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Priorities for Prehospital Evidence-Based Guideline Development: A Modified Delphi Analysis

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Abstract

Objective: Few areas of prehospital care are supported by evidence-based guidelines (EBGs). We aimed to identify gaps in clinical and operational prehospital EBGs to prioritize future EBG development and research funding. **Methods:** Using modified Delphi methodology, we sought consensus among experts in prehospital care and EBG development. Five rounds of surveys were administered between October 2019 and February 2020. Round 1 asked participants to list the top three gaps in prehospital clinical guidelines and top three gaps in operational guidelines that should be prioritized for guideline development and research funding. Based on responses, 3 reviewers performed thematic analysis to develop a list of prehospital EBG gaps, with participant feedback in Round 2. In Round 3, participants rated each gap's importance using a 5-point Likert scale, and participants' responses were averaged. In Round 4, participants rank-ordered 10 gaps with the highest mean scores identified in Round 3. In Round 5, participants indicated their agreement with sets of the highest ranked gaps. **Results:** Of 23 invited participants, 14 completed all 5 rounds. In Rounds 1 and 2, participants submitted 65 clinical and 58 operational gaps, and thematic analysis identified 23 unique clinical gaps and 28 unique operational gaps. The final prioritized list of clinical EBG gaps was: 1) airway management in adult and pediatric patients, 2) care of the pediatric patient, and 3) management of prehospital behavioral health emergencies, with 79% of participants agreeing. The final prioritized list of operational EBG gaps was: 1) define and measure the impact of EMS care on patient outcomes, 2) practitioner wellness, and 3) practitioner safety in the out-of-hospital environment, with 86% of participants agreeing. **Conclusions:** This modified Delphi study identifies gaps in prehospital EBGs that, if prioritized for development and research funding, would be expected to have the greatest impact on prehospital clinical care and operations. **Key words:** evidence-based guidelines; guideline; practice guideline; emergency medical services; prehospital emergency care; Delphi method

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Introduction

Emergency medical services (EMS) are the point of first medical contact for many patients, with one patient transported by ambulance every 2 seconds in the United States (1). Despite that frequency, the National Academy of Medicine (formerly the Institute of Medicine) in 2007 described a significant lack of evidence guiding prehospital care (1). Evidence-based guidelines (EBGs) synthesize available evidence in order to provide recommendations that improve medical care and are widely supported by national medical and EMS organizations (2, 3). Therefore, those vested in improving overall medical care have focused attention on increasing the use of EBGs by EMS practitioners. As one response to improving evidence-based prehospital care, the Prehospital Guidelines Consortium was established in 2016 to facilitate prehospital EBG development and dissemination (3).

Despite the recognized need for increased evidence-based prehospital care, a recent systematic review of existing prehospital EBGs by the Prehospital Guidelines Consortium found that the

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majority of prehospital EBG publications lacked key components recommended by the National Academy of Medicine (4). Furthermore, that same review found that only a limited number of domains comprising the American Board of Emergency Medicine Core Content of EMS Medicine were addressed by existing EBGs (5, 6). Additionally, the vast majority (96%) of existing prehospital EBGs pertain to clinical aspects of prehospital care, with far fewer (15%) addressing important non-clinical aspects of EMS medicine, such as medical oversight and operations (4).

Therefore, a need to expand prehospital EBG development exists, but with limited resources of researchers and sponsoring agencies, there is also a need to identify domains of prehospital care most urgently in need of prehospital EBG development. This study's objective was to identify existing gaps in current prehospital EBGs, both clinical and operational, that should be priorities for prehospital EBG development and research funding.

Methods

Study Design and Participants

A modified Delphi method was used to identify consensus recommendations among experts in the field of prehospital care and prehospital EBG development (7–9). Modified Delphi methodology has been used to develop prioritized lists of clinical and knowledge gaps in other health care settings, and this study used similar methodology (10–17). Expert participants were identified through their involvement as representatives of a member organization in the Prehospital Guidelines Consortium (3). We sought a range of background experience, professional affiliation, and practice settings. Although expert participants were identified as organizational representatives to the Prehospital Guidelines Consortium, they were instructed to answer as prehospital care experts, not on behalf of their organization. Prior to participation, a pre-participation survey asked panel members to self-report their prior experience with prehospital clinical care, prehospital operations, and EBG interpretation and development. Participants were not provided objective criteria when reporting prior experience in this pre-participation survey. Expert panel member participation in the project was voluntary, and no personal information was linked with individual responses; participant responses were maintained in a separate database from participant contact information. The American Institutes for Research institutional review board approved this project (EX00499).

Study Protocol and Data Analysis

The primary outcome was development of a prioritized list of three clinical and three operational gaps in prehospital EBGs which, if addressed, are expected to have the greatest impact on prehospital clinical care and non-clinical prehospital operations. Five rounds of online surveys were distributed via SurveyGizmo (Boulder, CO) using modified Delphi methodology between October 2019 and February 2020 (7, 16, 18). Reminders were distributed to non-responders 1–2 weeks after each survey round's initial invitation, in accordance with Dillman's tailored design methodology (19). Descriptive statistics of participants were calculated using STATA 16.1 (StataCorp, College Station, TX). Characteristics of participants who completed all 5 rounds compared with those who did not were analyzed using the Mann-Whitney U Test in STATA 16.1 (StataCorp, College Station, TX).

Round 1: The initial round of data collection asked expert panel members to identify current gaps in prehospital EBGs related to a) clinical aspects of prehospital patient care and b) operational aspects of prehospital care delivery. Participants were presented with two open-ended prompts: a) "What are the top three gaps in prehospital **clinical practice** guidelines that should be research priorities for funding in order to have the greatest impact on prehospital clinical care?" and b) "What are the top three gaps in prehospital **operations** guidelines that should be research priorities for funding in order to have the greatest impact on prehospital care delivery?"

In answering these two questions, participants were asked to consider the following documents: a) a systematic review of existing prehospital guidelines (4), b) the National Association of State EMS Officials' National Model EMS Clinical Guidelines (20), and c) the American Board of Emergency Medicine Core Content of EMS Medicine document for 2019 (6). Participants were asked to provide up to five responses for each prompt, including a short rationale for each response.

Responses, which included the gap and the participant's description and rationale of that gap, were collated. Members of the study team performed thematic analysis on the gaps and rationales to assemble initial lists of clinical and operational gaps, along with descriptions of the gaps. Initial thematic analysis was performed independently by two reviewers (CTR, ARP). Themes were concatenated by a third study team member (MKR), and any discrepancies were resolved by consensus among the

TABLE 1. Characteristics of expert participants

	Participants (Total n = 23)
Years in EMS (median, IQR, range)	25, 20–32, 10–46 years
Female (%)	13
Role in EMS (%)*	
Paramedic or EMT	48
EMS Physician	39
Non-EMS Physician	9
Registered Nurse	9
Other	9
Type of EMS Involvement (%)*	
Administrative	70
Clinical	43
Education	22
Research	13
Participant's EMS System Setting Location (%)*	
Urban	65
Suburban	30
Rural	13
Not applicable	17
Participants' Practice Environment (%)*	
Ground-based EMS	61
Emergency Department	13
Air Medical EMS	9
Not applicable	30
Participants' EMS System Experience (%)*	
Governmental/Third Service EMS	65
Fire-Based EMS	57
Private EMS	43
Hospital-based EMS	13
Air medical EMS	4
Experience Interpreting Evidence-Based Research (%)	
Expert	17
Significant Experience	65
Some Experience	17
Novice	0
None	0
Experience Developing Evidence-Based Guidelines (%)	
Expert	17
Significant Experience	26
Some Experience	52
Novice	0
None	4

Legend: Values are percentages of participants (n = 23) unless otherwise specified. * - participants may have identified more than one response per category, IQR – interquartile range, EMS – emergency medical services, EMT – emergency medical technician.

three reviewers (CTR, MRK, ARP) to produce a list of gaps and rationales. Using a grounded theory approach, all unique themes were included for analysis, and suggestions by participants that were thematically equivalent were incorporated into the same theme. Rationale and further explanation for each identified gap used language from participants' responses whenever possible and were included along with the gap in each subsequent survey round.

Round 2: Participants were presented with two lists of prehospital EBG gaps (clinical and operational) derived from the thematic analysis in Round 1. Participants were then queried via electronic survey if any other essential gaps were absent and were given the opportunity to provide additional gaps. Any new gaps identified in Round 2 were added to the Round 1 results.

Round 3: Participants were provided the list of prehospital EBG gaps identified in Rounds 1 and 2. Participants were asked to rate the importance of each gap with respect to potential impact on patient care or EMS system operations if there was a prehospital EBG addressing that gap. Participants used a 5-point Likert-type scale with the following descriptions: 1 - "not at all important," 2 - "minimal importance/negligible," 3 - "moderate importance but still a factor," 4 - "considerable importance," 5 - "very important/critical." The mean of the Likert-type scale scores were calculated, and the gaps with

TABLE 2. Top 10 gaps in prehospital clinical evidence-based guidelines, as identified by expert participants

Clinical Prehospital EBG Gaps	Total Points from Round 4 ("Ranking Round")	Rank Order by Total Points	Participants Ranking in Top 5 in Round 4 (%)
Airway management in adults and pediatrics	132	1	100
Care of the pediatric patient	88	2	64
Management of prehospital behavioral health emergencies	87	3	57
Managing medically complicated, high acuity patients	87	3	57
Care of the geriatric patient	68	5	43
Trauma resuscitation and blood product administration	67	6	50
Prehospital pain management	65	7	36
Sepsis and septic shock	62	8	29
Prehospital stroke management	61	9	29
Individualized management of cardiac arrest	53	10	36

Legend: For the frequency of responses, the numbers represent the number of participants that selected a particular rank position for that gap. The total points listed is a weighted sum based on the ranking (rank position 1 = 10 points, rank position 2 = 9 points, etc.). Sets were created out of the gaps that were ranked in the top 5 by greater than half of respondents, with the order of the gap in each set listed. EBG – evidence-based guideline.

the ten highest mean importance ratings were identified for each category (clinical and operational). At the end of Round 3, the order of the top ten clinical gaps and top ten operational gaps, as determined by mean importance rating, represented a preliminary expert panel consensus list.

Round 4: Participants were presented the preliminary consensus lists from the end of Round 3 and were asked to rank order the gaps in each list. The rank ordering was translated into a ranking score by assigning points to each rank option, according to methodology used in similar studies (16, 21). For example, a rank of 1 (most important) equaled 10 points and a rank of 10 (least important) equaled 1 point. For each gap, the mean of the points assigned from the rankings was calculated. Additionally, the percentage of participants that ranked each gap in the top 5 per category (clinical or operations) was calculated.

Round 5: We distributed a final survey to achieve a majority consensus from the expert panel on the top three clinical gaps and top three operations gaps. Gaps for which greater than half of participants ranked as being in the top five in Round 4 were included in the Round 5 survey. We determined *a priori* to create 3 sets with various combinations of ordered priority of three clinical gaps and three operational gaps to present to participants as Sets "A," "B," and "C" for clinical gaps and Sets "X," "Y," and "Z" for operational gaps. Participants were asked if they agreed that the highest ranking three gaps were the three most important prehospital gaps to prioritize for prehospital EBG development and research funding, as well as their relative order of importance. To further clarify participants' preference on relative importance of gaps, participants were asked their preference when pairs of sets were compared (for example, participants were asked if they prefer the content and relative priority of the gaps presented in Set "A" to the content and relative priority of gaps in Set "B"). The set of three clinical gaps and the set of three operations gaps with the highest agreement among participants were identified as the expert panel's final recommendation on priorities for future EBG development and research funding.

RESULTS

Participant Characteristics

A total of 23 individuals were invited to participate as members of the expert panel, and 14 completed all five rounds of the process. Expert panel members are listed in Table A1. All 23 individuals participated in Round 1, but if a respondent did not participate in a survey round, they were not eligible to participate in subsequent rounds. Respondents' self-reported

TABLE 3. Top 10 gaps in prehospital operational evidence-based guidelines, as identified by expert participants

Operational Prehospital EBG Gaps	Total Points from Round 4 ("Ranking Round")	Rank Order by Total Points	Participants Ranking in Top 5 in Round 4 (%)
Define and measure the impact of EMS care on patient outcomes	122	1	93
Practitioner wellness	112	2	86
Practitioner safety in the out-of-hospital environment	94	3	71
Challenges in data sharing between health care organizations	92	4	71
Best practices for quality assessment activities in EMS	76	5	43
Initial and continued practitioner training	69	6	43
Concerns with workforce shortage and allocation	64	7	29
Improved ambulance safety	60	8	36
Role of the EMS medical director	45	9	7
EMS response to the active assailant	36	10	21

Legend: For the frequency of responses, the numbers represent the number of participants that selected a particular ranking for that gap. The total points listed is a weighted sum based on the ranking (rank position 1 = 10 points, rank position 2 = 9 points, etc.). Sets were created out of the gaps that were ranked in the top 5 by greater than half of respondents, with the order of the gap in each set listed. EBG – evidence-based guideline, EMS – emergency medical services.

characteristics with respect to demographics, EMS system setting, practice type, and experience with developing EBGs are described in Table 1. Participants who completed all 5 rounds were more likely to have had more years of experience in EMS (median 29 years [interquartile range 24–35] vs 21 years [interquartile range 10–30], $p = 0.04$), but otherwise there were no statistically significant differences observed in the 9 respondents who did not complete all 5 rounds of the surveys.

Delphi Results

In Round 1, participants submitted a total of 65 clinical and 58 operational gap topics for consideration. From those submissions, thematic analysis revealed 23 unique clinical gaps and 28 unique operational gaps, listed in Tables A2 and A3, respectively. These themes were distributed to participants in Round 2, but no new unique themes were identified in Round 2 responses. The 10 clinical gaps with the highest mean importance scores from Round 3 are listed in Table 2, and the 10 operational gaps with the highest mean importance scores from Round 3 are listed in Table 3. The mean ranking scores from Round 4 are displayed in Tables 2 and 3 for clinical and operational EBG gaps, respectively. Four clinical gaps and 4 operational gaps were identified by more than half of participants as being in the top 5 most important clinical or operational gaps, and all of those top 4 gaps were above a natural inflection point at a mean importance score ranking score of 4 (Tables A2 and A3).

Those 4 clinical and 4 operations gaps were grouped into 3 sets, identified as Sets "A," "B," and "C" for clinical gaps (Table A2) and Sets "X," "Y," and "Z" for operational gaps (Table A3) for the Round 5 survey. For clinical gaps, 79% agreed that Set "A" was the set with the 3 most important prehospital clinical EBG gaps (Table A2). When comparing Set "A" to Set "B," 71% preferred Set "A." When comparing Set "A" to Set "C," 64% preferred Set "A." When comparing Set "B" to Set "C," 57% preferred Set "C." For operational gaps, 86% agreed that Set "X" was the set with the three most important prehospital EBG gaps (Table A3). When comparing Set "X" to Set "Y," 57% preferred Set "X." When comparing Set "X" to Set "Z," 86% preferred Set "X." When comparing Set "Y" to Set "Z," 50% preferred Set "Y" and 50% preferred Set "Z."

The final prioritized list of the top three prehospital clinical topic gaps with respect to guideline development was "Set A":

1. **Airway Management in Adult and Pediatric Patients:** Guidelines for basic and advanced

prehospital airway management for adult and pediatric patients are needed. Additional focus on interventions that improve patient outcomes and address strategies for each practitioner level are recommended.
2. **Care of the Pediatric Patient:** Concerning the high stress and low frequency of acute pediatric patient care episodes, a focus on improving overall pediatric care is important. Prehospital EBGs concerning the best practices for pediatrics, including better methods to mitigate pediatric medication errors and improve management of pediatric respiratory diseases, are lacking.
3. **Management of Prehospital Behavioral Health Emergencies:** There is an increased frequency of patients presenting with behavioral health emergencies in the prehospital setting. These patients may pose risk to themselves and EMS practitioners, and improved education and training for de-escalation skills are important. Further, associated risks of polypharmacy and comorbid conditions that are poorly defined in this population, emphasize the need for guidance regarding medical management.

The final prioritized list of the top three prehospital operational EBGs was Set "X":

1. **Define and Measure the Impact of EMS Care on Patient Outcomes:** EMS care is increasingly recognized as critically important to the clinical outcomes of patients in the prehospital setting. However, mechanisms to define and measure the impact of prehospital care on overall patient outcomes are limited.
2. **Practitioner Wellness:** Awareness of the effect of stress on the prehospital practitioner – manifest as burnout, compassion fatigue, post-traumatic stress disorder, substance abuse, divorce, and suicide – is increasing. Guidance is limited regarding effective implementation of strategies to recognize and mitigate the effect of stress on EMS practitioners, as well as improving mental and physical health of EMS practitioners.
3. **Practitioner Safety in the Out-of-Hospital Environment:** EMS care delivery happens in unique and challenging environments that at times put EMS practitioners at risk. Guidance regarding scene safety, escape maneuvers, de-escalation techniques for violent patients, ballistic vests and helmets, and lifting and moving techniques are limited.

Discussion

Prehospital care would be advanced with increased development, dissemination, and implementation of prehospital EBGs. Although a number of prehospital EBGs exist, there are many important prehospital clinical and operational domains that are not adequately addressed by existing EBGs (4). Informed by a panel of prehospital care experts using a modified Delphi analysis, we report current gaps in prehospital clinical care and operations that represent the highest priorities for future EBG development. The majority of experts agreed that the top three clinical gaps to be addressed by prehospital EBG development were airway management, care of pediatric patients, and behavioral health emergencies. The top three operational EBG gaps identified were defining and measuring the impact of the prehospital phase of care on the overall care of the patient, practitioner wellness, and practitioner safety.

Among clinical gaps identified by the participants, guidelines addressing specific patient populations were identified as most important. Specifically, pediatric patients, medically complex patients, and geriatric patients were selected as populations where prehospital EBGs are lacking. This likely reflects the increasing complexity and sophistication of prehospital care, as well as changing demographics patterns. For example, as the geriatric population grows, so does the number of geriatric patients treated by EMS practitioners. On the other hand, the pediatric patient population was identified as a population in need of prehospital EBGs despite pediatric encounters remaining a minority of overall EMS patient encounters (22, 23). Yet the low frequency of "high-stakes" skills, such as pediatric airway management, may cause some EMS practitioners to not feel adequately prepared (23–27). Additionally, behavioral health emergencies are common, and pharmacological approaches, non-pharmacological approaches, patient safety, and practitioner safety were identified as gaps in need of prehospital EBGs (28).

Regarding operational prehospital EBG gaps, defining and measuring the impact of EMS care on patient outcomes, practitioner wellness, and practitioner safety were rated highest. Additional operational gaps included data sharing among EMS and other entities in the health care continuum and assessing quality performance, topics that are complementary with the highest-rated operational EBG gap that links prehospital care to overall patient outcomes. Systematic integration of EMS data into existing health care infrastructure is seen as important, and as a priority for evidence-based guidance, rather than piecemeal information technology solutions at the local agency level. Defining, quantifying, and measuring the impact of prehospital care on patient care, namely through linkage and analysis of data repositories, is seen as an operational gap that

can inform and improve overall patient care. Additionally, a focus on prehospital care practitioners was an important commonality to several highly rated gaps – practitioner wellness, practitioner safety, ambulance safety, and workforce shortages. Specific operational considerations, such as the role of the EMS medical director and the approach to active assailant situations, were seen as important but not prioritized. Even in the context of this study being performed prior to the pandemic and civil unrest of 2020, importance of practitioner safety and wellness was identified as a priority.

It is important to consider the main task of the assembled experts when interpreting these results. The panel aimed to identify gaps in current prehospital EBGs that should be priorities for development and further research to have the greatest impact on prehospital clinical care and care delivery. Therefore, there may be topic areas in prehospital care that are critically important to EMS care but may not have been identified as gaps in existing EBGs. An example includes recent EBGs on fatigue in EMS – an important topic in prehospital care, but one in which robust prehospital EBGs exist (29, 30). Additionally, the participants were not asked to critically evaluate existing science that informed current guidelines, nor were they specifically asked to comment on the feasibility of implementing recommended guidelines. Therefore, panel members were not prompted to comment on the quality of existing research or research gaps, but rather where prioritized research addressing gaps in EBGs could have the greatest impact on overall prehospital care and EMS operations. Lastly, in the early round prompts, participants were asked to comment on what EBG gaps should be prioritized for guideline development and research funding. The intent of the survey prompts was to have participants reflect upon EBG gaps that should be prioritized for formal guideline development, a process that requires dedicated resources. However, participants may have felt that certain EBG gaps may not require dedicated funding for subsequent development. Additionally, while a natural infection point occurred in the top four clinical gaps and top four operational gaps, we report the recommendations as a top three list for each because of the methodology used in querying participants, as well as a reflection that limited resources exist for EBG development.

Participants assembled for this modified Delphi panel represent a wide range of experience and expertise in the field of prehospital care. All experts were identified through the Prehospital Guidelines Consortium, and, because of this, were interested and experienced in prehospital EBGs. The assembled group had experience in a variety of EMS systems and in a variety of roles within those system. Participants reported that they were involved in EMS for at least a decade, but most participants had many more years of experience in prehospital care. All participants rated themselves as being facile in critically evaluating evidence-based medicine, and several were experts in guideline development. In determining the prioritized list of prehospital EBG gaps, the experts were asked to consider the current evidence base for any particular area of prehospital clinical care and EMS operations, as well as the potential impact of an EBG where one does not currently exist. Due to the extensive experience of the assembled participants, we expect that the recommendations of this panel can help direct priorities for future prehospital EBG development. In addition to EBG development, subsequent evaluation of the implementation of prehospital EBGs is a critical next step (31).

LIMITATIONS

This study does have several limitations. While the expert panel drew from a wide range of perspectives and experience in EMS, participants were more likely to have experience in urban, ground-based EMS services. Therefore, participants were less likely to have key roles and experience in rural and frontier EMS and air medical EMS. Female gender was underrepresented among responding participants. Additionally, no respondents identified themselves as advanced emergency medical technician, emergency medical dispatcher, or emergency medical responder. Because of the weighted ranking and rating methodology used, topics that are more pertinent to those settings and populations may have been under-represented. Next, it is not knowable if any participant had sub-specialty training or focused topical interest beyond the participant's involvement as a representative of a member organization in the Prehospital Guidelines Consortium. While all participants contributed to identifying gaps early in the study, not all participants completed all five survey rounds. While those completing all 5 rounds did not differ significantly in terms of recorded characteristics aside having more years of experience in EMS and were a mix of participant types, there may have been a systematic difference in non-responders that our methodology was unable to capture. Next, as stated previously, all rounds of the modified Delphi process occurred in the months prior to the COVID-19 pandemic. Therefore, any prehospital EBG gaps that addressed pandemic response may not have been identified as a priority

by the experts prior to the COVID-19 pandemic. