMS presentations that were

non-transported. Another study looked to validate a rule for prediction to hospital admission based off patient characteristics from EMS presentations. No study explicitly sought to investigate the incidence of syncope presentations to EMS nor their associated outcomes.

Patient characteristics were heterogenous with five studies including all EMS activations, three studies including only EMS presentations that were transported and two studies including only those not transported. The remaining two studies looked at those who received an ECG or had presented with anginal complaints that included syncope.

Author	Year	Country	EMS Qualification	Study Design	Study Period	Study Druation (Months)	Study Population (n=)	Population Characteristics
Brunetti et al. 2012	2012	Apulia, Italy	RN & Physician	Prospective Cohort Study	Oct 2004 to Apr 2006	18	27,481	EMS presentations who received an ECG which was then transmitted for cardiologist review
Zegre-Hemsey et al. 2019	2019	North Carolina, USA	NR	Retrospective observational Study	Jan 1st 2010 to Dec 31st 2014	60	1,967,542	EMS presentations of chest pain or anginal equivalent complaints that were transported
Cwinn et al. 1988	1988	Denver, USA	Paramedic	Retrospective observational study	Sep 1984 to Sep 1985	12	1,952	Total of all EMS presentations within the airport
Duong et al. 2018	2018	USA	NR	Retrospective observational study	2014	NR	16,116,219	Total of all EMS presentations within USA aged 18 years or over
Panchal et al. 2022	2022	USA	AEMT & Paramedic	Retrospective observational study	2016	NR	13,353,268	Total of all EMS presentations within USA aged 18 years or over
Hensel et al. 2017	2017	Hamburg, Germany	Emergency Physician	Prospective observational study	Jan 2010 to Dec 2014	60	35,390	Total of all EMS presentations to Emergency Physicians between 0700 and 1900
Kucap et al. 2020	2020	Poland	NR	Retrospective observational study	Mar 15th to May 15th in 2018, 2019, 2020	9	1,479,530	Total of all EMS presentations during each 3 month period
Ebben et al. 2019	2019	Region unspecified, Netherlands	RN, NP & Physician assistant	Retrospective observational study	2015	NR	426	Random sample of 500 EMS presentations that resulted in non-transport (from 10,980)
Alzareeni et al. 2016	2016	Riyadh, Saudia Arabia	EMT	Retrospective observational study	Mar to May, 2014	3	1390	Total of all EMS presentations that resulted in non-transport
Meisel et al. 2008	2008	Region unspecified, USA	EMT & Paramedic	Retrospective cohort study	Aug and Dec, 2005	2	401	Total of all EMS activations transported to the two prespecified EDs and that were classified as non-trauma, non-psychiatric and non-labour
Ramadanov et al. 2019	2019	Bad Belzig, Germany	Emergency Physician	Retrospective observational study	Jul 1st 2013 to Jun 30th 2014. Jan 1st to Dec 31st 2015	24	1,055	Total of all EMS activations transported to any Emergency department where corresponding discharge summaries could be obtained.
Schewe et al. 2019	2019	Bonn, Germany	Paramedic & Emergency Physician	Retrospective observational study	Jan to Dec 2004 and 2014	24	1960	Total of all EMS activations aged 18 years and over, transported to any Emergency department where corresponding discharge summaries could be obtained

RN = Registered Nurse,
NR = Not Reported,
ALS = Advanced Life Support,
AEMT = Advanced Emergency Medical Technician,
EMT = Emergency Medical Technician,
NP= Nurse Practitioner

Table 1. Study Characteristics.

Quality Assessment of Studies

Seven studies were rated overall as being of good quality, with four being rated as fair and one as being of poor quality and at significant risk of bias. Lack of detail regarding loss to follow up and independent details, as well as blinding of outcomes by assessors were reasons for the four studies rated as fair (Alrazeeni et al., 2016; Cwinn, Dinerman, Pons, & Marlin, 1988; Duong et al., 2018; Schewe et al., 2019). The study by Ebben et al. was rated as poor quality due to a small sample of only 426 patients drawn from over 10,000 presentations with no explanation as to how the sample was obtained. This raised concerns for selection bias and was acknowledged by the authors (Ebben, Castelijns, Frenken, & Vloet, 2019). Seven studies did not provide a clear definition of syncope or provide criteria for how syncope was diagnosed by their clinicians (Table 2). Six studies reported syncope as being a clinical impression, whilst five studies reported syncope as the primary complaint, and one providing both. Only five studies clearly defined an adult (i.e. either 18 or 21 years) with several studies not specifying whether paediatric patients were included. There was 16% agreement amongst MC and MWS for studies rated as being of good quality, with 83% agreement for studies rates as being of good or fair quality. Inter-rater reliability for study quality was attempted for both measures but could not be calculated. Conflicts were resolved through an independent review by AO.

Evaluation of Primary Objective: Incidence of Syncope Presentations to EMS

The reported incidence of syncope varied between <1% and 24% amongst all studies (Table 3). The incidence rate varied significantly based on sample size and characteristics. The incidence of syncope was significantly reduced amongst studies with a sample size of more than one million (3% to 9%). The incidence was significantly higher in studies where transport was not provided (10% to 24%), compared to those who were transported (3% to 8%). Amongst studies that included all EMS presentations, the incidence was 4% to 11%. Variation in incidence

Study	Definition of Syncope Provided	Syncope as Primary Complaint or Clinical Impression	Definition of Adult	Inclusion of Paediatrics	NIH Quality Rating
Brunetti et al. 2012	Yes	Primary complaint	> 18	Yes	Good
Zegre-Hemsey et al. 2019	No	Primary complaint	21	No	Good
Cwinn et al. 1988	No	Primary complaint	NR	NR	Fair
Duong et al. 2018	No	Clinical impression	18	No	Fair
Panchal et al. 2022	No	Clinical impression	18	No	Good
Hensel et al. 2017	Yes	Clinical impression	NR	NR	Good
Kucap et al. 2020	Yes	Clinical impression	NR	NR	Good
Ebben et al. 2019	No	Clinical impression	NR	Yes	Poor
Alzareeni et al. 2016	No	Primary complaint	NR	NR	Fair
Meisel et al. 2008	No	Primary complaint	>18	No	Good
Ramadanov et al. 2019	Yes	Clinical impression	NR	Yes	Good
Schewe et al. 2019	Yes	Both	18	No	Fair

NR = Not reported.

*Syncope was reported within the study as being either the primary complaint or reason for calling, or as the clinical impression formed by the EMS provider.

Table 2. Quality assessment of studies.

also occurred between whether syncope was recorded as a primary complaint (3% to 24%) or clinical impression (4% to 11%) as well as by the region in which the study was completed (USA; 3 to 9%, EUR; 1% to 11%). Due to the significant heterogeneity amongst the studies (heterogeneity score was 100%), a meta-analysis was not performed (Figure 2).

Evaluation of Secondary Objectives

Transportation Rates

The study by Cwinn et al. (1988), was the only study to report the pre-determined secondary objective of transportation rates. They reported that 60 of 117 patients received transport by ambulance (51.3%) with 33 being patient initiated non-transports (28.2%) and 21 being paramedic initiated (17.9%). This study focused on a single paramedic response unit stationed within an international airport that serviced more than 50,000 people per day. Although the study population formed part of the EMS response catchment, the small sample size and focus on a single response unit not capable of transporting significantly biases this outcome. No other study reported the incidence of transportation. Due to the lack of alternative evidence a true rate of transport cannot be reliably determined.

Incidence of Adverse Outcomes

The study by Brunetti et al. (2012), was the only study to report the pre-determined secondary objective of adverse events. From more than 2648 patients receiving an ECG for a syncope presentation, they reported that the incidence of a severe arrythmia (defined as either a severe bradycardia or tachycardia) was age related (1.45% for those aged 50-60, to 3.13% for those aged 90-100), and that in patients less than 30 years of age, there were no instances of severe arrhythmia. No other study described the incidence of adverse outcomes. There were no studies that reported the incidence of mortality.

Patient Demographics

Study	Study Population (n=)	Incidence of Syncope (n=)	Incidence of Syncope (%)
Brunetti et al. 2012	27,841	2648	9.51[a,b]
Zegre-Hemsey et al. 2019	1,967,542	68,215	3.47[b]
Cwinn et al. 1988	1,952	117	5.99[b]
Duong et al. 2018	Total – 16,116,219	697,726.11[a,b]	4.33[a]
	65 and Older – 6,569,064	373,122.84[a,b]	5.68
	18 to 64 – 9,547,155	324,603.27[a,b]	3.40
Panchal et al. 2022	13,353,268	1,346,549[c]	9.13
Hensel et al. 2017	35,390	3,796	10.73[b]
Kucap et al. 2020	Total – 1,479,530	83,382[a,b]	5.64[a,b]
	2018 – 550,815	34,989	6.35[a,b]
	2019 – 527,837	31,889	6.04[a,b]
	2020 – 400,878	16,504	4.12[a,b]
Ebben et al. 2019	426	42	9.9
Alzareeni et al. 2016	1,390	333.6[a,b]	24
Meisel et al. 2008	401	16.04[b]	4
Ramadanov et al. 2019	1,055	84[c]	7.96[b,d]
Schewe et al. 2019	2004 – 594	-[a]	0.09[b,e]
	2014 – 1,366	-[a]	0.12[b,f]

a Not reported.

b manually generated.

c Number of clinical impressions made. Some patients were given multiple impressions.

d 1,055 patients presented, resulting in 1,378 provisional diagnoses, 84 of which were syncope. Incidence reported in study as 6.1% based on total provisional diagnoses.

e Incidence of syncope reported as 87/100,000 residents/year.

f Incidence of syncope reported as 119/100,000 residents/year.

Table 3. Primary outcome - Incidence of syncope.

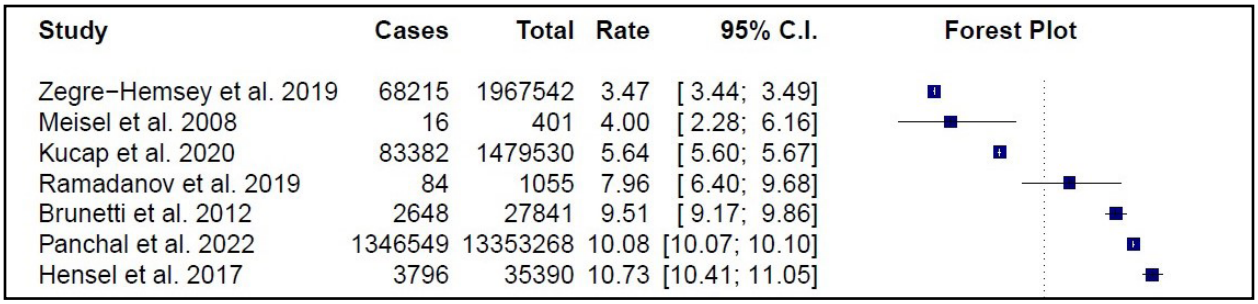

Figure 2. Forest plot of the incidence of syncope from articles rated as good quality.

Description of patient demographics occurred in only three studies and were limited to age and sex. There was agreement amongst the two studies that assessed age. Duong et al. (2018) reported a higher incidence amongst those aged 65 years and older (5.68%), compared to those aged under 65 years (3.4%) from a sample of almost 700,000 syncope presentations. Brunetti et al. (2012), reported a mean age of 66 years (+/-20) amongst their 2,648 syncopal presentations. This suggests that the incidence of EMS syncope presentations may increase with age, however this cannot be reliably concluded due to significant differences in study characteristics.

There were two studies that assessed gender. Brunetti et al. (2012), reported that 53% of all syncope presentation were male, with Hensel et al. (2017) reporting an odds ratio of 1.31 towards female presentations. Although these results may suggest a disagreement of findings, a direct comparison was prohibited due to a difference in sample sizing and reporting measurements.

Other Outcomes

Initial dispatch for syncope was reported by Kucap et al. (2020) and Eben et al. (2019), at 8% and 17% respectively, of all total calls received. As this is higher than the EMS provisional diagnosis of syncope, at 5.64% and 9.9% respectively, this suggests that dispatch may have a lower specificity for syncope. However, this cannot be reliably concluded. Interestingly, Kucap et al. (2020) reported the incidence of both initial dispatch for syncope and provisional diagnosis of syncope reduced by more than 2% during the reported SARS-CoV-2 (COVID-19) pandemic period.

Two studies looked at diagnostic agreement between prehospital emergency physicians and emergency physicians within the ED. Ramadanov et al. (2019) found that diagnostic agreement was achieved 81% of the time from 84 patients. Schewe et al. (2019) reported a drop in diagnostic agreement from 81% in 2004 to 56% in 2014. The authors attributed this drop in agreement to a possible increase in recognition of alternative diagnoses (Schewe et al., 2019). There was no study that looked at diagnostic agreement between EMS providers of other qualification such as paramedics, registered nurses, or Emergency Medical Technicians (EMTs), and in-hospital diagnosis.

DISCUSSION

To our knowledge, this is the first systematic review that has sought to explore the incidence of syncope presentations to EMS and their associated outcomes amongst the current literature. The key finding is that there is no high-quality data specifically looking at syncope presentations and their associated outcomes in the prehospital setting. Instead,

Study	Study Population n=	Initial Dispatch for Syncope n= (%)	T[a] n=(%)	Non-T[a]	Diagnostic Agreement Syncope% (n)	Age	Sex
Brunetti et al. 2012	27,841	NR	NR	NR	NR	Mean age 66 (+/- 20)	53% Male
Zegre-Hemsey et al. 2019	1,967,542	NR	(100)	(0)	NR	NR	NR
Cwinn et al. 1988	1,952	NR	60b	54	NR	NR	NR
Duong et al. 2018	Total – 16,116,219	NR	NR	NR	NR	NR	NR
	65 and Older – 6,569,064	NR	NR	NR	NR	NR	NR
	18 to 64 – 9,547,155	NR	NR	NR	NR	NR	NR
Panchal et al. 2022	13,353,268	NR	NR	NR	NR	NR	NR
Hensel et al. 2017	35,390	NR	NR	NR	NR	NR	1.31 OR Female
Kucap et al. 2020	Total – 1,479,530	119,352[c] (8.07)[c]	NR	NR	NR	NR	NR
	2018 – 550,815	48,121 (8.74)[c]	NR	NR	NR	NR	NR
	2019 – 527,837	45,157 (8.56)[c]	NR	NR	NR	NR	NR
	2020 – 400,878	26,074 (6.50)[c]	NR	NR	NR	NR	NR
Ebben et al. 2019	426	71 (16.7)	(0)	(100)	NR	NR	NR
Alzareeni et al. 2016	1,390	NR	(0)	(100)	NR	NR	NR
Meisel et al. 2008	401	NR	(100)	(0)	NR	NR	NR
Ramadanov et al. 2019	1,055	NR	(100)	(0)	81	NR	NR
Schewe et al. 2019	2004 – 594	NR	(100)	(0)	81	NR	NR
	2014 – 1,366	NR	(100)	(0)	56	NR	NR

a T= Transported. NR = Not reported.
b Three patients also transported by private means.
c Not reported, manually generated.
d Unable to manually generate due to lack of data.

Table 4. Secondary outcomes.

findings are predominantly indirect results from large scale epidemiological studies that lack detailed analysis, or small-scale studies focused only on certain patient characteristics or presentations. Due to the heterogeneity of study characteristics, direct comparisons and conclusions could not be determined. The incidence, risk factors and outcomes of syncope presentations to EMS continue to remain unknown despite the vast research on syncope presentations within the ED and the close interaction between ED and EMS.

Most studies reported an incidence of more than two to three times the reported 1 to 3% incidence of presentations within the ED (Bernier et al., 2020; Long et al., 2016; Somani et al., 2012). However, the incidence of syncope presentations varied significantly, and the significant heterogeneity of studies meant a pooled rate of incidence could not be obtained through meta-analysis. Whilst the rate of transportation remains unknown, prior research has shown that most ED presentations arrive by ambulance (Bernier et al., 2020; Long et al., 2016; Somani et al., 2012; V. Thiruganasambandamoorthy et al., 2013; Thiru-

ganasambandamoorthy et al., 2022; Yau et al., 2019). Given these findings, a significant gap exists within the literature to examine EMS presentations, as well as the relationship between EMS and ED presentations. An understanding of this relationship is essential not only to determine if appropriate transport decisions are being made, but how they are being made and the impacts of these decisions on patient outcomes.

Epidemiological features of patient presentations are of critical importance for the understanding of patient outcomes and determination of risk stratification (Bernier et al., 2020). Studies have shown that the incidence of adverse events within 30 days for patients presenting privately to the ED with syncope to be 10%. However, the incidence amongst those who present to ED via ambulance was found to be even higher at 14.6% (Thiruganasambandamoorthy et al., 2015; Yau et al., 2019). The reasons for this are unknown. Given the transient nature of syncope, most symptoms will have resolved by the time a patient presents to the ED (Somani et al., 2012). EMS providers have the unique advantage of being able to provide early assessment in the field and could be called to presentations that are more severe. In doing so, they may be identifying key findings that would have otherwise resolved prior to arrival at ED (Somani et al., 2012). Alternatively, if EMS providers are possibly attending a higher incidence of syncopal presentations, they may already be diverting patients away from the ED. If so, important questions remain. How are EMS clinicians currently assessing and risk stratifying syncopal presentations? Is this being done safely?

The studies from this review, suggesting that syncope may increase with age and was higher in those aged over 65, is congruent with previous ED research (Brunetti et al., 2012; Duong et al., 2018; Sutton et al., 2022; Yau et al., 2019). However, no study provided a further breakdown of medical history, medications, or other risk factors nor sought to identify a link with patient outcomes. Only the study by Brunetti et al. evaluated the incidence of an adverse event amongst prehospital syncope presentations, finding a positive correlation with age (Brunetti et al., 2012).

Through ED studies such as the EGSYS 2 and RiSEDS study, an understanding of patient outcomes and their relationship to risk factors have been achieved. These studies have then been integral in the development of risk stratification tools to help guide clinical decision making within the ED (Cosgriff, Kelly, & Kerr, 2007; Venkatesh Thiruganasambandamoorthy et al., 2020; Andrea Ungar et al., 2010). These risk stratification tools are cost-effective and are now being shown to effectively reduce patient hospitalisation (Anand et al., 2018; Brain et al., 2023; Zimmermann et al., 2022).

The results from this review show that EMS have a potentially significant role in the initial assessment and management of syncope patients. Despite this, an understanding of the epidemiology and outcomes of syncopal presentations to EMS remains poorly understood when compared to ED. Whilst several risk stratification tools exist within the ED setting for syncope, there is no such tool available within the prehospital setting. The development of a validated risk assessment tool or guideline within the prehospital setting would allow EMS providers to identify, safely and correctly, those requiring emergency care from those of lower risk. This could then reduce unnecessary transports leading to improved and more cost-efficient patient care. For this to be achieved, further evidence is firstly required to provide a greater understanding of the incidence of syncope presentations to EMS and their associated outcomes.

LIMITATIONS

A key limitation within the evidence of this review is that most studies were either large scale epidemiological studies that lack detailed analysis or had small samples focusing on only certain patient characteristics or presentations. Most of the studies did not define syncope and in several studies the inclusion of paediatric presentations could not be reliably removed.

