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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.,

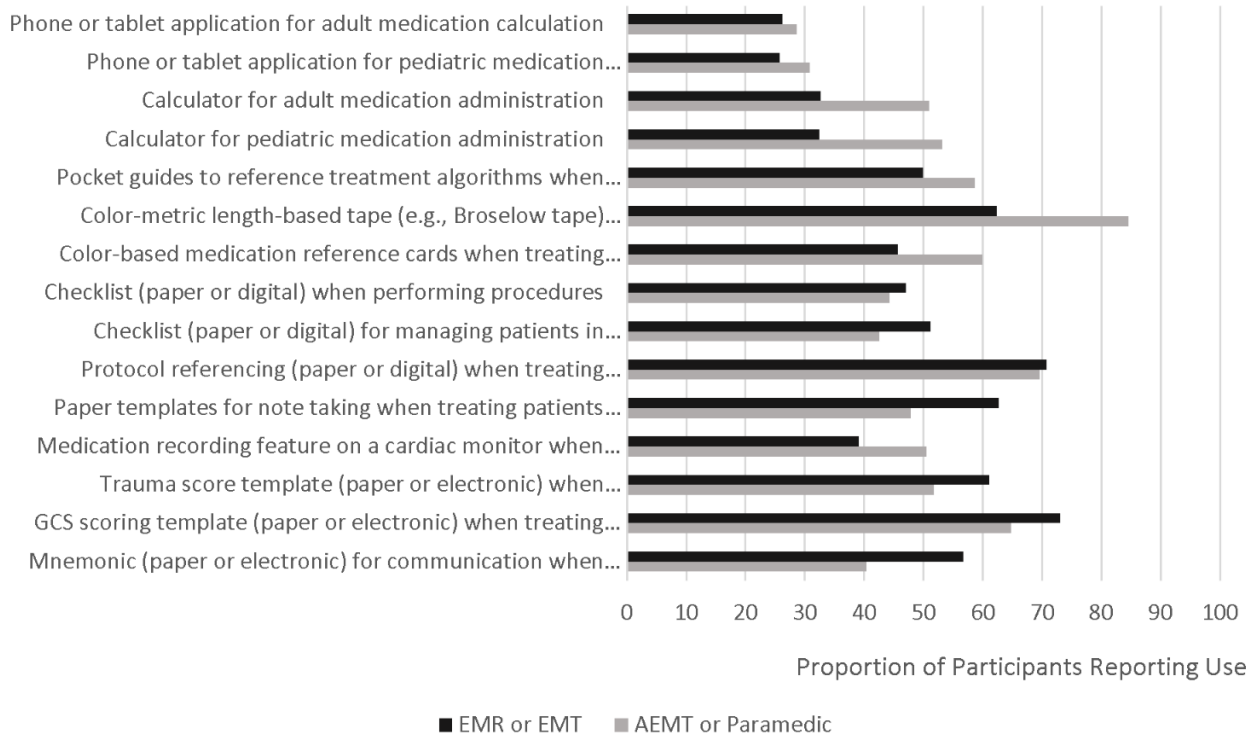

Figure 1. Comparison of Cognitive Aid Use in Education Programs Between EMS Clinician Levels.

(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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