Whilst the definition of syncope seems clear, the aetiology and subsequent diagnosis is less so. The omission of a clear definition for the diagnosis of syncope within certain studies puts into question whether such presentations would have been otherwise included or excluded from similar studies that did provide a definition of syncope. Similarly, different studies determined syncope to be either a primary complaint or clinical impression. The variance in the reported incidence of syncope found in these studies could also be explained if EMS providers are listing syncope as the primary complaint or reason for calling, rather than as a provisional diagnosis after a clinical assessment. Ultimately, these considerations represent a significant limitation upon the reported incidence of syncope.

Limitations of the Review Process

There was significant disagreement between reviewers regarding inclusion of studies which may have produced a bias of results. On investigation of the disagreement regarding inclusion of studies, a key finding was that many studies met the inclusion criteria: where the study sample had contact with EMS, with a primary complaint/clinical impression of syncope, and there was epidemiological data available regarding the EMS contact. However, the studies were still conducted from within the ED setting, using ED data. This meant that the data was not actually obtained from the prehospital setting. Upon further review and discussion, there was consensus that such papers should be excluded as the exclusion criteria could not be reliably determined. In other studies, a clear determination of a provisional diagnosis or clinical impression for syncope could also not be made. Whilst exclusion of these studies may have created a bias within the results, the authors believe this to be minimal.

There was also significant conflict regarding assessment of study quality. Upon investigation, a key finding was the experience between MC and MWS in assessment of studies. This conflict did not impact on the outcomes of this study.

A meta-analysis of the data could not be completed due to insufficient studies available for pooling and the heterogeneity sample characteristics. Similarly, a sensitivity analysis was not appropriate given the low number of studies, and as the heterogeneity of their findings meant pooling of data was inappropriate.

CONCLUSION

There is no high-quality data specifically looking at syncope presentations and their associated outcomes in the prehospital setting within the current literature. Instead, a limited number of studies reported on the incidence, patient demographics, and associated outcomes indirectly from either large-scale epidemiological studies that lack detailed analysis, or small-scale studies focused only certain patient characteristics or presenta-

tions. Syncope presentations in the prehospital setting may be more than two to three times the incidence of presentations within the ED, but the true rate of incidence remains unknown. Despite this finding, there is a further lack of data describing the epidemiology and the associated outcomes of these patients. EMS clinicians could play an important role in assessing and diverting low risk patients away from the ED. For this to be done safely and efficiently, a better understanding of the epidemiology, outcomes, and associated risk factors of syncope patients presenting to EMS is required.

APPENDICES

Population		"AND"	Exposure (18)	
1. Ambulances/	OR		1. exp Syncope/	OR
2. Emergency Medical Technicians/	OR		2. Syncop*.mp.	OR
3. Air Ambulances/	OR		3. "transient loss of consciousness".mp.	OR
4. Emergency Medical Services/	OR		4. Unconsciousness/ or syncope/	OR
5. Paramedic*.tw.	OR		5. "altered level of consciousness".mp.	OR
6. ems.tw.	OR		6. "altered consciousness".mp.	OR
7. Emt.tw.	OR		7. Consciousness disorders/	OR
8. Prehospital.tw.	OR		8. Vasovagal.mp.	OR
9. pre-hospital.tw.	OR		9. Hypotension, Orthostatic /	OR
10. first responder*.tw.	OR		10. Orthostatic hypotension.mp.	OR
11. emergency medical technicians.tw.	OR		11. faint*.mp.	OR
12. ambulance*.tw.	OR		12. collapse.mp.	OR
13. HEMS.tw.	OR		postural hypotension.mp.	
14. field triage.tw.	OR			
15. out-of-hospital.tw.				

Appendix 1. Ovid Search Strategy Using the Boolean Operators.

Inclusion Criteria	
✓	Contact with pre-hospital emergency medical service AND
✓	Primary complaint / clinical impression of syncope AND
✓	Epidemiological data regarding EMS contact with syncope patients, such as incidence, patient demographics and associated outcomes such as EMS interventions, transports vs non-transport, aetiology, mortality, morbidity or adverse outcomes.
Exclusion Criteria	
×	Case reports, literature reviews, perspective or editorials, conference abstracts OR
×	Syncope in the setting of an alternative provisional diagnosis/clinical impression, such as Acute myocardial infarction (AMI). Cardiac arrest. Lethal arrythmia such as ventricular fibrillation (VF) or ventricular tachycardia (VT), stroke or aortic dissection OR
×	Syncope in patients who have received life supporting interventions such as defibrillation, cardioversion, cardiopulmonary resuscitation (CPR), extracorporeal membrane oxygenation, vasopressor or anti-arrhythmic medications OR
×	Pre-syncope or near-syncope only OR
×	Paediatric patients as defined by study authors in individual studies OR
×	Specific settings not generalisable to daily public life OR
×	Specific events such as mass gatherings, sporting events, festivals, or exposure to new environments, such as high altitude
Exclusion Reasons	
×	Not EMS setting
×	Full text not available
×	No contact with registered pre-hospital emergency medical service
×	Unable to clearly determine provisional diagnosis/clinical impression of syncope - Data presented as collapse, or altered conscious state or falls only
×	No epidemiological data on syncope or on patient outcomes
×	Syncope in the setting of an alternative provisional diagnosis/clinical impression
×	Unable to separate syncope data from other grouped data - Syncope data grouped in with other conditions such as seizure, coma, altered conscious state, acute coronary syndrome etc. or age
×	Full text not in English

Appendix 2. Inclusion and Exclusion Criteria.

Section and Topic	Item #	Checklist item	Location Where Item is Reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Attachment
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 4
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Table 5
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 5
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Table 5
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 5
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 6
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 6
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Page 6
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 6
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 6
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 6
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Page 6
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Page 6
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Page 6
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	N/A

Appendix 3. Prisma Checklist.

Section and Topic	Item #	Checklist item	Location Where Item is Reported
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 7
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Figure 1
Study characteristics	17	Cite each included study and present its characteristics.	Table 1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Page 8
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Table 3
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Page 8
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Figure 2
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Page 12
	23b	Discuss any limitations of the evidence included in the review.	Page 13
	23c	Discuss any limitations of the review processes used.	Page 13
	23d	Discuss implications of the results for practice, policy, and future research.	Page 12
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Page 5
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Page 5
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Page 15
Competing interests	26	Declare any competing interests of review authors.	Page 15
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	N/A

Appendix 3 (continued). Prisma Checklist.

Section and Topic	Item #	Checklist item	Reported (Yes/No)
TITLE			
Title	1	Identify the report as a systematic review.	Yes
BACKGROUND			
Objectives	2	Provide an explicit statement of the main objective(s) or question(s) the review addresses.	Yes
METHODS			
Eligibility criteria	3	Specify the inclusion and exclusion criteria for the review.	Yes
Information sources	4	Specify the information sources (e.g. databases, registers) used to identify studies and the date when each was last searched.	Yes
Risk of bias	5	Specify the methods used to assess risk of bias in the included studies.	Yes
Synthesis of results	6	Specify the methods used to present and synthesise results.	Yes
RESULTS			
Included studies	7	Give the total number of included studies and participants and summarise relevant characteristics of studies.	Yes
Synthesis of results	8	Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (i.e. which group is favoured).	Yes
DISCUSSION			
Limitations of evidence	9	Provide a brief summary of the limitations of the evidence included in the review (e.g. study risk of bias, inconsistency and imprecision).	Yes
Interpretation	10	Provide a general interpretation of the results and important implications.	Yes
OTHER			
Funding	11	Specify the primary source of funding for the review.	Yes
Registration	12	Provide the register name and registration number.	Yes

Appendix 4. Prisma Abstract Checklist.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

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REVIEW

OCCUPATIONAL FACTORS INFLUENCING PARAMEDIC HEALTH AND WELLBEING: A SCOPING REVIEW

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ABSTRACT

Introduction: Health and wellbeing is essential to perform professionally and personally. The demanding workload and high-pressure nature of the paramedic profession undoubtedly have an influence on health and wellbeing; however, the individual variance and factors associated with this are poorly understood. The objective of this review is to identify what is known about the occupational factors that influence paramedic health and wellbeing and to make recommendations on how to improve working conditions and promote the health and wellbeing of the paramedic workforce.

Methods: The Joanna Briggs Institute (JBI) approach was used to perform a scoping review to assess the availability of literature dating from January 2003 to January 2023. Keywords including paramedic*, emergency medical technician*, first responder*, influence* OR perception*, health, wellbeing were input into the OVID, PsycINFO, and PubMed databases. Titles and abstracts were reviewed by two independent authors, and inclusion and exclusion criteria were applied. The remaining articles were reviewed in full text by two authors, and conflicts were managed by the primary author.

Results: The search of the electronic databases identified 314 articles. Of these, 33 informed the results of the review. The search highlighted paramedics' poor reportable levels of health compared to other occupations. An analysis identified key themes emerging from the literature including (1) shift work, (2) mental health issues, (3) exposure to critical incidents, and (4) the influence of the profession on physical activity and ailment.

Conclusion: A paramedic's occupation significantly influences the individual's health and is associated with an increased incidence of reportable illness and injury. The review concluded insufficient data to identify the paramedic's personal perception of the influences on their health and wellbeing. There is little understanding of why the paramedic has poor reportable levels of health, which would be invaluable forming preventative and supportive approaches

INTRODUCTION

Health and wellbeing are essential for effective functioning both in the workplace and in everyday life. The occupational stressors faced by paramedics in their day-to-day work have been shown to negatively impact on their health and wellbeing (Wheeler &

Dippenaar, 2020). Paramedics are often required to work extensive hours in challenging conditions, impacting on their health and wellbeing and potentially impacting patient care (Meadley et al., 2020). Exploring these influences is vital to ensure paramedics are supported to carry out their duties and provide high patient care standards, without compromising their health and wellbeing (Meadley et al., 2020; Wheeler & Dippenaar, 2020).

Lawn et al. (2020) share the concern that paramedics are often a forgotten profession whose work in the healthcare system is concealed by more dominating areas, including emergency departments and acute care. A study conducted by Petrie, Smallwood, Pascoe, and Willis (2022) reporting on the working environments and mental health symptoms of Australian paramedics shared that the recent COVID-19 pandemic posed a significant threat to the wellbeing of paramedics, and during this time, only 66.3% of paramedics in this study believed that their wellbeing was being actively supported by their workplace leaving 33.6% stating they neither agree or disagree; or disagree/strongly disagree to the fact. These statistics are in addition to isolation from friends and family during this time, which was also seen to negatively effect on paramedic wellbeing (Petrie et al., 2022).

Lawn et al. (2020) further explain a high prevalence of physical and psychological ailments experienced by the paramedic workforce ultimately negatively impacting their wellbeing with a very limited understanding in the literature of the key elements within the profession that contribute to the issue.

Potential areas of concern are expressed by Heath, Wankhade, and Murphy (2021), who noted that 29% of ambulance staff report bullying, harassment, or abuse from other members within the workplace. The same study also highlighted that paramedics are placed unnecessarily under stressors through public perception and depiction of paramedics as heroes and masculine, which may put more pressure on the workforce to risk their wellbeing in trying to uphold this image (Heath et al., 2021).

A significant amount of the responsibility in ensuring the wellbeing of paramedics falls on the organization. Research shows that when this is carried out, a positive wellbeing outcome can be achieved (Wheeler & Dippenaar, 2020). Some strategies are provided in the literature addressing the health and wellbeing of paramedics, such as Lawn et al. (2020) approach of program specific interventions to address the psychological impact of attending a stressful case in addition to programs designed to address organisational issues and constructs.

However, while it is of benefit to identify the statistics of paramedic wellbeing and strategies which are in place to mitigate challenges to health and wellbeing , there is not enough evidence to demonstrate that generalizing these strategies across different services will address the broader population of paramedics (Lawn et al., 2020). To ensure that paramedic wellbeing is genuinely being addressed, we seek to understand the extent to which working in the paramedic profession influences health and wellbeing as individual variances are unknown. Meadley et al. (2020) argue that focusing on this will optimise paramedics' health and wellbeing, allowing ambulance services to meet their duty of care in establishing a safe and healthy workplace. This review aims to identify what is known regarding the occupational factors that influence paramedic wellbeing

and to make recommendations on how services can improve working conditions and promote the health and wellbeing of their employees.

METHODS

Methodological Framework and Reporting

This scoping review adheres to the Joanna Briggs Institute (JBI) methodology and the preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews (PRISMA-ScR). The search was registered through the OSF register DOIÊ10.17605/OSF.IO/6JF4R.

Inclusion Criteria

For evidence to be included within the scoping review, articles must have met a pre-determined set of inclusion and exclusion criteria outlined in Table 1. These were developed in line with the agreed PCC (population, concept, context) to examine the question of what occupational factors influence paramedic health and wellbeing? The criteria were discussed and unanimously agreed upon by all authors.

Criteria for Inclusion	Criteria for Exclusion
Population – Paramedics	Other healthcare workers and allied health professionals
Context – Paramedic health and wellbeing	Relating to in-hospital health care or healthcare professionals within tertiary facilities
Context – comparable health systems	Literature reviews, systematic reviews, meta-analysis
Concept – pertaining to the identification of influences on health and well being	Studies predating 2003
Concept – the identification of incidence and prevalence of disease within the paramedic cohort	Grey literature including unpublished studies
Concept – identification of patient or organisational stressors	Not in the English language

Table 1. Inclusion and exclusion criteria.

Search Strategy

A comprehensive three-step search strategy was undertaken to identify relevant published studies for the review. An initial limited search was undertaken to identify articles relating to the topic. The text words contained in the titles and abstracts of relevant articles, as well as the index items used to describe the articles were used to develop a full search strategy for MEDLINE ALL, Scopus, and OVID. These databases were selected as they are archives of pre-hospital and paramedicine literature. This was important as the extent of the existing literature on the topic was unknown.

The search utilized a combination of the following key terms: Paramedic*, emergency medical technician*, influence*, perception*, health*, wellbeing*. Other key terms included ambulance*, occupation*, first responder*, EMS, EMT, prehospital, attitude*, impression*, health*, effect* and welfare. Search terms were combined with appropriate Boolean terms and truncation symbols. The search strategy, including all identified keywords and index terms, was adapted for each database and/or information source. All reference lists of sources included were reviewed to identify further publications. Only studies published in English were included, and the date of publication was limited to studies published since January 2003 to determine the contemporary evidence base.

Evidence Screening and Selection

Following the search, all identified citations were collated and uploaded into EndNote, and duplicates were removed. The initial search of OVID, Scopus, and MEDLINE ALL identified 446 results following limiting and restricting data from the last twenty years (2003-2023). Following the removal of duplicates, 314 articles remained for screening. Following a pilot test, titles and abstracts were then screened by two independent reviewers for assessment against the inclusion criteria for the review. Relevant sources were reviewed in full, of which there were 65, and citation details were imported into the JBI System for the Unified Management, Assessment and Review of Information (JBI SUMARI) (JBI, Adelaide, Australia). Teo independent reviewers assessed the full text of selected citations in detail against the inclusion criteria. Reasons for the exclusion of sources in full text were recorded and reported. Any disagreements between reviewers at each stage of the selection process were resolved through discussion with all authors. Of the 65 results screened in full, 33 were included in the scoping review. The search results and the study inclusion process were reported in the final scoping review and presented in a Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for scoping review (PRISMA-ScR) flow diagram (see appendix 1).

Data Extraction

Data was extracted from papers included in the scoping review by two independent reviewers using a data extraction tool developed by the reviewers (see Appendix 2). The data extracted included specific details about the population, concept, context, study methods, and key findings relevant to the review objective. Any disagreements between reviewers were resolved through discussion with an additional reviewer.

Data Analysis and Presentation of Results

In keeping with Arksey and O'Malley's fourth stage of performing a review, the data was analyzed and charted. This refers to the process of extracting and summarising data logically and descriptively from which further narrative can be written. Six criteria were used to analyze and present the results of each article, which included: author(s), date of publication, origin, aim, study design, and key findings. Refer to Appendix 2 for the summary of included articles, which provides an overview of the 34 included articles.

RESULTS

The above search strategy retrieved 314 results, of which 65 appeared potentially relevant. The full-text review identified 33 papers that informed the the scoping review results. An analysis of the included publications identified four recurrent themes in the literature which addressed the question of what occupational stressors influence paramedic health and wellbeing, including (1) shift work, (2) mental health issues, (3) exposure to critical incidents, and (4) the professions influence on physical activity and ailment.

Shift Work

Due to the nature of paramedic work, shift work and rotating shift patterns are unavoidable. Shift work was found to result in fatigue and sleep disturbance in several articles reviewed in this study (Aasa et al., 2005; Betson, Kirkcaldie, Zosky, & Ross, 2022; Blau,

2011; Courtney, Francis, & Paxton, 2013). A field investigation by Khan, Jackson, Kennedy, and Conduit (2021) assessed the rotating shifts and the relationship of shift work to sleep, mental health, and physical activity in Australian paramedics. It was found that night shifts were associated with higher levels of fatigue, sleepiness, and stress. This was in addition to the finding that rotational shifts caused the participants to experience sleep restriction (Khan et al., 2021). Fatigue and sleep disturbances were identified as key indicators of paramedic perception of their health in an earlier study (Aasa et al., 2005), and paramedics with poor sleep quality were particularly at risk of increased levels of fatigue, most notably in the rural population (Courtney et al., 2013). Self-reported poor sleep patterns had a significantly poor effect on the perceived general health and retention intent of American paramedics (Blau, 2011). More contemporarily, in an Australian study highlighted that poor sleep quality increased by 35.4% (n=28) in the first five months of a paramedic's career (Betson et al., 2022). The impact of shift work creating fatigue and sleep disturbances, which influence paramedic health, is significantly reported in the literature identified in this review, as is the effect of paramedic shift work on the individual's mental health and thus, wellbeing.

Mental Health Issues

Several studies examined the overall mental health of paramedics (Bennett, et al., 2004; Iranmanesh, Tirgari, & Bardsiri, 2013; Jonsson, Segesten, & Mattsson, 2003; Roberts, Sim, Black, & Smith, 2015). Jonsson highlighted that one-third of their 362 survey participants indicated high levels of psychopathology, burnout, and posttraumatic symptoms (Jonsson et al., 2003). More contemporarily, Roberts et al. identified that paramedics have the highest rates of mental injury in comparison with other healthcare workers. This was approximately 13 times higher than nurses (Roberts et al., 2015). Similarly, Iranmanesh et al. (2013) found 94% of Iranian paramedics and hospital emergency personnel (n=400) reported moderate posttraumatic stress disorder (Iranmanesh et al., 2013). This was significantly more than an earlier study by Bennett, where 22% of 617 paramedics in the United Kingdom had posttraumatic stress disorder, and one in ten reported "probable" clinical depression (Bennett et al., 2004). However, it is important to note that their working environments may have differed significantly. In comparison to the general population of Australia and Western countries, Khan, Conduit, Kennedy, and Jackson (2020), reported findings in paramedics of significantly higher levels of fatigue, anxiety, depression, and PTSD (all $p < .05$) (Khan et al., 2020).

Further studies (Crampton, 2014; Petrie et al., 2018) identify the link between paramedic mental health and organizational behavior. Petrie et al. identified that the manager psychosocial safety climate accounted for a significant amount of variance in levels of mental health disorders in the workforce but only identified 7.6% of their 1622 participants as having a mental health disorder, which is significantly less than other studies (Petrie et al., 2018). This study was completed in Australia and highlighted the perceived importance of managerial behavior as a protective effect on employee mental health (Petrie et al., 2018). Crampton (2014), in the United States of America identified that a lack of support by the employing organization. No rural paramedics within the population sampled felt that the organization offered any significant support, while their metropolitan counterparts found that 18% were offered significant support (Crampton, 2014). Lack of organizational support, including social aspects of the working environment, most

poignantly the lack of support from supervisors, were a significant risk factor for stressors in the workforce and resultant wellbeing effects (van der Ploeg & Kleber, 2003).

There is evidence of post-traumatic stress disorder being reported at a rate of 14.6% in paramedics (n=668) compared to 1.3Ñ3.5% in the general population of Switzerland; however, factors which contributed to this were unknown (Streb, HŠller, & Michael, 2014). Rates of depression and anxiety amongst paramedics are reported as statistically significant, along with rates of obesity, cardiovascular disease, and sleep disorders (Courtney et al., 2013). In an Australian study comparing the resilience of working paramedics (n=146) to student paramedics (n=73), it was found that working paramedics were more resilient; however, this resilience began to decline after five years of work experience (Gayton & Lovell, 2012). Another study in Norway found that paramedics had a higher prevalence of post-traumatic stress disorder than the general population. Interestingly, 77% (n=370) of respondents reported personal growth due to their working experiences (Reid et al., 2022). Paramedics were also assessed following exposure to a significant airplane crash, a critical incident. It was highlighted that there were more significant rates of acute stress disorder, PTSD, and depression at 13 months post-exposure than comparison participants. Acute stress disorder rates were 25.6% (n = 53), whereas comparison participant rates were 2.4% (n=10). Similarly, PTSD rates at 13 months were reported at 16.7% (n = 19) compared to 1.9% (n = 4), highlighting the deleterious effects of the work which they are required to do (Fullerton, Ursano, & Wang, 2004). While paramedic perception of their health is poorly understood, there appears to be a consensus across research that the paramedic understands the link between their career and their level of health and wellbeing, albeit their state of mental health (Sofianopoulos, Williams, Archer, & Thompson, 2011).

Exposure to Critical Incidents

Avraham, Goldblatt, and Yafe (2014) highlighted through interviews the overwhelming deleterious effect that exposure to critical incidents has on paramedic mental health (Avraham et al., 2014). Aasa et al. (2005), identified that 25% (n=60) of female and 20% (n=240) of male paramedics identified two or more significant health complaints associated with psychological demands of critical incidents (Aasa et al., 2005). In the trainee workforce of paramedics, Fjeldheim et al. (2014) noted 94% (n=131) had directly experienced trauma, with a high number meeting post-traumatic stress disorder criteria along with depression, alcohol abuse, and chronic perceived stress (Fjeldheim et al., 2014). Furthermore, Hansen, Rasmussen, Kyed, Nielsen, and Andersen (2012) identified that the paramedic workforce was exposed to an emotional demand that was statistically significant and that the nature of the work, most notably critical incident exposure, served as a barrier to improving the psychosocial working environment for this occupation (Hansen et al., 2012). Pyper and Paterson (2016) supported this more contemporarily in their study of paramedics (n=134) where treating critically ill patients was identified as a key component of stress linked with emotional trauma (Pyper & Paterson, 2016). In a New Zealand study comparing the effect of critical incidents and the health of ambulance, fire, and police personnel, the average reported level of trauma reactions was similar across services (Brough, 2004). However, in a later study, Gist and Taylor (2008) found that paramedics endure significantly greater stress than other emergency workers (Gist & Taylor, 2008).

Maunder, Halpern, Schwartz, and Gurevich (2012) investigated the responses of paramedics to critical incidents and identified that those who had experienced childhood abuse or neglect more frequently experienced signs of acute stress immediately following critical incidents and during the two weeks following. Childhood abuse and neglect were associated with significantly higher levels of burnout and interestingly had a higher prevalence of Ôcases' scoring above the threshold for clinical significance (Maunder et al., 2012). This finding related to a subgroup within the workforce highlighting the impact of critical incidents. Back et al. (2009), explored salivary cortisol in paramedics during their shifts, concluding that paramedics appeared to build a tolerance to critical situations. However, when comparing cortisol levels in patient transport officers and paramedics, paramedics had significantly higher cortisol levels ($p<0.5$) at the commencement of the shift than those in patient transport, suggesting an adjustment to forthcoming demand (Back et al., 2009). This confirmed the findings of an earlier study by Aasa, Kalezic, Lyskov, ngquist, and Barnekow-bergkvist (2006), which found that the highest levels of cortisol stress markers were observed at the commencement of shift (Aasa et al., 2006).

Professions Influence on Physical Activity and Ailment

Aasa et al. (2005), highlighted that headache and stomach issues were frequent in paramedics and significantly associated with work conditions (Aasa et al., 2005). Similarly, Courtney et al. (2013) highlighted that low levels of physical activity were reported by paramedics. They attributed these to the lifestyle that limits the opportunity for regular exercise and a commitment to team-oriented sporting activities (Courtney et al., 2013). Sofianopoulos et al. (2011), also identified significantly reduced levels of physical activity, which led to physical fatigue in the paramedic population (Sofianopoulos et al., 2011). A Hungarian study identified that physical activity during personal time played a protective role and improved the perception of paramedic physical health (Pek et al., 2015). In Sweden, Karlsson identified that ambulance personnel were at higher risk of being affected by musculoskeletal disorders and atrial fibrillation than other occupational groups (Karlsson, Nasic, Lundberg, MŒrtensson, & Jonsson, 2022). Another smaller study (n=25) that highlighted poor cardiovascular health was that of Tremblay, Albert, Fischer, Beairsto, and Johnson (2020), who explored the health status of experienced New Brunswick Paramedics. They found that only two-fifths of the population were considered Ôhealthy' (Tremblay et al., 2020). An additional study also conducted in America identified that paramedics who had optimal cardiovascular health tended to be younger, female, and more highly educated. They also found that a large proportion of paramedics were classified as obese, which is a known cardiovascular risk factor (Cash, Crowe, Bower, Foraker, & Panchal, 2019). The current evidence base links the influence of the paramedic's job to their poor levels of health and wellbeing, by physical activity and ailments.

While there is a clear emergent theme on the profession's effect on paramedic's physical health, one study did identify a disparity in health metrics between different levels of paramedics. An Australian longitudinal cohort study found that intensive care flight paramedics had metabolic health markers within normal reference ranges. This was despite prolonged exposure to shift work patterns and is thought to be largely due to increased physical activity levels compared to the general paramedic population (Meadley, Perraton, Smith, Bonham, & Bowles, 2022). Additionally important to note are the

results of a contemporary study completed in Australia where graduate paramedics were assessed and monitored over the first twelve months of their career, and changes to cardiometabolic, dietary, and physical health were tracked. They identified that baseline BMI, physical activity levels, and dietary behaviors were suboptimal for recruitment into the ambulance service (Meadley, Wolkow, et al., 2022). This alludes to the potential that the paramedic professional cohort has risk factors present prior to joining the industry, which may be deleterious due to the profession's exacerbation of these. This is further supported by Tsismenakis et al. (2009), they identified in a study of 370 emergency responder candidates in America that 77% had a body mass index in excess of 25kg/m2 and 33% were classified as obese. Thus, excess weight is highly prevalent and associated with elevated cardiovascular risk among the future workforce in a population expected to perform physically demanding duties (Tsismenakis et al., 2009).

DISCUSSION

Shift work has been identified as hurting sleep quality resulting in increased levels of fatigue and on perceived wellbeing, mental health, and job satisfaction (Dawson, Ferguson, & Vincent, 2021; E. A. Donnelly et al., 2019; Kirby, Moreland, & Pollard, 2016; Nguyen et al., 2023; Ramey et al., 2019; Sofianopoulos et al., 2011; Yung, Du, Gruber, & Yazdani, 2021). The impact of shift work on sleep and fatigue have been widely reported among professionals across multiple occupations, with negative effects often more pronounced in those working in high-pressure, cognitively demanding occupations such as healthcare and emergency services roles (Courtney et al., 2013; Okechukwu et al., 2023; Sofianopoulos et al., 2011). The inherent unpredictability of these occupations, which may result in peak demand, affecting opportunities for breaks and resulting in end of shift overtime further compounds the existing challenges associated with shift work (Courtney et al., 2013; Kirby et al., 2016). Shift work disorder (SWD) characterized by insomnia and excessive sleepiness, can result in increased levels of depression, anxiety and reduced quality of life. It may result in impaired performance and increased risk of occupational accidents and workplace violence (Eldevik, Flo, Moen, Pallesen, & Bjorvatn, 2013).

Fatigue has been shown to have negative impacts on physical health, contributing to increased rates of chronic illness, cardiovascular conditions, obesity, chronic sleep deprivation, and poor general health (Barth, Greene, Goldstein, & Sibley, 2022; Nguyen et al., 2023). There are several studies reporting high levels of fatigue among shift workers (Dawson et al., 2021; Kirby et al., 2016; Shriane, Russell, Ferguson, Rigney, & Vincent, 2023) with Richter, Acker, Adam, and Niklewski (2016) reporting almost 90% of shift workers suffering from fatigue and sleepiness at work. Sofianopoulos et al. (2011) reporting similar figures. Shift work can result in circadian misalignment and sleep loss, which impact the safety of clinicians (increased risk of driving accidents) and patients (increased risk of medication errors), with night shifts being the most high-risk shift (E. A. Donnelly et al., 2019; Ganesan et al., 2019; Pyper & Paterson, 2016; Sofianopoulos et al., 2011). The circadian misalignment associated with shift work, especially night shifts, results in physiologic changes, further impacting the risk of illness and chronic disease among shift workers (Barger et al., 2018).

Given the negative impact of shift work and fatigue on paramedics and other emergency service workers and the increased risks of adverse events which may result in harm

to the individual or their patients, research into the impact of different shift patterns to mitigate fatigue should be prioritized, and there should be an increased focus on implementing fatigue management programs for emergency service workers (Barger et al., 2018; Cheng, Roach, & Petrilli, 2014; Patterson et al., 2018).

The impact of occupational stressors on the mental health and wellbeing of paramedics and other first responders has been well-studied, and there is consensus among the literature surrounding the negative impact of the occupation on mental health and wellbeing. Paramedics and emergency service workers have been reported to have higher rates of depression, anxiety, PTSD, and associated psychological morbidities, as well as a higher risk of burnout and higher risk of mortality (Blau, 2011; Clompus & Albarran, 2016; McIntosh et al., 2016; Sterud, Ekeberg, & Hem, 2006). These high rates of morbidity in the profession highlight the need for research to identify individual factors that paramedics perceive to influence their health and wellbeing (Hegg-Deloye et al., 2014); R. Roberts et al. (2021), noted the impact of COVID-19 in further increasing the rates of depression, anxiety, and burnout among Australian paramedics and other first responders (R. Roberts et al., 2021). UK statistics reported that 87-93% of first responders experienced mental health problems at some point during their career (Mind, 2014), and paramedics and first responders have been found to have higher levels of suicidal ideation, with one study reporting up to one-third of paramedics had considered suicide (Newland, Barber, Rose, & Young, 2015).

One significant contributing factor is exposure to critical incidents and the cumulative impact. The literature suggests exposure to critical incidents is common among paramedics, with one study reporting 64% of paramedics were exposed to two or more critical incidents over five years and a further study reporting 72-97% of paramedics had been exposed to at least one critical incident (E. Donnelly & Siebert, 2009; Oginska-Bulik & Kobylarczyk, 2015; Skeffington, Rees, & Mazzucchelli, 2017; Whiting, Costello, & Williams, 2019). Exposure to critical incidents is linked to an increased risk of mental health problems, notably PTSD and burnout, and this risk increases further with cumulative exposure to critical incidents (Alexander & Klein, 2001; Boland et al., 2018). In a New Zealand study comparing the effect of critical incidents and health between police, fire, paramedics, and emergency department personnel the average reported level of trauma reactions was similar across services (Brough, 2004).

There is limited literature concerning the mental health impacts of exposure to critical incidents among student paramedics (Lowery & Stokes, 2005) and a lack of data on the mental health of early career paramedics, although several studies are underway, including the International Paramedic Anxiety and Wellbeing Study (IPAWS), the first longitudinal study to investigate the mental wellbeing of paramedic graduates in the first five years of their careers (Asbury et al., 2018). While it is acknowledged that exposure to critical incidents cannot be avoided due to the inherent nature of the occupation, there are opportunities to develop strategies to mitigate the impact of exposure to critical incidents on paramedic's mental health and to proactively equip them to better manage the associated stressors.

Paramedics are reported to have poor levels of physical health with an increased risk of shift work disorder (Barth et al., 2022; Nguyen et al., 2023; Pallesen et al., 2010), chronic illness, cardiovascular conditions and hypertension (MacQuarrie et al., 2018; Torquati,

et al., 2018), and obesity and cancer (Gan et al., 2018; Pahwa, Labr che, & Demers, 2018). As shift workers, paramedics are also at higher risk of other health problems such as metabolic disease, disorders of the immune system, and depression (Wolkow, Ferguson, Aisbett, & Main, 2015). Other symptoms can manifest following chronic exposure to stress and common occupational challenges (extended shift times), such as fatigue, headaches, and gastrointestinal disturbances (E. Donnelly & Siebert, 2009; Halpern, Gurevich, Schwartz, & Brazeau, 2009; Klimley, Van Hasselt, & Stripling, 2018; Knutsson & B¿ggild, 2010; Rice, Glass, Ogle, & Parsian, 2014; Sterud et al., 2006).

Paramedics have higher rates of musculoskeletal and back injuries due to the manual handling requirements associated with operating in hostile and unpredictable environments (Karlsson et al., 2022). The risk of musculoskeletal injuries is increased further due to the prevalence of obesity, and the lack of physical fitness compounded by fatigue of shift work (Gallagher & McGilloway, 2008; Hegg-Deloye et al., 2014; MacQuarrie et al., 2018; Rice et al., 2014; Tsismenakis et al., 2009). Paramedics are also at increased risk of other workplace incidents such as needlestick injuries (Flannery, 2015; Larsson, Berglund, & Ohlsson, 2016; Rice et al., 2014).

Paramedics acknowledge the importance of physical fitness but highlight the difficulties of maintaining an active lifestyle due to the challenges of shift work and the impact of fatigue. The physical and cognitive demands of emergency work often prevent adequate rest in between shifts and paramedics may struggle to maintain a healthy work-life balance (Hegg-Deloye et al., 2014; Larsson et al., 2016; Regehr & Millar, 2007). The literature shows poor levels of health and fitness among paramedics with the exception being those who operate in more specialized roles such as flight medics (Meadley, Perraton, et al., 2022). Organizational support is vital in supporting staff to manage or maintain their fitness, to remove barriers to good health, and to actively promote the importance of maintaining a healthy work-life balance (MacQuarrie et al., 2018; Rice et al., 2014)

LIMITATIONS

Notwithstanding the strengths of the scoping review, there are apparent limitations. The search terms in the strategy, while broad, did not capture all relevant literature. Additionally, while international findings were reviewed, only studies published in English were included, potentially limiting results.

CONCLUSION

Paramedics are front-line emergency service workers who see a diverse range of patients daily. The workforce is often constrained to the inside of their ambulance for significantly lengthy hours, with limited time for breaks (Meadley et al., 2020). A comprehensive search of the literature was undertaken to find relevant information regarding the influence of the paramedic profession on the health and wellbeing of paramedics. Results found shift work to significantly influence fatigue, leading to poor sleep patterns for paramedics. Research into strategies to mitigate fatigue, such as evaluating the impact of different shift patterns should be prioritized, and fatigue management programs should be implemented and evaluated for effectiveness (Barger et al., 2018; Cheng, Roach, & Petrilli, 2014; Patterson et al., 2018). The profession was also seen to be a catalyst for developing mental illnesses, including burnout and post-traumatic stress disorder, which can be exacerbated by exposure to critical incidents and can impact paramedics' physical

health. Further research is recommended into strategies to mitigate the impact of exposure to critical incidents and to enhance the mental preparedness of paramedics to cope with occupational stressors. A further research priority concerns the impact of leadership in promoting psychologically safe workplaces and how organizations can better support employee health by removing barriers and supporting positive health behaviors (MacQuarrie et al., 2018; Rice et al., 2014).

There is insufficient data in the literature to identify the paramedics perception of the key influences on their health and wellbeing resulting in a lack of understanding of the reasons for paramedic's poor levels of self-reported health. Further research is recommended to fully comprehend the paramedics personal perception of their health and wellbeing, as the benefits of these perceptions could assist organizations to develop tailored support and prevention strategies to improve paramedics' overall health and wellbeing. This may also assist in alleviating the economic burden of death and disability within the workforce and the discontinuation of support services with no proven benefit to the individual clinician.

ETHICAL APPROVAL

Ethical approval was not required as only available published data was analysed and the review results were informed.

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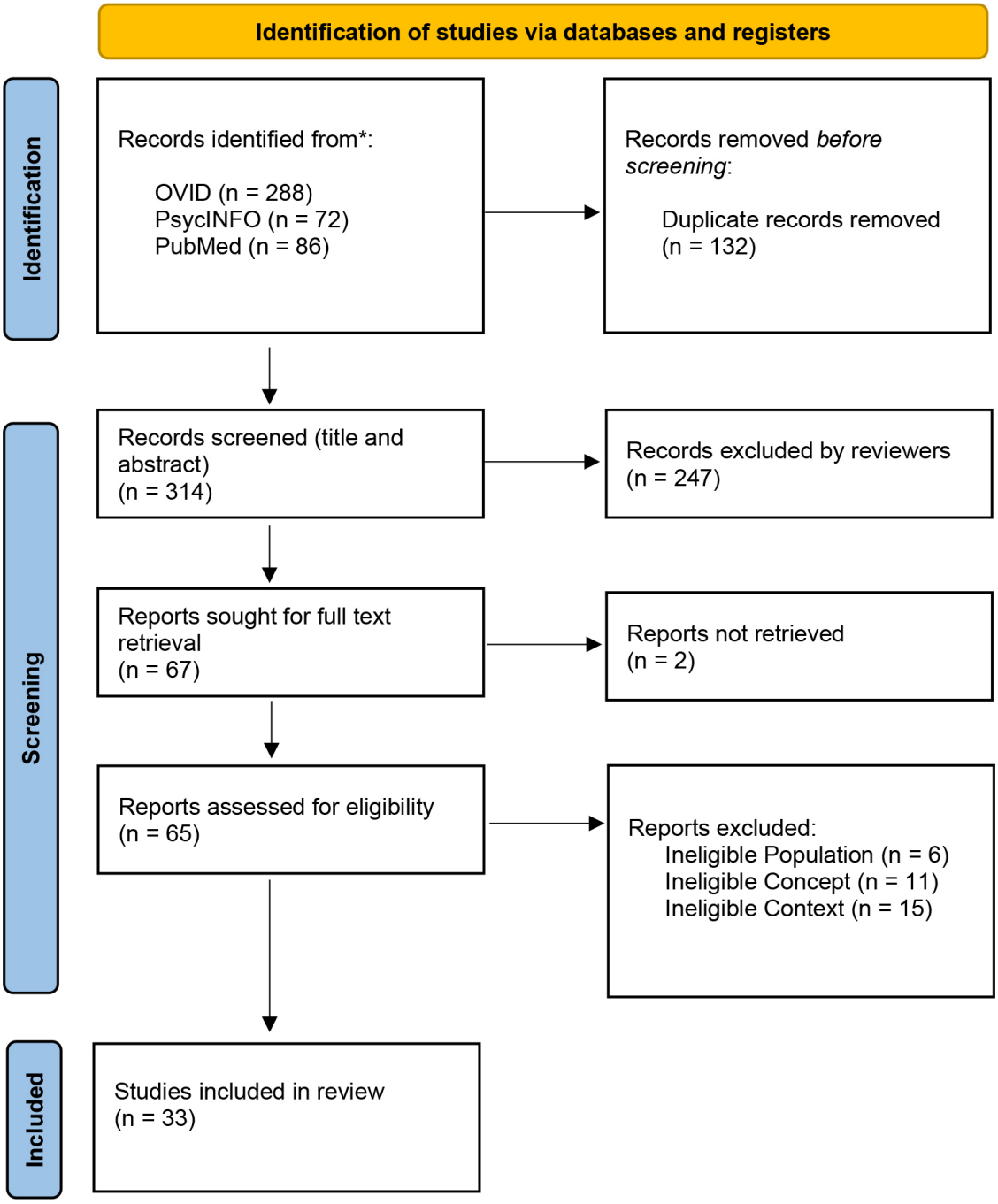
APPENDIX



Appendix 1. Fig. PRISMA-ScR

*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

Author(s) & year of publication	Aim	Methods & Participant Characteristics	Relevant Findings
Karlsson, K., Nasic, S., Lundberg, L., Martensson, J. & Jonsson, A. 2022. Sweden	To compare the occurrence of health problems between Swedish ambulance personnel and other occupational groups.	Longitudinal study involving two cohorts of ambulance staff from 2001 (1778 individuals) and 2008 (2753 individuals).	Paramedics have an increased risk of cardiovascular disease most notably atrial fibrillation. They also report increased of knee arthritis and back problems than other occupational groups.
Betson, J., Kirkaldie, M., Zosky, G. & Ross, R. 2022. Australia	To measure the health activity and sleep quality of graduate paramedics in their first 5 months or work on road.	Quantitative study of 28 recently graduated paramedics in Victoria.	Poor sleep quality increased by 35.4%, sedentary behaviour increased by 4.8% and nil changes were recorded in physical activity, fasting blood glucose levels, blood pressure, weight, or waist circumference.
Reid, B., Naess-Pleym, L., Bakkelund., Dale., Uleber, O. & Nordstrand, A. 2022. Norway	To report the prevalence of mental health conditions amongst Norwegian ambulance personnel.	Analysis of 479 cross-sectional anonymous, web-based survey undertaken by operational personnel employed by Emergency Medical Services in the Regional Health Trust of Central Norway between February and April 2021.	Prevalence of mental illness was slightly higher in men than in women. The degree of peer support and having a partner appeared to influence levels of posttraumatic stress and development.
Meadley, B., Perraton, L., Smith., Bonham, M. & Bowles, K. 2022. Australia	To explore the health-related quality of like in a sample of experienced intensive care flight paramedics.	Cross-sectional study of 15 intensive care flight paramedics between 42-48 years from Ambulance Victoria.	In this population, cardiometabolic and physical activity outcomes represent good health. Intensive care paramedics likely demonstrate an excellent health profile due to physical activity levels and a health BMI.
Meadley, B., Wolkow, A., Smith, K., Perraton, L., Bowles, K. & Bonham, M. 2022. Australia	To identify changes in health related quality of life in graduate paramedics during thier first twelve months on road.	12-month longitudinal study of 56 graduate paramedics with no history of shift work (28 females and 29 males aged between 23-26 years).	Body weight decreased in males and increased in females and consumption of healthy foods was lower than recommended at all time points. However, none of the markers changed meaningfully in the first year of practice.
Khan, W., Jackson, M., Kennedy, G. & Conduit, R. 2021. Australia	To investigate the relationship between a rotating shift work and sleep, stress, and fatigue amongst Australian paramedics.	Cohort study of 12 Victorian paramedics working rotating shifts full-time.	Levels of stress, fatigue and sleepiness were related to sleep restriction that occurred due to night shift and that the nature of shift work may be detrimental to the workers' health.
Khan, W., Conduit, R., Kennedy, G. & Jackson, M. 2020. Australia	Investigate the prevalence of issues associated with sleep and mental health in Australian paramedics.	Cross-sectional surveys from 136 Victorian paramedics.	Paramedics report significantly high levels of depression, anxiety, fatigue, PTSD, insomnia, narcolepsy, and poor sleep quality. Addressing sleep issues and matching chronotype to shift preference may help to reduce these and improve wellbeing.
Tremblay, M., Albert, W., Fischer, S., Beairsto, E. & Johnson, M. 2020. Canada	To characterise the health status of a cohort of experienced paramedics.	Cross-sectional observational based design involving 25 paramedics from Ambulance New Brunswick.	A third of the cohort appeared unaware of their health condition. Additionally, only two fifths of the cohort had nil health related co-morbidities and were considered healthy.
Cash, R., Crowe, R., Bower, J., Foraker, R. & Panchal, A. 2019. United States of America	Compare the distribution of cardiovascular health in EMTs and identify associations between demographic and employment characteristics in EMS professionals.	Cross sectional survey completed by 24 708 nationally certified EMTs and paramedics.	More EMT's achieved optimal health than paramedics. Factors associated with better health included higher education level, higher personal income and working in an urban versus rural environment.
Petrie, K., Gayed, A., Bryan, B., Deady, M., Madan, I., Savic, A, Wooldridge, Z., Counson, I., Calvo, R., Glozier, N. & Harvey, S. 2018. Australia	To examine the impact of management support and behaviours on the mental health outcomes of ambulance personnel.	Cross-sectional survey completed by 1622 participants in two Australian states.	Manager psychosocial safety climate accounted for a significant amount of variance in the levels of employee common mental health disorder symptoms and wellbeing.
Pyper, Z. & Paterson, J. 2016. Australia	To investigate fatigue, stress, and emotional trauma amongst rural and regional ambulance staff.	Mixed methods survey involving 134 (103 male and 31 female) ambulance personnel from rural and regional Australia.	Participants reported high levels of fatigue and emotional trauma. They also reported negative effects of this including drug administration errors and falling asleep whilst driving.
Pek, E., Fuge, K., Marton, J., Banfai, B., Gombos, G. & Betlehem, J. 2015. Hungary	To Assess the self-reported physical and mental health status of Hungarian ambulance personnel.	Cross-sectional study involving 810 (770 male and 40 female) workers from the northern and western regions of Hungarian National Ambulance Service.	Respondents regarded their physical functioning the best and vitality the worst. The longer a staff member had been working for the worse their health was and those with a higher BMI regarded their health status worse.
Roberts, M., Sim, M., Black, O. & Smith, P. 2015. Australia	To investigate risk of musculoskeletal and mental injury among paramedics and other professionals using workers' compensation claim statistics.	Multivariable regression analysis utilising 214 355 claims dated between July 2003 and June 2012 retrieved from the Victorian Compensation Research Database.	Paramedics had higher workers compensation claim rates for injuries overall and the highest for musculoskeletal and mental injury.
Streb, M., Haller., P. & Michael, T. 2014. Switzerland	To examine if there is a relationship between sense of coherence and high resilience with the severity of in paramedics.	Cross sectional study involving 688 paramedics, 210 women and 447 men (31 participants did not specify gender).	Resilience and sense of coherence were negatively correlated with PTSD symptoms. Paramedics prepared for dealing with work related trauma and received psychological help had less severe PTSD.
Avraham, N., Goldblatt, H. & Yafe, E. 2014. Israel	To explore the experiences of paramedics during critical incidents and explore the coping strategies utilised to deal with them.	Qualitative analysis of 15 semi-structured interviews with paramedics (5 women, 10 men) from a large emergency service organisation.	Those that connected their feelings to the patient and/or family along with those who sensed a loss of control experienced difficult and negative emotions.
Crampton, D. 2014. United States of America	To identify differences in prevalence of PTSD and compassion fatigue between rural and urban paramedics.	Questionnaires involving 31 rural and 56 urban paramedics from a Colorado EMS agency.	No significant differences between rural and urban paramedics suffering from PTSD or compassion fatigue. No rural paramedics (n=31) felt that they were offered significant help from their employing organisation, in comparison to 18% of urban paramedics (n=56).

Appendix 2. Summary of Characteristics Articles Included .

Author(s) & year of publication	Aim	Methods & Participant Characteristics	Relevant Findings
Fjeldheim, C., Nothling, J., Pretorius, K., Basson, M., Ganasen, K., Heneke, R., Colete, K. & Seedat, S. 2014. South Africa	To examine the prevalence of direct trauma exposure, PTSD symptoms and other mental illness amongst paramedic trainees and identify risk factors associated with the same.	Logistic regression analysis involving 131 trainee paramedics recruited from a local university in Cape Town	94% of trainees had directly experienced trauma with 16% meeting PTSD criteria. High rate of depression, alcohol abuse and chronic perceived stress with low levels of social support was found.
Iranmanesh, S., Tirgari, B. & Bardsiri, H. 2013. Iran	To examine the prevalence of PTSD among Iranian paramedics and emergency personnel.	Descriptive cross-sectional study involving 400 paramedics and emergency service personnel associated with Kerman Medical University.	94% (n=400) of participants reported moderate PTSD.
Courtney, J., Francis, A. & Paxton, S. 2013. Australia	To examine relationships between sleep quality and a variety of mental and physical health measures of rural paramedics in Australia.	Survey of 150 rural paramedics. Regression analysis of variables within survey and reference group from previously published studies.	Rural paramedics had significantly poorer sleep quality with higher fatigue in comparison to similar reference group samples. No significant differences in depression were found.
Hansen, C., Rasmussen, K., Kyed, M., Nielsen, K. & Andersen, J. 2012. Denmark	To Compare the physical and mental health status of paramedics with the general workforce in Denmark.	Online and post distributed questionnaire involving 1691 ambulance personnel and 735 non ambulance personnel.	Similar levels of mental health exist between ambulance personnel and the core work force but substantially higher levels of musculoskeletal pain.
Gayton, S. & Lovell, G. 2012. Australia	To determine if increased resilience is related to paramedic time in service.	Survey of 219 participants. 146 Queensland Ambulance Service paramedics and 73 paramedicine students.	Experienced paramedics displayed significantly higher levels of resilience than students. Resilience significantly correlated with general health and wellbeing.
Maunder, R., Halpern, J., Schwartz, B. & Gurevich, M. 2012. Canada	To determine prevalence of paramedic childhood abuse and neglect and if this experience is associated with paramedic's response to critical incidents.	Univariate analysis of surveys involving 235 paramedics (150 males 81 females 1 undisclosed).	Abuse was reported by 38.4% of respondents. Paramedics who reported abuse or neglect more frequently experiences signs of acute stress immediately following critical incident and the following two weeks.
Sofianopoulos, S., Williams, B., Archer, F. & Thompson, B. 2011. Australia	To determine the impact of shift work on paramedic fatigue, sleep, and psychological health in Australia.	Cross-sectional study of 60 paramedics utilising the Epworth Sleepiness Scale, Berlin Questionnaire, Pittsburgh Sleep Quality Index, Beck Depression Inventory and a demographic questionnaire.	90% reported fatigue affecting performance at work. Statistical significance found in chance of falling asleep when sitting and talking to someone and while stopped in traffic.
Blau, G. 2011. United States of America	To determine the impact of sleep issues on perceptions of health and intention to leave by paramedics.	Surveys conducted 2005, 2006 and 2007. 288 paramedic participants.	Sleep impairment had a significant additional impact that explained following years of perceived health and intention to leave.
Tsismenakis, A., Christophi, C., Buress, J., Kinney., Kim. & Kale, S. 2009. United States of America	Study the prevalence and health associations of excess weight among firefighters and ambulance personnel.	Mixed methods cohort study involving 370 participants (160 ambulance personnel and 210 firefighters).	Excess weight is highly prevalent and associated with elevated cardiovascular risk and this prompts public health intervention.
Backe, E., Kaul, G., Klubmann, A., Liebers, F., Thim, C., Mabbeck, P. & Steinbtoerg, U. 2009. Germany	To investigate salivary cortisol of ambulance personnel during different work demands and compare the perception of these demands to their physiological response.	Observational study involving 25 ambulance personnel aged form 20 and 43 years. (19 male and 5 female).	Rise in cortisol was significantly higher in paramedics than patient transport officers. In 31% of paramedics there was a rise in cortisol of 50% above baseline and in 3 of these 12 cases there was a rise above 200% however there was no link to the individual perception of demand.
Aasa, U., Kalezic, N., Lyskov, E., Angquist, K. & Barnekow-Bergkvist, M. 2006. Sweden	To assess physiological and subjective stress markers of ambulance personnel whilst at work and away from work and compare this to health-related complaints.	Cohort longitudinal study involving 26 ambulance staff during a 24 hr work shift and the following 2 days off work.	Physiological and subjective characteristics did not indicate distinctive stress during the shift. Relationship between frequent health complaints and specific work-related factors need further study.
Aasa, U., Angquist, K. & Barnekow-Bergvist, M. 2005. Sweden	Investigate the relationship between health complaints and psychosocial work factors in ambulance personnel.	Qualitative questionnaire involving 1500 (300 female, 1200 male) ambulance personnel.	Psychological demands were associated with sleeping problems, gastrointestinal symptoms, and headaches. Worry about work conditions had a significant association with health complaints.
Fullerton, C., Ursano, R. & Wang, L. 2004. United States of America	To examine psychological health and healthcare utilisation in disaster workers.	Statistical analysis of exposed disaster workers (n= 19) and a comparison group (n= 51) of disaster workers who were not exposed to the disaster.	Exposed workers are at an increased risk of acute stress disorder, depression or PTSD and seek care for emotional distress at an increased rate.
Bennett, P., Williams, Y., Page, N., Hood, K. & Woollard, M. 2004. United Kingdom	To examine the prevalence of PTSD, depression, and anxiety in ambulance personnel.	Questionnaires involving 194 EMTs and 380 paramedics (513 male, 91 female).	Overall rate of PTSD was 22% (n=617) and men had a higher reported rate than women. One in 10 reported clinical levels of depression and 22% identified clinical levels of anxiety.
Brough, P. 2004. New Zealand	To investigate trauma and organisational stress within police, fire, and ambulance services.	Cohort study questionnaire involving 223 police officers, 232 ambulance personnel and 231 firefighters.	Organisational and traumatic stress reactions were predictive of psychological strain to similar extents. Organisational stressors predicted job satisfaction to a far greater extent than trauma symptomatology.
Jonsson, A., Segesten, K. & Mattsson, B. 2003. Sweden	To identify the prevalence of PTSD symptoms among Swedish paramedics.	Analysis of surveys completed by 362 Swedish ambulance personnel.	Of 362 paramedics who completed the survey, 223 reported that they had experienced a traumatic situation and of those 15.2% scored a reaction which predicted a high likelihood of PTSD.
Van Der Ploeg, E. & Kleber, R. 2003. The Netherlands	To explore PTSD, fatigue and burnout due to work related stress in ambulance personnel.	Questionnaires involving 123 ambulance personnel (Paramedics and drivers) from 10 ambulance services in the Netherlands).	Paramedics are at risk of developing health symptoms due to work related stressors however it was not found to predict health symptoms in the long term.

Appendix 2 (continued). Summary of Characteristics Articles Included .

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REVIEW

PARAMEDIC EXPOSURE AND RESPONSE TO NON-TRAUMATIC DENTAL CONDITIONS: A SCOPING REVIEW

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Keywords: ambulance service, non-traumatic dental injury, low acuity pathways, knowledge, attitude, training, emergency medical services, EMS, paramedicine

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ABSTRACT

Introduction: As the global demand for emergency health services continues to expand, the role of paramedics persists and grows alongside the expansion of ambulance services. The need to explore alternative pathways for enhancing service efficiency and alleviating hospital demands is increasingly evident, particularly for low-acuity cases. Non-traumatic dental conditions (NTDC) can be ongoing and have far-reaching health implications if not treated correctly. This scoping review aims to explore what is known about the incidence of NTDC cases attended by paramedics internationally.

Methods: Three electronic databases (Medline, Scopus, CINAHL) were searched between 1 Jan 2000 and 30 April 2023, using the primary search terms "paramedics," "prehospital," and "dental emergency." In addition, grey literature was examined using Google Scholar. Studies were included if they investigated NTDC as the primary treatment condition in the prehospital setting (excluding clinical settings) and were written in English.

Results: Of 1755 articles identified only four studies met the inclusion criteria. Three were quantitative descriptive surveys, and one study included interview data. Studies originated in Poland, the United States, Turkey, and India. Paramedics who reported attending an NTDC case varied between 28% and 72%. Two papers reported on the demographics of patients most affected by NTDC, including young children aged 7-15 and older individuals between the ages of 45-64. Despite limitations and bias across all studies, results indicated insufficient knowledge and education of paramedics regarding dental anatomy or proper management of NTDC.

Conclusion: This scoping review identified a paucity of robust research and publications investigating the paramedic role in initial treatment and referral pathways of dental injuries. There was limited information on the paramedic's knowledge, attitude, and training in dental injuries. Further research is required to determine paramedics' preparedness to manage and improve patient outcomes to reduce the growing burden on emergency departments.

INTRODUCTION

Over the last decade, the demand for health and social services has been a global surge, surpassing population growth rates (Jain et al., 2023). The heightened demand is reflected in the increased frequency of emergency department presentations (Lowthian et al., 2011; Romeo et al., 2017), with reported annu-

al increases of between 0.9 and 7.8% as documented in the United States (Pickens et al., 2022), United Kingdom (NHS England, 2024), Canada (Canadian Institute for Health Information, 2024), and Australia (Australian Institute of Health and Welfare, 2022). Consequently, there have been recent expansions in the role of paramedics to address the needs associated with low-acuity clinical presentations, generally defined as semi-urgent or non-urgent cases (Andrew et al., 2020; Eaton et al., 2021). Historically, paramedics attending low-acuity cases had no option other than to transport their patients to the hospital due to the absence of alternative pathways or appropriate scope of practice to manage the cases themselves in the field. While this has been the subject of slow change, it is increasingly recognized that providing alternative pathways can improve ambulance service efficiency and reduce demands on hospital services (Blodgett et al., 2021). Many ambulance services are now developing or have developed pathways which include clinical guidelines for low acuity cases, incorporating options such as treatment without transport, referral to alternative health services, or transport to the hospital where required (Shannon et al., 2021).

Paramedic roles have expanded to accommodate these changes, including practitioner paramedics such as Extended Care Paramedics (Audit Office of New South Wales, 2017; Swain et al., 2010) and Community Paramedics (Chan et al., 2019; O'Meara et al., 2018). As these responsibilities evolve, there will be a natural expansion in the range of low-acuity presentations that are accommodated; however, there remains little evidence in the literature surrounding the current incidence and management of these cases by paramedics.

Non-traumatic dental conditions (NTDC) are one example of a low acuity presentation that, when treated inappropriately, can have multiple impacts on a patient's quality of life. The social impacts are also high as they can be immediate or long-term, impacting aesthetics and psychosocial behavior (Arhakis et al., 2017; Siqueira et al., 2013). There is a lack of recognition of dental conditions as a burden of disease, in part due to inadequate information and standardization, underreporting, poor processing of data, and sparse data collection (Vos et al., 2016). The lack of recognition has created an absence of awareness amongst health professionals and emergency care providers, such as paramedic services (Abbott, 2018; Vos et al., 2016). Dental health is a complex issue, with accessibility concerns and costs of dental care increasing globally, which has led to an increase in the number of patients presenting to Emergency Departments (ED) with dental conditions, including preventable and non-traumatic injuries, across the United States and even in countries with Universal health care, such as Australia, Canada, and the UK (Kisely et al., 2021). NTDC patients receiving treatment in ED have been identified as being at risk of serious complications due to a lack of definitive treatment (Bassey et al., 2020). Paramedics are in an ideal position to improve the outcomes of these patients through immediate management of the condition and referral to dental health professionals where appropriate.

Little is known about the incidence of NTDC cases; however, there is evidence to support that ambulance services are attending to this type of case, both anecdotally and due to the development of clinical practice guidelines relating to NTDC presentations. For example, two of the largest ambulance services in Australia, Queensland Ambulance Service and The Ambulance Service of New South Wales, have clinical practice guidelines

for managing dental presentations (New South Wales Ambulance, 2021; Queensland Ambulance Service, 2019).

A preliminary search for previous scoping or systematic reviews on the topic was conducted in June 2023, utilizing the Cochrane Database of Systematic Reviews, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and PubMed. No reviews on prehospital NTDC presentations were identified. This scoping review aims to explore what is known about the incidence of NTDC cases attended by paramedics internationally. The goal is to inform further research inquiries into this type of low-acuity clinical presentation, to better inform future guideline development.

METHODS

This scoping review used Arksey and O'Malley's methodological framework for conducting a scoping study with enhancements proposed by Peters et al. (Arksey & O'Malley, 2005; Peters, 2016; Peters et al., 2015). Dental conditions in the emergency health setting are often associated with traumatic events, such as car crashes; however, for this study, we were interested in examining cases in which the dental condition was not a secondary treatment consideration. For this reason, only studies investigating a dental condition as the primary reason for paramedic attendance were included. 'Paramedic' was defined as a person trained and certified to appraise and initiate treatment for emergency medical incidents who worked in an emergency medical service, including emergency medical technicians (EMTs). As the scope of practice for paramedics is expanding to include out-of-hospital care, for this study the term 'prehospital' referred to a setting in which emergency care was provided by paramedics, regardless of subsequent transportation or not to hospital.

Data Sources and Search Strategy

Three electronic databases (Medline, Scopus, CINAHL) were searched for articles. In addition, grey literature was examined using Google Scholar. Searches were limited to articles in English published between 1 Jan 2000 and 30 June 2023. This timeframe was chosen to include up-to-date and still relevant strategies and tools. Three researchers (RB, DE, and SB) independently performed the literature search. A healthcare librarian assisted in the development of initial search terms, which were used to search Medline and Scopus to identify common keywords and themes in the titles and abstracts of relevant articles. Full search strategies were then developed and included the search terms "dental emergency," "paramedic," and similar terms using Boolean operators and included Medical Subject Headings (MeSH). The search strategy applied in the CINAHL database is shown in Table 1.

Search Category	Search Term
Population: Paramedics **Context**: Prehospital	((MH "Allied Health Personnel+") OR (paramed*) OR ("allied health personnel") OR ("emergency medical technician") OR ("emergency medical services") OR (MH "Prehospital Care") OR (MH "Ambulances") OR (ambulance) OR (prehospital) OR ("emergency responders"))
Incidence: Dental emergency	AND (((MH "Tooth Avulsion") OR (MH "Tooth Injuries") OR (MH "Tooth Replantation")) OR ("dental emergenc*) OR ("dental trauma") OR ("dental avulsion") OR (toothache) OR ("oral trauma") OR ("tooth injuries") OR ("oral emergency") OR ("tooth avulsion") OR ("tooth replantation") OR ("maxillofacial injuries")))

Table 1. Search strategy applied to CINAHL database, including key terms, Boolean operators, and MeSH headings.

Inclusion and Exclusion Criteria

Inclusion criteria: Prehospital settings, studies in which NTDC was the primary treatment condition. Exclusion criteria: Clinical settings (dental surgeries, emergency departments, etc), trauma presentations, Non-English language and Other (e.g., full-text planning approach or equivalent referenced not found or available to use).

Study Selection

Identified articles were imported into the web-based reviewing platform Covidence™ for study selection. Two authors (DE, RB) initially screened abstracts for inclusion against the inclusion and exclusion criteria. Inclusion criteria were: Non-health settings or topics, e.g., Education; Publication date >2000. This timeframe was chosen to include up-to-date and still relevant strategies and tools. Exclusion criteria were non-English language and Other (e.g., full-text planning approach or equivalent referenced not found or available).

Any conflicts were resolved by a third author (SB). Reviewers (DE, RB) then independently assessed the full text against the inclusion and exclusion criteria, with conflicts resolved by a third reviewer (SB). A snowballing approach was used to identify additional relevant papers.

Data Extraction

Three reviewers extracted data (RB, DE, SB) using the prespecified data extraction table. The information extracted included studies, topic, purpose, study design, context, setting, population, and results.

RESULTS

Overview of Included Studies

The database search revealed a total of 1755 articles (Figure 1). After removing 813 duplicates, 942 papers were identified as irrelevant following an initial screening of abstracts. Twenty full-text articles were screened, of which 16 were determined to be irrelevant, including one previously unidentified duplicate (Figure 1). This resulted in including four citations in the review, summarised in Table 2.

The work originated from four different countries: Poland (Lewandowski et al., 2016), the United States (Shenkin et al., 2018), Turkey (Aras & Dogan, 2020), and India (Joybell et al., 2019). All studies were quantitative descriptive survey studies, with one study also including interview data (Joybell et al., 2019). Three studies recruited participants directly from emergency health services, while one used data from the United States National Hospital Ambulatory Medical Care Survey (NHAMCS). Data analyses ranged from basic descriptive statistics to multivariate logistic regression.

The population and sample size varied between studies, making comparison of results difficult. Two studies included paramedics and EMTs working in ambulance stations or hospital emergency departments. In contrast, one study included all employees of ambulance services, with no further explanation of the participants' roles. For the three studies recruiting participants directly from emergency health services, sample sizes ranged from 100 to 389 participants. As studies did not differentiate between paramedics and EMTs in their results, for this section, discussion of 'paramedics' will include EMTs.

Characteristics of Included Studies

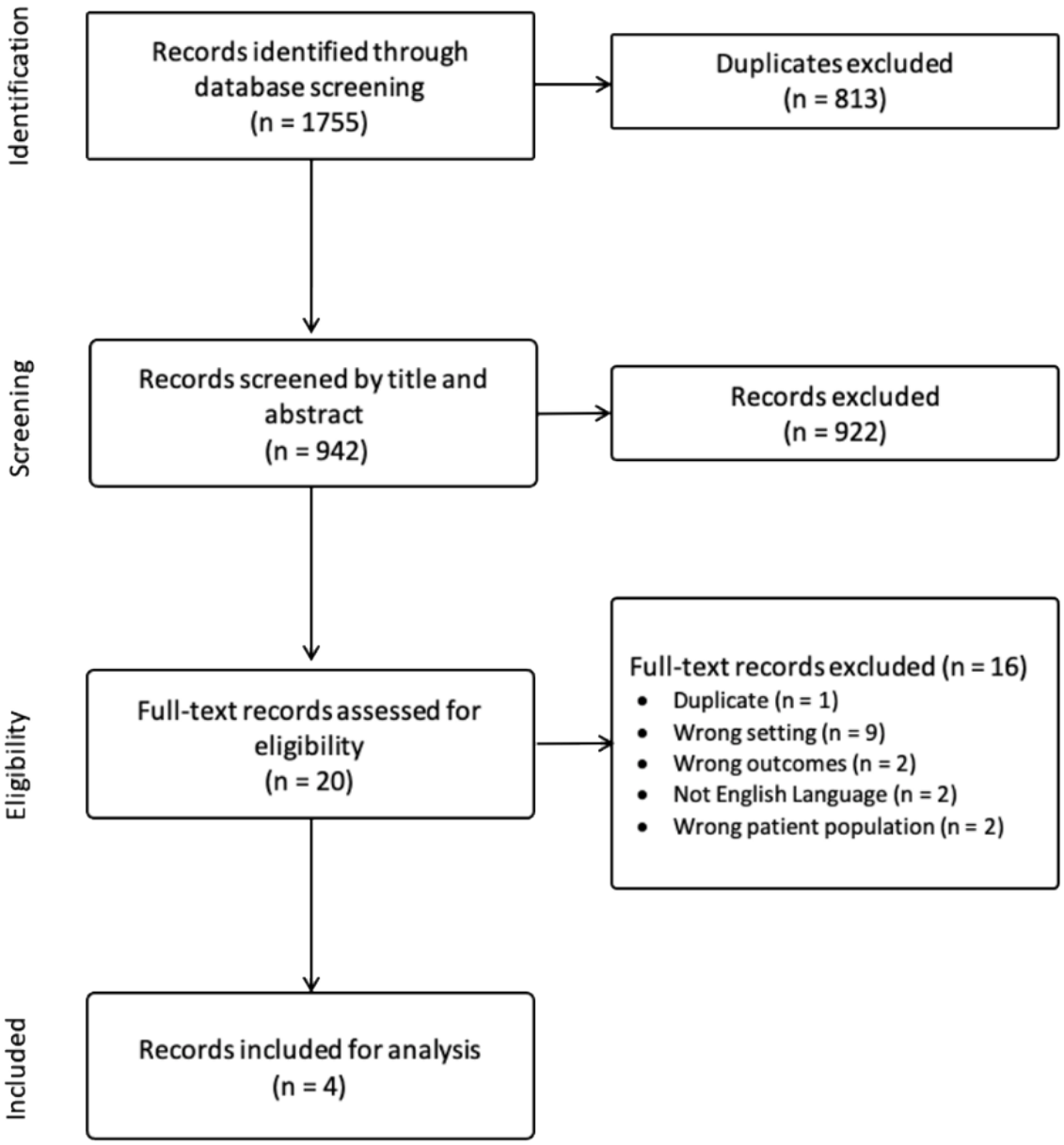

Figure 1. PRISMA Flow Chart.

This review found only four unique citations.

Exposure to NTDC

Paramedics who reported having attended an NTDC case varied between 28% and 72%; however, the incidence was identified as rare. While the order of cases varied between studies, tooth avulsion, tooth fracture, and tooth displacement were identified as the most encountered cases. Shenkin et al. reported that 1.1% of ED visits for tooth pain were transported by ambulance (Shenkin et al., 2018); however, did not identify the cause of pain nor report on cases that were not transported by ambulance to the ED.

Authors / Year / Country	Stated Aim	Design / Population / Sample size / Analysis	Findings	Conclusions / Limitations
Aras and Dogan, 2019 Turkey	To evaluate the training that emergency medical technicians and paramedics received about traumatic dental injuries, the cases they encountered in the field, and their knowledge of the issue.	Quantitative descriptive survey study. EMTs and paramedics working in emergency ambulance stations or hospitals. N=389 Descriptive statistics.	Over 63% of participants had encountered NTDC cases. The most common dental injury attended by participants was tooth fracture, followed by tooth avulsion and displacement. The 7-15 year age group was identified as the most likely to experience TDI; fall was recognized as the most common cause of TDI. Most respondents indicated they did not receive training specific to TDI.	There needed to be more training or knowledge regarding TDI. Risk of recall bias; survey not based on case numbers.
Joybell, Kumar and Ramraj, 2019 India (Tamil Nadu)	To assess the attitude, awareness, and knowledge of the personnel employed in ambulance services towards the immediate emergency management of dental trauma.	Quantitative descriptive survey study. Employees of emergency ambulance services (108 services total). N=100 Descriptive statistics; non-parametric independency tests.	NTDC was frequently encountered by almost a third of respondents. 28% of respondents indicated they had used ambulance services for DI. There was no association between exposure or transport with any tested variable.	There needed to be more training or knowledge regarding TDI. Risk of recall bias; responses were binomial (frequency of exposure either often or rare); no information on employee role in service; survey not based on case numbers; small region of India
Lewandowski et al., 2016 Poland (Rzeszów region)	To evaluate knowledge of traumatic dental and oral cavity injuries. To determine whether factors such as education, professional experience, and place of employment had an impact on paramedics' knowledge in the field.	Quantitative descriptive survey study. Paramedics working in ambulance stations and hospital emergency departments. N=138 Descriptive statistics.	Majority (72%) of respondents had been exposed to a tooth injury incident. The most commonly reported consequence of dental trauma was an avulsed tooth, followed by tooth displacement and fracture of tooth root.	There needed to be more training or knowledge regarding TDI. Risk of recall bias; low completion rate; survey not based on case numbers.
Shenkin et al., 2018 USA	Prevalence of and factors associated with ambulance use for nontraumatic tooth pain visits to emergency departments.	Quantitative survey study. Patients report tooth pain as the primary reason for ED visit. N=3649 Descriptive statistics; non-parametric independency tests; multivariate logistic regression	Ambulance transport was recorded in 1.1% of tooth pain visits to the ED. Age and payment type were significantly associated with ambulance use. The 45-64-year age group had almost four times higher odds of transport to the ED by ambulance.	

Table 2. Characteristics of Included Studies.

Two papers reported on the demographics of patients most affected by NTDC. Aras and Dogan21 identified that children aged between 7 and 15 were the age group most exposed to NTDC, while Shenkin et al. found that patients aged between 45 and 64 were significantly more likely to be transported to ED for tooth pain than other age groups (Shenkin et al., 2018). Shenkin et al. also suggested that transportation for tooth pain increased in publicly insured populations and that there was a need for alternative pathways to reduce the burden on emergency health systems (Shenkin et al., 2018).

Knowledge, Attitude, and Training

In addition to presentation data, knowledge and attitude were investigated in three of the four included studies (Aras & Dogan, 2020; Joybell et al., 2019; Lewandowski et al., 2016). The results indicated insufficient knowledge and education regarding dental anatomy or proper management of NTDC. In one study, up to 42% of paramedics answered incorrectly when questioned about dentition and oral anatomy (Lewandowski et al., 2016). Knowledge of the correct management of an avulsed tooth was identified as a primary concern, with as few as 3% of paramedics reporting that they would implant an

avulsed tooth and between 12% and 59% of paramedics identifying a correct medium for transportation. All three studies suggested that most paramedics were unsatisfied with the level of training they received for NTDC (70Ð86%) and reported positive attitudes towards further education (62-85%).

DISCUSSION

This scoping review aimed to explore the prehospital care of and emergency response to non-traumatic dental conditions, including tooth avulsion, dental injuries, and replantation.

The review identified papers from diverse regions of the world; however, there needs to be more literature regarding NTDC. We note a lack of diversity in the research narrative, which is unsurprising as there is little epidemiological research regarding dental trauma; even less is known about the emergency response to NTDC by ambulance services. Yet, the involvement of paramedics as first responders is important due to a growing demand for their services, which is particularly true for NTDC given they are recognized as a condition for which hospitalization is potentially preventable with appropriate management (Australian Institute of Health and Welfare, 2023).

The included studies surveyed paramedics exposed to NTDC cases and reported insufficient knowledge of the principles of providing first aid in managing dental conditions among responders (Aras & Dogan, 2020; Joybell et al., 2019; Lewandowski et al., 2016), indicating a need for more experience and training regarding the proper management of these cases. The researchers aligned years of experience and level of position with knowledge and competency, suggesting that increased exposure and vocational learning results in improved management of such cases (Joybell et al., 2019).

Non-traumatic dental conditions are common and may or may not present with other injuries. The lack of research and lack of adequate information on dental conditions reported globally leads to inadequate management and policies, as outlined by Abbott (2018). More focused research can raise awareness amongst health professionals of NTDC and reduce diagnostic confusion, misclassification, and non-classification of dental injuries. Our paper highlights the lack of global research on NTDC in the prehospital setting, supporting our suggestion that more research would provide new opportunities to understand the care and emergency response required, as well as the oral health outcomes experienced by patients.

Any dental condition can be a significant public health concern with a substantial burden on healthcare systems due to their frequency, impact on quality of life, and resource requirements. While our review has highlighted that children most often present with NTDC, the long-term consequences impact the individual, the family, and the broader community (Antunes et al., 2020). Furthermore, the severity of a dental condition can influence the prognosis of deciduous teeth and the formation of permanent successors with potentially long-term complications on oral health-related quality of life (Antunes et al., 2020). The potential role of paramedics in relation to initial treatment and referral to specialist pathways requires further research. There is the possibility that prehospital management will reduce disparities in oral health status between privileged and underprivileged population cohorts, including children and adolescents, as well as those that have difficulties accessing healthcare.

LIMITATIONS

A difficulty with all prehospital research is the variation in education and training and clinical practice guidelines, not only between countries but also between states and regions. This variation leads to difficulties in comparing studies, identified in this work. There needed to be more clarity regarding the role of paramedics attending NTDC in the included studies. The research design and approach to data collection could be improved by incorporating more details, such as how patients arrive at hospitals or health care facilities (i.e. transported by ambulance or other means) and whether they require emergency response. In addition, the details of the condition itself and any injury of the dentoalveolar system are necessary to understanding the size of the problem. This would provide valuable information for emergency healthcare services for the development of clinical practice guidelines, professional development, and education programs.

CONCLUSIONS

This scoping review has highlighted the paucity of robust research and publications investigating paramedic and prehospital healthcare workers' recognition of and exposure to NTDC. Given the recognized increase in both dental presentations to hospitals and increased preventable dental conditions, understanding the role of paramedics in both initial treatment and referral to specialist pathways is vital to improved patient outcomes and assisting in reducing the growing burden on emergency departments. Further research is required to determine the prevalence of cases of NTDC in the prehospital setting and the treatment provided by healthcare workers to determine if it should be an education focus.

Primary care and allied health professionals must recognise their role in treating oral injuries and preventing compounding conditions. Developing a collaborative relationship between dental practitioners and primary care providers may improve oral health care in rural and remote communities where access to oral health services is limited (Stuart et al., 2017). Emergency health services are developing a range of mechanisms to manage the growth in demand due to low acuity cases, from the inclusion of practitioner models of service delivery (Eaton et al., 2021) to the implementation of secondary triage models (Eastwood et al., 2019) and incorporation of oral health into emergency preparedness.

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CONCEPT

BREAKING BAD NEWS IN THE PREHOSPITAL SETTING: A GUIDE FOR EMS CLINICIANS

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ABSTRACT

Roughly 90% of the 1,000 daily, US based prehospital cardiac arrests ultimately end in a patient's death. EMS clinicians responding to these emergencies are often tasked with breaking the bad news to families that their loved one has died. EMS clinicians report experiencing negative emotional sequalae related to these difficult conversations. EMS trends have shown increasing frequency of EMS dispatches that involve an on-sceneon-scene death. Despite the increasing frequency of this event, EMS clinicians have reported little to no training around the delivery of bad news as well as a desire to receive additional training around this subject. Formal conversation programs and curriculums do exist but have been hospital based and studied only in that setting. The prehospital environment carries unique challenges that have not been addressed by previously established conversation programs and curriculums. Our aim with this paper was to create a prehospital conversation guideline to improve both the comfort level and the skills of EMS clinicians when delivering a death notification. Our guideline was created by using established medical communication approaches with the multi-disciplinary expertise of palliative care, pediatric, emergency, and EMS clinicians with adaptations to address challenges that are specific to the prehospitall environment. The authors hope that the guide can offer a step wise approach with suggested techniques that may help EMS clinicians better navigate challenging conversations. Focused recommendations include techniques to address anger and navigating the presence of children when an on-scene death has occurred. The authors also aim to inspire, emphasize, and increase research into the very important subject of prehospital communication skills.

INTRODUCTION

Delivering a death notification is one of the most challenging and fraught parts of any health care provider's job. Roughly 1,000 cardiac arrests occur in the US daily with greater than ninety percent of prehospital cardiac arrest calls ending in death (Benjamin et al., 2019). In 2011 NAEMSP guidelines recommended that EMS agencies adopt evidence-based methodologies for the termination of non-traumatic cardiac arrest in the field (National Association of EMS Physicians, 2011). Many agencies and states such as Maine (Maine Emergency Medical Services, 2021) began implementing these protocols, likely leading to an increase in termination of prehospital cardiac arrests. A recent retrospective

review (Breyre et al.2023) of EMS calls found an increasing temporal pattern of encounters of deaths on-scene that rose from 49,802 in 2018 to 80,388 in 2021. The authors also noted in 2018, 56% of EMS clinicians responded to a call with a death on-scene, and this significantly increased to 63% in 2021 ($p<.001$). Another study of over 1,000 U.S. based EMS clinicians (Tillett et al., 2022) found that 86% of respondents reported giving a death notification within the last year. Respondents also reported receiving limited to no education around this topic, with 42% reporting never receiving any education around the subject. Greater than half of these respondents reported negative sequalae related to delivery of difficult news including intrusive thoughts, insomnia, and emotional difficulty. The overwhelming majority (96%) of EMS clinicians from this study reported that additional training around breaking bad news would be helpful.

Despite the increasing frequency of on-scene death, there is no mandated national standard or curriculum to offer guidance to EMS clinicians on death notifications. Established communication training for the delivery of difficult news exists but has been designed for care providers in the hospital and clinic settings. The prehospital setting is vastly different and poses unique challenges for EMS clinicians that are different from traditional medical settings. The need for a model of bad news delivery that addresses the unique challenges of the prehospital environment has been proposed (Campbell, 2021). To our knowledge, there is no established educational curriculum or model for communication of death notification in the EMS literature. The objective of this paper is to create a communication guide for prehospital death notification that incorporates well established communication approaches used by palliative care teams and emergency physicians.

Prehospital Guide to Making Death Notifications

Collaboration for our guide included the combined expertise of a palliative care physician, a pediatric palliative care social worker, emergency medicine physicians and EMS clinicians. We incorporated concepts developed by formal communication programs including The Serious Illness Conversation Program (SICP) and Vitaltalk adapted to the prehospital setting. The result is a stepwise approach to deliver the difficult news of a death (figure 1) in the prehospital setting. We will detail each of the steps separately, discuss navigating the presence of children, and how to deal with anger from families.

Assemble

When we deliver a death notification, it is important to assemble the 'key players', which is commonly identified to be immediate family or next of kin. However, the definition of key players can vary for each patient depending on social, religious, and cultural values. As a result, it is important to acknowledge that some patients consider other non-family individuals as key players (i.e.: clergy, non-married life partners). Key players not physically present may be included by phone. The presence of children will be addressed separately in this paper. Use the name of the deceased during conversation and ask their name if you do not know. If possible, locate the most comfortable place to gather – ideally a place that is out of public view to offer privacy and ability to sit (grass or dining room). In the ambulance is another option if no other environment is feasible. Turn down excessive noises such as radios or televisions. Be mindful of the possibility of a language barrier and need to obtain some form of interpreter such as a family

member, law enforcement, or an online application. The clinician who is delivering the news should sit or squat. Studies have shown that patients perceive providers to be more empathetic and to have spent more time during an interaction if the provider is seated (Strasser et al., 2005; Swayden et al., 2012). Given the unpredictability of a loved one's response to bad news, we recommend placing yourself in a position where you are not blocking egress from a room or space.

Understand

In having difficult conversations, the importance of listening is paramount. A dynamic conversation is crucial, where asking questions should hold equal weight to the offering of information. Ask what the key players understand has happened to their loved one. A lay person's understanding of cardiac arrest and CPR outcomes is often different than that of a medical provider. In a study of older adults, 92% stated that their knowledge of CPR came from television (Schonwetter et al., 1991). Another study observed outcomes after CPR on television and found that patients on TV had a 75% survival rate after cardiac arrest (Diem et al., 1996). Establishing what the families understand will help guide the conversation more efficiently. It will also aid you in understanding their health literacy, so you can match your delivery of information to their level of understanding.

Share

We recommend offering a 'warning shot' at the start of delivery of the news. We advise avoiding apologetic terms such as 'sorry' as this can imply blame or fault for the care provided. Instead, we suggest, "I worry that I have some terrible news about your loved one." Worry statements allow for honesty, but also a delivery with a sensitive tone (SICP, 2023). Briefly summarize the events and care provided. Avoid medical jargon and use words like "breathing tube" instead of "intubation". If you begin with announcing a death has occurred, people will often not hear anything that follows. Avoid unnecessary details (i.e.: number of shocks); instead provide a simple summary such as, "When we arrived your husband had no pulse which means his heart had stopped. We performed CPR, gave medications, and placed a breathing tube. Despite all these efforts, his heart did not start again, and he has died." We advise that the term died, or dead is used. We do not recommend euphemisms for death such as 'passed' or 'gone', as these are not universally understood and can lead to confusion. When a conversation is uncomfortable, it can be natural for some providers to fill the space with words. Allow for silence and pause to open room for the family to process what you have shared. Make a conscious effort to slow your speech and delivery down to ensure the family can process and hear what you are saying.

Close

People will react in a myriad of ways upon being notified of a loved one's death, including both physically and emotionally. Be empathetic and allow family to provide expressions of grief with you. Often all that is needed is to actively listen. A good way to respond to intense emotion is "I can see how deeply you loved him/her/they and how absolutely devastating this is for you." You can also provide non-verbal support such as offering tissues or going and getting family some water. If key players express guilt about lack of action (i.e.: not calling sooner), it is important to mitigate this with compliments such as "you did a great job calling for help so quickly" or "when we arrived, we

saw how well you were doing high quality CPR" or "you did everything we would ask a family member to do in this situation." Responding to anger will be addressed in a separate section below. Leave some time for them to ask questions. If you do not have the answer, do not speculate but instead say "I wish I could answer that for you, but I have no way of knowing that."

Delivering a Death Notification to a Child

STEP 1: Assemble
• Bring key players together (in person/phone) • Find a space for privacy and areas to sit • Clinician should be seated
STEP 2: Understand
• Ask more than tell • Identify name of the patient and use the name • Assess understanding of the significance of event • Evaluate health literacy level
STEP 3: Share
• Give a warning shot (worry statement) • Brief, simple summary of events • Use 'dead' or 'died' to describe outcome • Allow for silence
STEP 4: Close
• Allow space for grief response • Expect wide range of physical and emotional reactions • Address feelings of family guilt/regret • Leave time for questions • It is better to not know than to speculate answers

Table 1. Prehospital death notification guide summary.

Children process difficult events in a way that is vastly different from an adult and as a result require a different approach to communication. It is important to discuss with family if they would like your assistance in breaking bad news to a child such as for a death notification. It may be appropriate to delay delivery of bad news to a child depending on parental wishes or to allow the family to organize available support. Children should not be lied to and depending on the age of the child attempts to hide what has happened could be detrimental to their mental health.

Assemble

If possible, it is important to identify a trusted adult (parent/friend/caregiver) to be present and help to share difficult news with the child. Find a space that feels comfortable for the child, offer comfort items (i.e. favorite teddy bear), and sit at the child's level. Introduce yourself and your role, "Hi Sam. My name is Eric. I am a paramedic and I help people who have emergencies."

Understand

Children understand and make sense of experiences depending on their developmental ability. Identify their age and their relationship with the loved one. Children are likely

to be anxious, scared and confused. Naming their emotion can validate what the child is feeling, "It can be scary to see a loved one have an emergency." Providing positive support is duly important, "You are doing a great job being brave while our team is here." It is important to tell the child they did not cause the event, as younger children may believe they caused their loved one's emergency.

Share

Communicating the death of a loved one to a child will depend on their developmental level which can generally be understood by their age. Depending on their age, children process information through different lenses that can include both magical and literal thinking. For example, children between the ages of 3-5 years will not understand that death is permanent, so in this age group it is very important to use the terms "died" or "dead" rather than stating the loved one is sleeping, passed away, or at peace. In contrast, children between the ages of 6-10 years do understand that death is permanent and their loved one will not return. They are more likely to ask questions around the details of the death and the body. They will listen in on conversations between adults about their loved one. Children 11 years and older may ask questions about the future and how this will impact their family. They may have ideas on how they would like to say goodbye or rituals to honor their loved one. Keeping the differences of these developmental stages in mind, figure 2 will offer age specific examples on delivering death notifications to children.

Close

In times of stress or uncertainty, it is natural to speak in order to fill the silence. Be sure to allow space for the child to ask questions. Encourage the child to continue to ask questions to a trusted adult after you leave. Recognize that it is normal for a child to distract themselves with play or activities as a way of coping. Remind family that additional support resources are available to the child through their pediatrician and school.

Young Children (Ages 3-5 years)	
• Do not understand death is permanent • Avoid death euphemisms (i.e.: sleeping, passed) • Will ask the same question many times	"Grandpa's heart was very old and it stopped working. When his heart stopped working, his body died." "Mommy was in a bad accident and her body was very, very hurt. She died today." "Daddy's body is not breathing, moving, or thinking. He is dead."
School Age Children (Ages 6-10 years)	
• Understand death is permanent • May ask details about death and the body • May seek distraction to cope	"Daddy's body is not breathing, moving, or thinking. He is dead." "Grandpa's cancer made his lungs and heart not work anymore. He died."
Pre-teen and Adolescents (> 11 yrs)	
• Concern over impact on their family • May have an idea of how they want to say goodbye • Teens may be a source of support for younger children	"Mom has been ill from her diabetes. Her sugars got very high and her body became very sick. Her heart was not strong enough to keep working and her heart stopped. She died tonight."

Table 2. Pediatric age-based examples.

Dealing with Anger

Anger is not an uncommon response to stress, including the death of a loved one. Staying calm and not responding with emotion in return, albeit difficult, is vital to handling an angry person. It takes a particular self-awareness when the anger is pointed at you to not respond emotionally. For example, a loved one may scream, "If you had gotten here faster, he might not have died!" A non-defensive response such as "I can understand that you feel that if we got here faster, things may be different. We drove as fast as we could, and worked as hard as we could to help your loved one. We too wish we could have gotten their heart to beat again. I wonder if it would be helpful to walk you through all the things we did to try to help your loved one?" It is also important not to fan the flames of blame that can accompany anger. A family member may start to assign blame towards other providers such as, "If that stupid doctor would have ordered their stress test sooner, do you think they'd still be alive?" We advise avoiding playing into this and instead a response might be, "I can see how deeply your love for him/he/they is, and I can understand how hard it is for you not to think about ways this might have gone differently." Most people will calm down with standard de-escalation techniques, patience, and a little bit of time.

DISCUSSION

Delivering difficult news such as a death notification is likely becoming a more frequent task for EMS clinicians in the prehospital setting. Despite the increasing frequency of this task, education has been limited and not a standard part of the current educational curriculum. Most EMS clinicians reported having minimal or no education around this skill set (Tillett et al.2022). They also endorse negative emotional sequalae from these events (Tillett et al.2022). Just as the clinician delivering bad news can suffer, there are consequences for those receiving the news when it is perceived to be delivered poorly. This was described in the hospital setting (Ellis et al.2009), when families perceived poor delivery of difficult news by a physician, there was an increased association of psychological distress, anxiety, and depression. Although research is limited in this topic for prehospital clinicians, one study demonstrated increased confidence and competency amongst EMS clinicians after as little as 90 minutes of training on breaking bad news (Hobgood et al., 2013). This suggests that education around the delivery of difficult news may be beneficial to EMS clinicians and improve the experience of families and loved ones.

Our guideline incorporates concepts from established communication programs for medical providers (SICP, Vital Talk) with additional expertise added from palliative care providers, emergency physicians, and EMS clinicians. Research has shown that use of the SICP in the hospital and clinic settings showed improvement in many areas of provider communication (Ma et al. 2020, Paladino et al.2019) and a described positive experience for most patients (Kumar et al.2020). The Vital Talk program provides evidence-based recommendations for communication (Vital Talk 2022) and has been shown to improve the confidence and skills reported by participating physicians (Gleicher et al. 2022). Similarly, to the favorable outcomes of these hospital and clinic-based communication programs, we hope that our guideline will be of benefit for EMS clinicians who tackle difficult conversations in the prehospital setting.

Published studies surrounding communication interventions for prehospital clinicians around breaking bad news is limited. Future research efforts to examine the effectiveness and limitations of implementation of prehospital communication guidelines are needed. We hope that this paper will lead to more discussion, research, and investment in enhancing education around the very important skill of communication of difficult news for EMS clinicians. In addition to enhancing education around delivery of bad news, more research is needed to determine whether it may also mitigate the downstream psycho-social sequelae for EMS clinicians tasked with this duty. Communication skills are challenging to teach, and no script or training can consistently prepare providers for every incidence of breaking bad news, attempts must be made to further the education around this topic and to better support those who will be delivering this news.

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SPECIAL REPORT

WHEN SHOULD EMS CALL A CHILD A SMALL ADULT: DISPARITIES IN PROTOCOL DEFINITIONS

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ABSTRACT

Understanding age-related patient differences is important to those providing care in the prehospital environment, yet there is currently no research evaluating how emergency medical services (EMS) systems across the US categorize patients as pediatric. The US Health Resources and Services Administration's Maternal Child Health Bureau (HRSA MCHB) through their Emergency Medical Services for Children (EMSC) program has coordinated a focus on pediatric EMS care. However, there is a wide variety of age and other categorizations used to define the pediatric EMS population. In order to start discussion on this variation, this paper reviews the current state of pediatric EMS categorization from several sources, including national-level agencies and organizations, EMS Protocols, and other sources, and provides an overview of the anatomic, physiologic, and behavioral parameters that are generally expected within the range of pediatric ages. We found that, of 32 states publishing statewide EMS protocols online, there was great variability in the definition of a pediatric patient. The age at which states identified the transition from pediatric to adult patient ranged from 12-18 years old, and several states used non-aged-based definitions. Consistent definitions of pediatric patients across regional or national boundaries may provide a base for future research on pediatric outcomes and interventions and may allow for better development of evidence-based pediatric EMS protocols.

INTRODUCTION

19.1% of US emergency department visits and 13% of EMS patient transports involve patients generally defined as pediatric (Moore et al., 2017; Shah et al., 2008). The US EMSC effort began in its current form in 2016 ("About EIIC", n.d.), after the realization that US ambulances, EMS personnel, and emergency departments often lacked at least some of the equipment, training, and other resources necessary to provide optimal pediatric care. Despite this extensive effort, one missing feature is a universally accepted and implemented definition of the age when a child becomes a small adult. Indeed, this debate continues far beyond

the world of EMS. While the American Academy of Pediatrics now discourages formal age limits, it defines adolescence as the period from 12-21 years old (Hardin et al., 2017). While not an official definition of "pediatric", the American College of Surgeons 2021 revised trauma triage criteria includes vital sign categories for patients aged 0-9, 10-64, and 65+ (Newgard et al., 2017). This is an especially salient data point, as traumatic injury remains the leading cause of death for those aged 0-14 years in the United States (Centers for Disease Control and Prevention, 2023). The National Association of State EMS Officials (NASEMSO) model EMS guidelines define pediatric patients as "those patients who weigh up to 40 kg or up to 14 years of age, whichever comes first" (National Association of State EMS Officials). Disparities between individual state protocols' definitions of pediatric span a 6-year time range and include variations on the methodology used to determine which patients are considered pediatric.

This paper reviews the current state of this situation to begin discussions regarding the varied definitions of pediatric patients and reviews some of the anatomical, physiological, and behavioral aspects of EMS patients at various ages to serve as a streamlined reference point. This paper is divided into 2 sections: Section 1 is a descriptive study of the currently available pediatric EMS definitions from national organizations and from an available sample of EMS protocols; Section 2 reviews developmental anatomy, physiology, and behavior as a reference for EMS clinicians to inform future discussions regarding the definition of a pediatric patient in EMS.

SECTION 1

Methods

Our research project was exempt from IRB review. To assess the EMS protocol landscape nationally, we used an internet search to locate all available EMS protocols that apply to an entire US state and are available for detailed review online, as there is no centralized database for state or local EMS protocols. We read these protocols, searching for criteria that identify patients as pediatric or adult, including a narrative definition of pediatric, age-based criteria, anatomic or physiologic criteria, or a combination of the above.

Findings

We located 32 states with available statewide EMS protocols. After review and analysis, we identified large variations in the definition of a pediatric patient between states, and sometimes within a single state's protocols. The distribution of ages (for states that identify a transition age) or other criteria that define pediatric patients in each state protocol is shown in Figures 1 and 2 below. A full list of specific protocols and where to find them can be found in Supplemental Spreadsheet 1.

Additionally, six states explicitly enable EMS clinician judgment in their statewide protocols, shown in Figure 3, allowing paramedics to select the most appropriate pediatric or adult protocols for the specific patient encounter.

SECTION 2

There are many important physiologic and psychological differences between pediatric and adult patients. In this paper, we will highlight the important differences in pediatric shock, airways, vital signs, injury patterns, and psychosocial development to provide

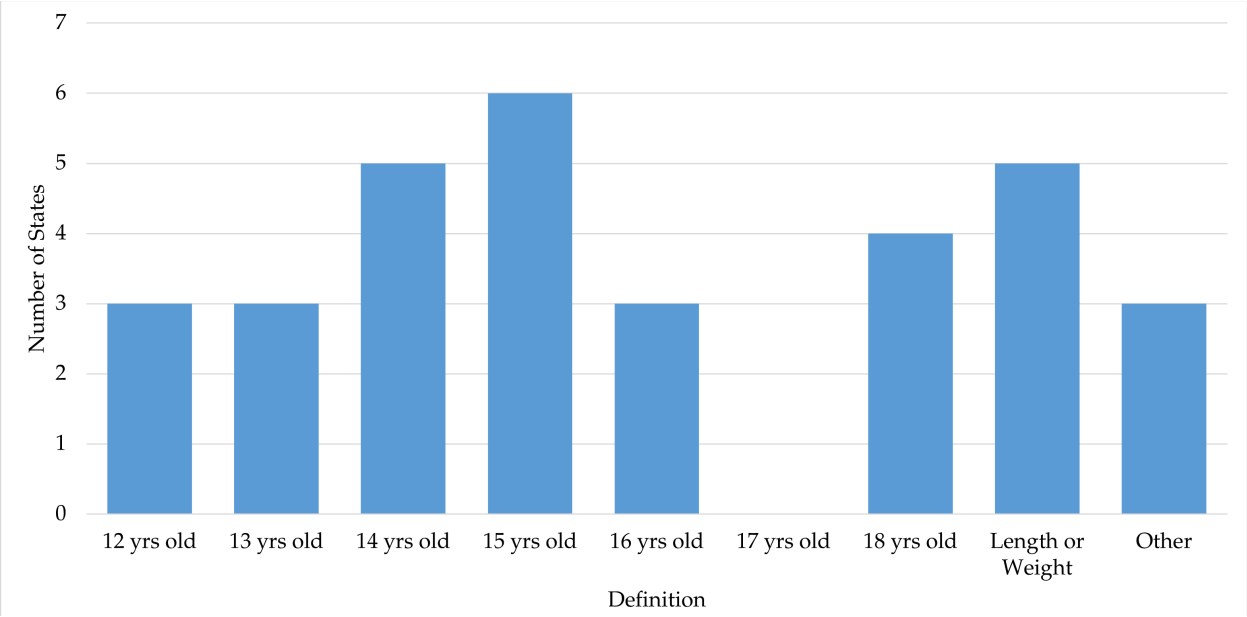

Figure 1. Distribution of pediatric definition criteria.

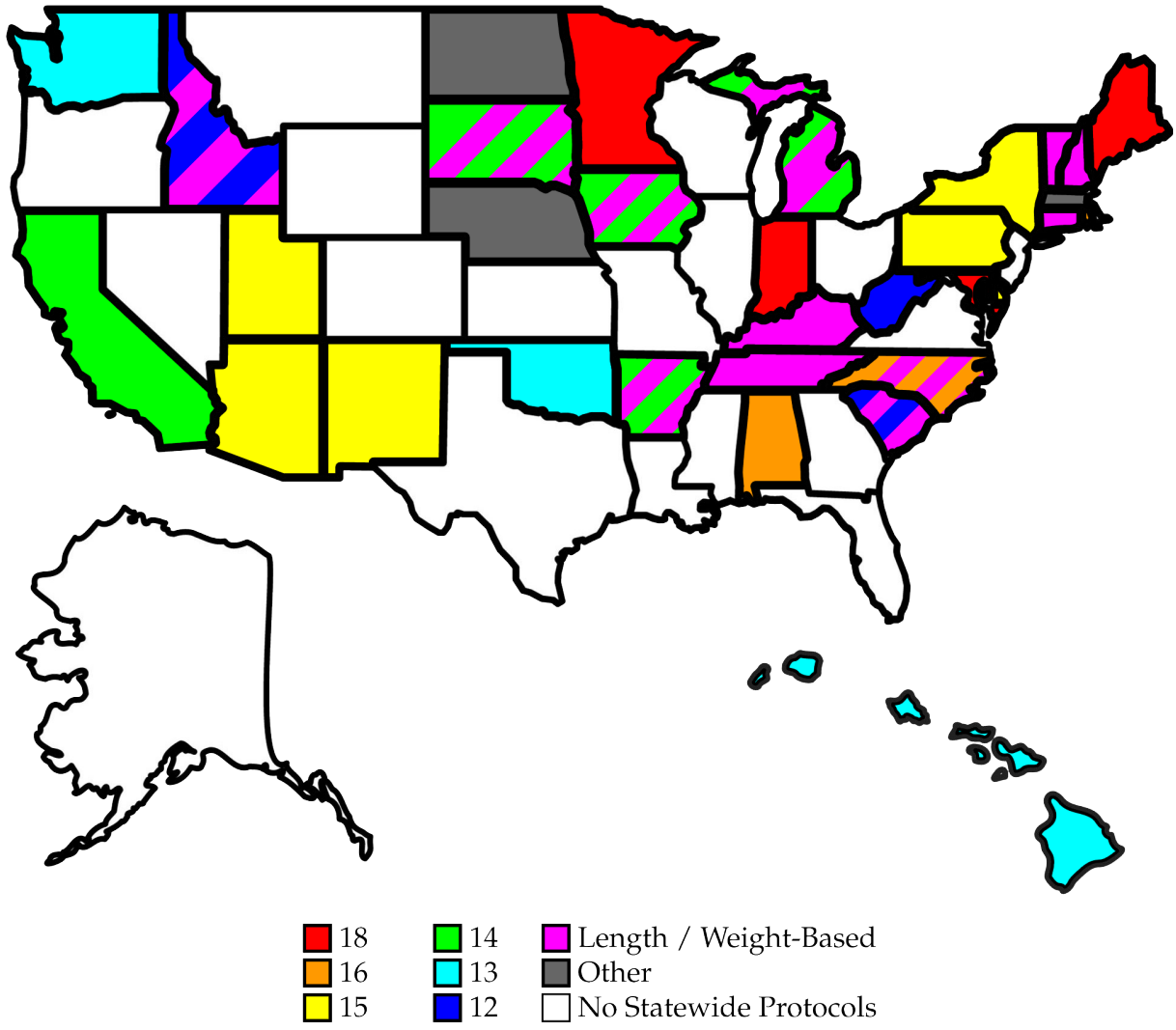

Figure 2. Pediatric definitions by state.

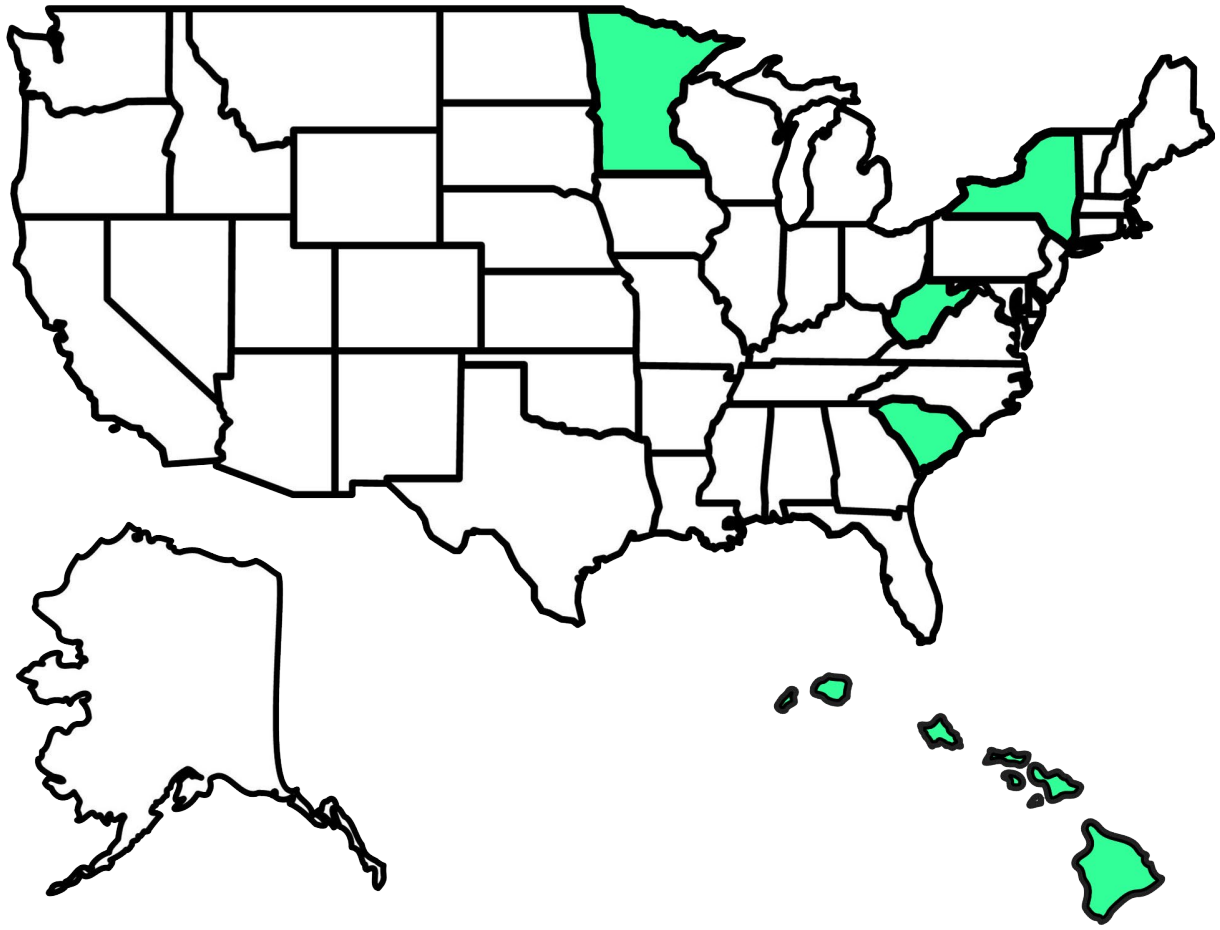

Figure 3. States enabling EMS clinician judgement.

points of reference for future discussions regarding a more standardized definition of pediatric patients.

State	Pediatric Definition
Massachusetts	Determination is different for different protocols. 20 kg for "Diabetic Emergencies" (Protocol 2.3P) 25 kg for "Bronchospasm/Respiratory Distress" (Protocol 2.6P) 25 kg for "Pain & Nausea Management" (Protocol 2.13)
Nebraska	Newborn to 1 year is determined as an infant for resuscitation. 1 year to onset of puberty is defined as a child for resuscitation.
North Dakota	Length/Weight-based dosing for most protocols, with age-based differentiation for anaphylaxis, 12-lead EKG obtainment, and LUCAS application.

Table 1. Elaboration of statewide protocol definitions of "pediatric" for selected states.

Shock

The ability to identify a patient in shock, especially during the early compensated phase, is a vital skill for prehospital clinicians. Pediatric patients in shock have a similar course to adult patients in shock; they will progress from compensated to decompensated shock, then to coma and/or death without recognition or intervention. However, the physical exam findings for children in shock can be more subtle and potentially ignored by practitioners unfamiliar with them. Early recognition of shock is key to improved survival (Evans et al., 2018). Thus, EMS protocols must pay attention to the differences between pediatric and adult presentations of shock, providing clear guidance for EMS clinicians. Here we outline signs of shock in a pediatric patient progressing from early to late signs,

with the information summarized in Appendix 1. Children rely on heart rate to boost cardiac output more than adults (Peitzman, 2008), with tachycardia being an early sign (Mendelson, 2018). They may also show subtle signs like delayed capillary refill (>2 sec) or mild irritability (Kleinman et al., 2010). As shock worsens, orthostatic vital sign changes can occur (Peitzman, 2008). EMS personnel trained in Pediatric Advanced Life Support (PALS) are better at recognizing pediatric shock (Baker et al., 2009). Note that 2020 PALS guidelines define infants as patients up to approximately 1 year old and children as patients between 1 year old and the onset of puberty, defined as "breast development in females and the presence of axillary hair in males" (Topjian et al, 2020).

If compensated shock is not noticed or corrected, it progresses. Tachypnea worsens as a respiratory response to metabolic acidosis. Capillary refill further delays (>4 sec), and extremities become pale, cool, or mottled due to peripheral vasoconstriction. Hypotension is an ominous sign (Kleinman et al., 2010). Children can maintain normotension until significant blood loss (Wolfson et al, 2009). Their smaller baseline circulating volume exacerbates this (Howie et al 2011).

Decreased perfusion leads to altered mental status, coma, abdominal distention, decreased bowel sounds, constipation, and reduced urine output. Dyspnea, tachypnea, and cyanosis may result from an inflammatory response (Wolfson et al, 2009). Bradycardia in decompensated shock indicates ischemic cardiac muscle. Neurogenic shock may present with bradycardia (Peitzman, 2008). Pediatric patients are more prone to hypothermia due to their body size and thermoregulation (Kleinman et al, 2010).

Vital Signs

A review of the normal vital signs in patients of different ages is included in Tables 2 and 3. This is especially important to note, as previous research indicates that most pediatric categories had reduced odds of complete vitals documentation, pain score documentation was lower in children after trauma (Ramgopal et al, 2018), and oxygen saturation documentation was lower in children with respiratory complaintsÐ effectively demonstrating that EMS personnel tend to assess pediatric patients less thoroughly than their adult counterparts.

Age	HR	RR
Neonate	120-160	40-60
<1 yr	100-160	30-60
1-2yrs	90-150	24-40
2-5yrs	80-140	22-34
>6-12yrs	60-100	12-16

Table 2. Normal pediatric vital signs (Freeborn et al, 2021, Lindh, 2006).

Airway

Pediatric airways are notoriously different from those of adults. One 2015 retrospective study found a rate of 1 pediatric intubation per 2,198 EMS responses; 44% of which were for patients in cardiac arrest and 66% of which were intubated on the first attempt. The most common challenge identified by this study was bodily fluids obstructing the laryngeal view (Prekker et al, 2016). Table 2 summarizes the anatomical changes of pediatric patients' airways as they age, which may be of use in reaching a more unified definition of pediatric patients for EMS clinicians.

Age (yrs)	Systolic	Diastolic
1	74-100	50-70
3	80-112	50-80
6	82-110	50-78
10	84-119	54-80
17	94-119	62-88

Table 3. Normal pediatric blood pressure (Lindh, 2006).

Age	Oro-pharynx	Larynx	Epiglottis	Glottis	Cricoid	Chest Wall
Neo-nate	Degree of relative microg-nathia	Cephalad and more com-pressed Making it ap-pear anterior at direct laryn-goscopy	<id-level of C1 45-degree position-ing and contact with soft palate allows for sucking and breathing simulta-neously and protects from aspiration but makes visualization of larynx difficult	Mid C3	Superior border of C4	Weak intercostal and diaphragmat-ic muscles (lack of type 1 fibers), horizontal ribs and a protuberant abdomen results in earlier onset of fatigue and less efficient ventilation. Chest wall-specific compliance is higher, and intercostal or sternal recession is readily visible with in-creased respiratory effort or airway obstruction.
Year 4-5		similar laryn-geal view to adults by year 4–5	mid C3	C4–C5 interspace	Mid C5	
puber-ty				Mid C5	C6–C7 interspace	

Table 4. Summary of anatomical changes of the pediatric airway (Westhorpe, 1987, Wilton and Hack, 2021).

Psychosocial Development

It is important for prehospital clinicians to be familiar with milestones and their time-line to properly assess mental status, tone, and social needs. These milestones may help differentiate certain categories of patients (e.g. "toddler") within the broader category of pediatric patients. Here, we discuss some of the more important and easily remembered milestones. More can be found in Appendix 2 (Zubler et al, 2022). Knowing develop-mental milestones aids in assessing mental status, tone, and social needs. By the age of 2 months, infants should be soothed easily and track movement (Zubler et al, 2022). At 4 months, they become more interactive and coo. By 6 months, they recognize familiar people and may put objects in their mouth. At 9 months, stranger anxiety develops. At 1 year, children become more interactive and start basic language. At 15 months, they follow instructions with gestures. By age 2, they respond to others' emotions. At 3, they ask questions and state their name. At 4, vocabulary and fine motor skills improve. Around 5, vocabulary expands, including time-related words (Zubler et al, 2022). These milestones have variability as to when children reach them; however, clinicians should have general expectations for how a healthy patient of that age should present in order to recognize a sick child.

Injury Patterns

Pediatric injury patterns differ from adults due to musculoskeletal differences. The dis-tribution of these injury patterns may also be important for defining pediatric patients for EMS categories or defining specific categories therein. Children are more prone to bony injuries than ligamentous or tendinous injuries (Marzi et al, 2023). There's also a risk of cervical spine displacement in young children. Hip dislocation is rare and suspi-cious. Scapular fractures are rare but concerning. Pelvic injuries are worrisome, with or without fractures. Lung contusion can occur without rib fractures. "Nursemaid's elbow" is common in young children, usually due to sudden arm pulling. Head size changes affect the estimation of burn injury severity (Table 5).

Finally, as children's relative head size decreases as age increases, the % Body Surface Area (BSA) in each part of the body changes with age, impacting the estimation of severity of burn injuries. This is summarized in Table 5.

Area	Birth to 1 year	1 to 4 years	5 to 9 years	10 to 14 years	Adult
Head	9.5	8.5	6.5	5.5	4.5
Neck	1	1	1	1	1
Trunk	13	13	13	13	13
Upper arm	2	2	2	2	2
Forearm	1.5	1.5	1.5	1.5	1.5
Hand	1.25	1.25	1.25	1.25	1.25
Thigh	2.75	3.25	4	4.25	4.5
Leg	2.5	2.5	2.5	3	3.25
Foot	1.75	1.75	1.75	1.75	1.75
Buttock	2.5	2.5	2.5	2.5	2.5
Genitalia	1	1	1	1	1

Table 5. Percent BSA of Body Parts by Age (Strobel et al 2018, Murari and Singh, 2019).

DISCUSSION

As children's development varies, so too does the definition of a pediatric patient across EMS systems in the United States. The variation in protocols does not seem to follow significant regional patterns. This is clearly a highly complex and multifactorial issue where more standardization appears to be needed. As a point of comparison, geriatric patients are widely understood to be those patients aged 65 and up, allowing for clinicians and researchers to have a common understanding when discussing these patients and develop evidence-based guidelines for the treatment of these patients. Some situations, such as medication dose, may benefit from a weight-based definition, while others, such as equipment choice, may make better use of a length-based definition. Age of legal adulthood for purposes of consent may require an age-based definition. Therefore, different definitions may make sense within a set of protocols, but wide definition variation between states likely does not serve patients or EMS professionals well. As discussion of these standards occurs in the appropriate forums, we highly encourage EMS systems to establish more consistent, logical, and applicable definitions.

CONCLUSION & RECOMMENDATIONS

The authors recommend further discussion at a national level to determine a consistent definition of pediatric patients. Consensus regarding the definition of pediatric patients will allow for enhanced monitoring of patient care trends at regional or national levels and will better inform future research regarding and care of pediatric patients. The authors acknowledge that there may not be a singular definition of pediatric that is suitable for all patients and presentations. We encourage future investigation as to whether different definitions for certain presentations (e.g., traumatic injury, airway emergencies, acute psychiatric emergencies, etc.) may be most appropriate, as some states have already elected to include in their statewide protocols. However, the authors recognize the difficulty that these differing definitions may impose on EMS clinicians and researchers. While no single definition of a pediatric patient seems eminently available, increased national concordance regarding the definition of pediatric patients is of paramount importance for future development of EMS protocols and pediatric EMS research.

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APPENDICES

Early (compensated) Shock		Late (uncompensated) Shock	
signs/symptoms	**physiology**	**signs/symptoms**	**physiology**
tachycardia	Increased cardiac output; compensation for decreased stroke volume	Bradycardia (sign of impending cardiac arrest)	Ischemic heart unable to match demand/ compensate for decreased stroke volume
Mild tachypnea	To meet oxygen demand of under perfused organs	Increased tachypnea	Compensatory respiratory alkalosis for increasing metabolic acidosis
Slightly delayed capillary refill	Due to peripheral vasoconstriction to maintain core organ perfusion (may not be true in some cases of septic shock)	Increasingly delayed capillary refill (>4sec) Mottled or pale skin with cool extremities	Severe peripheral vasoconstriction to shunt blood to brain, kidneys, and heart
Orthostatic BP	Decreased circulating volume causes orthostatic changes	hypotension	Failure of compensatory measures to maintain a perfusing pressure Note: unlike adults, children maintain an almost normal blood pressure until 25% to 35% of their circulating blood volume is lost
Orthostatic pulse changes	Decreased circulating volume causes orthostatic changes		
Mild irritability		AMS progressing to coma	Decreased brain perfusion
		Oliguria	Decreased cardiac output and vasoconstriction cause renal ischemia
		Abdominal distension and decreased motility	Gastrointestinal ischemia due to decreased perfusion
		Dyspnea, tachypnea, and cyanosis refractory to oxygen therapy	massive systemic inflammatory response to ischemia causes endothelium damage and allows fluid into alveolar space

Appendix 1. Summary of pediatric presentation of shock.

Age	Social-emotional	Language	Cognitive	Motor
2 months	Calms down when spoken to or picked up Looks at your face Seems happy to see you Smiles when you talk to or smile at them	Makes sounds other than crying Reacts to loud sounds	Watches you as you move Looks at a toy for several seconds	Holds head up when in prone position Moves both arms and legs Opens hand briefly
4 months	Smiles to get your attention Chuckles (not yet a full laugh) Looks at you, moves, or makes sounds to get or keep your attention	Makes sounds like "oooo" and "aahh" (cooing) Makes sounds back when you talk to them Turns head toward the sound of your voice	If hungry, opens mouth when the breast or bottle is seen Looks at own hands with interest	Holds head steady without support Holds a toy when put in hand Uses arm to swing at toys Brings hands to mouth Pushes up onto elbows/forearms from prone position
6 months	Knows familiar people Likes to look at themself in the mirror Laughs	Takes turns making sounds with you Blows "raspberries" (sticks tongue out and blows) Makes squealing noises	Puts things in mouth to explore Reaches to grab a toy Closes lips to show they does not want more food	Rolls front to back Pushes up with straight arms when in prone position Leans on hands to support self when sitting
9 months	Is shy, clingy, or fearful around strangers Shows several facial expressions, like happy, sad, angry, and surprised Looks when name is called Reacts when you leave (looks, reaches for you, or cries Smiles or laughs when you play peek-a-boo	Makes different sounds like "mamamama" and "babababa" Lifts arms up to be picked up	Looks for objects when dropped out of sight Bangs 2 things together	Gets to a sitting position without assistance Sits without support Uses fingers to "rake" food toward self Moves things from one hand to the other
12 months	Plays games with you, like pat-a-cake	Waves "bye-bye" Calls a parent "mama" or "dada" or another special name Understands "no" (pauses briefly or stops when you say it)	Puts something in a container, like a block in a cup Looks for things he sees you hide, like a toy under a blanket	Pulls up to stand Walks, holding onto furniture Drinks from a cup without a lid, as you hold it Picks things up between thumb and pointer finger, like small bits of food
15 months	Copies other children while playing, like taking toys out of a container when another child does Shows you an object that they like Claps when excited Hugs stuffed doll or other toy Shows you affection (hugs, cuddles, or kisses you)	Tries to say 1 or 2 words besides mama or dada, like "ba" for ball or "da" for dog Looks at a familiar object when you name it Follows directions given with both a gesture and words. For example, gives you a toy when you hold out your hand and say, "Give me the toy." Points to ask for something or to get help	Tries to use things the right way, like a phone, cup, or book Stacks at least 2 small objects, like blocks	Takes a few steps on their own Uses fingers to feed self
18 months	Moves away from you, but looks to make sure you are close by Points to show you something interesting Puts hands out for you to wash them Looks at a few pages in a book with you Helps you dress them by pushing arm through sleeve or lifting up foot	Tries to say ≥3 words besides mama or dada Follows 1-step directions without any gestures, like giving you the toy when you say, "Give it to me."	Copies you doing chores, like sweeping with a broom Plays with toys in a simple way, like pushing a toy car	Walks without holding onto anyone or anything Scribbles Drinks from a cup without a lid and may spill sometimes Feeds self with their fingers Tries to use a spoon Climbs on and off a couch or chair without help
24 months	Notices when others are hurt or upset, like pausing or looking sad when someone is crying Looks at your face to see how to react in a new situation	Says at least 2 words together, like "More milk." Points to at least 2 body parts when you ask Uses more gestures than just waving and pointing, like blowing a kiss or nodding yes	Holds something in 1 hand while using the other hand, for example, holding a container and taking the lid off Tries to use switches, knobs, or buttons on a toy Plays with >1 toy at the same time, like putting toy food on a toy plate	Kicks a ball Runs Walks (not climbs) up a few stairs with or without help Eats with a spoon

Appendix 2. Summary of pediatric developmental milestones.

Age	Social-emotional	Language	Cognitive	Motor
30 months	Plays next to other children and sometimes plays with them Shows you what they can do by saying, "Look at me!" Follows simple routines when told, like helping to pick up toys when you say, "It's clean-up time."	Says ≥2 words, with 1 action word, like "Doggie run." Says around 50 words Names things in a book when you point and ask, "What is this?" Says words like I, me, or we	Uses things to pretend, like feeding a block to a doll as if it were food Shows simple problem-solving skills, like standing on a small stool to reach something Follows 2-step instructions, for example, "Put the toy down and close the door." Shows that they know at least 1 color, like pointing to a red crayon when you ask, "Which one is red?"	Uses hands to twist things, like turning doorknobs or unscrewing lids Takes some clothes off by themself, like loose pants or an open jacket Jumps off the ground with both feet Turns book pages, one at a time, when you read to them
3 years	Calms down within 10 minutes after you leave, like at child care drop off Notices other children and joins them to play	Talks with you in conversation using at least 2 back-and-forth exchanges Asks who, what, where, or why questions, like "Where is mommy/daddy?" Says what action is happening in a picture when asked, like running, eating, or playing Says first name when asked Talks well enough for others to understand, most of the time	Draws a circle when shown how Avoids touching hot objects, like a stove, when warned	Strings items together, like large beads or macaroni Puts on some clothes by themself, like loose pants or a jacket Uses a fork
4 years	Pretends to be something else during play (teacher, superhero, dog) Asks to go play with children if none are around, like "Can I play with Alex? Comforts others who are hurt or sad, like hugging a crying friend Avoids danger, like not jumping from tall heights at the playground Likes to be a "helper" Changes behavior on the basis of location (place of worship, library, playground)	Says sentences with four or more words Says some words from a song, story, or nursery rhyme Talks about at least one thing that happened during the day, like "I played soccer." Answers simple questions, like "What is a coat for," or "What is a crayon for?"	Names a few colors of items Tells what comes next in a well-known story Draws a person with three or more body parts	Catches a large ball most of the time Serves food or pours water , with adult supervision Unbuttons some buttons Holds crayon or pencil between fingers and thumb (not in a fist)
5 years	Follows rules or takes turns when playing games with other children Sings, dances, or acts for you Does simple chores at home, like matching socks or clearing the table after eating	Tells a story that was heard or made up with at least two events, like a cat stuck in a tree and a firefighter saving it Answers simple questions about a book or story after you read or tell it to them Keeps a conversation going with more than three back-and-forth exchanges Uses or recognizes simple rhymes (bat-cat, ball-tall)	Counts to 10 Names some numbers between one and five when you point to them Uses words about time, like yesterday, tomorrow, morning, or night Pays attention for 5–10 minutes during activities, for example, during story time or making arts and crafts (screen time does not count) Writes some letters of their name Names some letters when you point to them	Buttons some buttons Hops on 1 foot

Appendix 2 (continued). Summary of pediatric developmental milestones.

Injury	Ages more common	Anatomical/ physiological reasoning	Bones most affected	Mechanism of Injury	Notes
Stress fractures	2-4 years Puberty		Tibia, fibula, tarsus, and femur Proximal tibia or the metatarsals	Young children learning to walk or run Excessive sports activity	
Osseous, chondral, or periosteal ligament tears	10-12 years	Ligaments are more stable than their attachments			
Avulsion or growth plate injuries	Children with open epiphyseal junctures (~<12years)	Tendons and ligaments are not directly connected to the growing skeleton in childrenbut are attached to the cartilage or the growth region. The high elasticity and plastic deformability of the tendons and ligaments in children often lead to bony injuries and not to intra-ligamentous/intra-tendinous ruptures			
Ligament rupture	> 12 years	After the growth phase, laxity described above decreases and risk of ligament rupture is increased			
Muscle tendons tear/ bone avulsion	Adolescents	Hormonal influence	Humeral medial epicondyle, anterior iliac spines, lesser trochanter	Increased risk at adolescence due to hormonal changes and increased sports stress	
Greenstick (Classic)		Pediatric periosteum has a higher fat content, increased vascularization and is thicker than that of adults	Shaft of forearm long bones is most common	Fall on outstretched arm or other blunt trauma	High refracture risk
Greenstick (Compressed)	<5				Not associated with healing problems
Greenstick (Bowing)	Late childhood/ adolescence				
Shoulder Dislocation	> 10-12 years				
Posterior Hip Dislocation				A result of high speed trauma	High index of suspicion for other injuries
Physiological anterior displacement of C2 on C3 or C3 on C4 with the potential for pseudo-subluxation	Up to age 8	Greater elasticity of pediatric spine			
Muscle contusions/ sprain	Adolescents playing sports (rare in young children)			Sports related	
Scapular fractures	Rare			High speed traffic accident or falls from height	Suspect concomitant rib and/ or vertebral fxfractures
Supracondylar humerus fracture	Peaks at age 5		Metaphysis of distal humerus	Fall on outstretched, hyperextended arm (breaking a fall)	
Transcondylar humerus fractures (Medial condyle)	Peaks at 12 years			Fall onto outstretched hand; sometimes direct trauma	Often seen with elbow dislocation
Transcondylar humerus fractures (Lateral condyle)	4-5 years				Missed lateral condyle fractures can lead to significant function deficit/ deformity and ulnar nerve irritation
Transcondylar humerus fractures (T-fractures)					
Elbow dislocation	> 10 years			Fall on outstretched hand leads to posterolateral dislocation; rarely, a direct fall on the posterior elbow will lead to anterior dislocation	
Subluxation of proximal radius "Nursemaids elbow"	< 4 years more common in girls and left arm	Annular ligament's distal attachment to proximal radius strengthens as child ages	Proximal radius slips out of the annular ligament when the muscles cannot counter-stabilize the joint	Abrupt force, often an adult pulling up or twisting an extended arm	Presents holding the injured elbow in moderate extension and pronation
Proximal Forearm		Supinator and biceps muscles pull the proximal fragment into supination and flexion. The pronator quadratus and teres muscles pronate the distal fragment	Radius and ulna		Immobilize in supination to approximate fracture

Appendix 3. Summary of pediatric musculoskeletal injury patterns.

Injury	Ages more common	Anatomical/ physiological reasoning	Bones most affected	Mechanism of Injury	Notes
Mid shaft forearm	Ages 6-8; more common in boys	Pronator teres and the supinator neutralize each other, leaving only the biceps acting to flex the proximal fragment	Radius and ulna	Fall onto the outstretched hand	Immobilize in neutral or mild supination
Distal Forearm	Age 10	Supinates due to pull of the brachioradialis muscle	Usual distal third of radius and ulna		Immobilize in slight pronation
Carpal injuries	10-15 year	Carpal complex consists almost entirely of cartilage; as bones ossify injury patterns similar to adults is seen	Generally of scaphoid, lunate, and capitate bones	Fall from bike or while skating	Often in combination with distal radius fracture
Hip (Proximal femur)		Bone is more robust than adults		Massive trauma	Must suspect concomitant injuries; complicated healing due to vascular supply
Hip (Femur shaft)	Younger children/ infants	Femoral shaft diameter increases with increasing cortical diameter during growth, while canal diameter proportionally decreases.; bone less stable		Consider child abuse; falls from changing tables	Consider shock from blood loss, vascular, and nerve injury; evident from swelling, shortening, and rotation of affected leg
Hip (Distal femur)				Often sports related, can be from high-speed trauma or falls	Assess for vascular damage
Lower leg			Tibia only (70%) Tibia and fibula (30%)		High-risk for compartment syndrome
Talus				Severe force trauma	High index for other injuries
Pelvis		Strong ligaments and multiple cartilaginous growth centers can absorb significant force without fracturing	Isolated ring fracture possible due to elasticity of hemipelvis	High energy trauma: traffic accident and fall from height; approx 25% of children with a fracture will have associated traumatic brain injury	High incidence of additional injuries; high- risk of organ injuries without fracture; evaluate for perianal and scrotal hematomas; transport to center with pediatric surgery/ trauma highly encouraged

Appendix 3 (continued). Summary of pediatric musculoskeletal injury patterns.

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PARAMEDICINE LITERATURE SEARCH: DECEMBER-FEBRUARY 2024

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To help keep current with the literature in the paramedicine discipline, the Paramedicine Literature Search Update provides the results of a standardized search of the PubMed database that includes articles from paramedicine as well as other fields, such an ones about EMS care for cancer patients that might appear an oncology journals.

The formatting of the Paramedicine Literature Search is designed to allow the reader to scan the titles of articles out-dented in the listings. Where available, a link string starting with "https://doi.org/" is provided and may be copied and pasted into a browser to access the article or its landing page. Please note that not all search results included a link.

The search criteria used represent a diligent effort in balancing sensitivity (i.e., getting all relevant articles in paramedicine) with specificity (i.e., excluding articles not relevant to paramedicine). The balance is imperfect, so every relevant article is not included, and some non-relevant articles are included. The search results are filtered to limit to those articles with publication dates, as indexed in PubMed, for the time frame shown below. Some of the actual publication dates may fall outside of this range due to how the article metadata was indexed by the publisher and processed by the National Library of Medicine.

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"paramedic"[Text Word] OR "paramedics"[Text Word] OR "prehospital"[Text Word] OR "pre-hospital"[Text Word] OR "emergency medical technician"[Text Word] OR "emergency medical technicians"[Text Word] OR "Ambulance"[Text Word] OR "emergency medical services"[Text Word] OR "fire-rescue"[Text Word] OR "fire-rescue"[Text Word] Filters: from 2023/12/1 - 2024/02/29 Sort by: Publication Date.

This search strategy yielded a total of 1,209 citations and are listed below.

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International Journal of Paramedicine

Published by the National EMS Management Association (USA)

GUIDELINES FOR AUTHORS

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

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

GENERAL GUIDELINES AND NOTES

The *IJOP* only publishes material in English. Please use Academic English.

The *IJOP* accepts submissions in the following categories:

- Case Studies (2,000 words)
- Concepts (3,000 words)
- Correspondence / Commentary (1,000 words)
- Education (3,000 words)
- Empirical Investigations / Original Research (4,500 words)
- Methodology (2,000 words)
- Quality Improvement Project Reports (3,000 words)
- Reviews / Synthesis (4,000 words)
- Special Reports (2,000 words)
- Toolbox (1,500 words)

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

Merriam-Webster's Collegiate Dictionary (11th ed.) should be consulted for spelling.

Contributions that explore non-clinical topics such as leadership, operations, education, professional practice, and the culture of paramedicine are strongly encouraged.

Based on the international scope of the *IJOP*, contributions should provide a degree of generalizability and transferability to global settings and should have relevance to the *IJOP's* broad readership.

IJOP discourages multiple publications derived from a single study.

All original research submissions must have received approval from an Institutional Research Board (IRB) or Research Ethics Board (REB).

Once a submission has been assessed for suitability by the editorial team, it will undergo a double-blind peer-review by independent, anonymized reviewers.

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

The submission cannot be previously published or in the submission process of another publication (or an explanation has been provided a cover letter to the Editor).

The Author and Funding File and the Main Submission File are both in Microsoft Word document file format.

An ICMJE Form for Disclosure of Potential Conflicts of Interest is submitted for each author.

All illustrations, figures, and tables should be placed within the text at the appropriate points AND submitted as separate files in a high resolution format.

Supplemental media files (e.g., spreadsheets, slides, audio or video files) may be included for reader access. The file should be hosted by the authors unless other arrangements have been made with the Editors.

Where available, URLs for each reference have been provided.

The text is double-spaced in a 12-point font.

Page numbers and line numbering is 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 research. These include, but are not limited to:

- Randomized trials
  - CONSORT and its extensions
    - https://www.equator-network.org/reporting-guidelines/consort/
- Observational studies
  - STROBE and its extensions
    - https://www.equator-network.org/reporting-guidelines/strobe/
- Systematic reviews
- PRISMA and its extensions
  - https://www.equator-network.org/reporting-guidelines/prisma/
- Study protocols
  - SPIRIT and the PRISMA-P extension
    - https://www.equator-network.org/reporting-guidelines/spirit-2013-statement-defining-standard-protocol-items-for-clinical-trials/
- Diagnostic/prognostic studies
  - STARD and the TRIPOD extension
    - https://www.equator-network.org/reporting-guidelines/stard/
- Case reports
  - CARE and its extensions
    - https://www.equator-network.org/reporting-guidelines/care/
- Clinical practice guidelines
  - AGREE and the RIGHT extension
    - https://www.equator-network.org/reporting-guidelines/care/
- Qualitative research
  - SRQR and the COREQ extension
    - https://www.equator-network.org/reporting-guidelines/srqr/

- Animal pre-clinical studies
  - ARRIVE
    - https://www.equator-network.org/reporting-guidelines/improving-bioscience-research-reporting-the-arrive-guidelines-for-reporting-animal-research/
- Quality improvement studies
  - SQUIRE and its extensions
    - https://www.equator-network.org/reporting-guidelines/squire/
- Economic evaluations
  - CHEERS
    - https://www.equator-network.org/reporting-guidelines/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 Page

All authors of a manuscript should provide their full name with up to four post-nominals and up to two organizational affiliations and titles – exactly as they should appear in the publication.

The email of all authors should also be included.

If available, please include ORCiDs (http://orcid.org) numbers for each author.

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

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.

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.).

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' 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) direct-

ly 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 for reference marks and endnotes must be used.

In each endnote, 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 speadsheets 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 es-

tablished 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.

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.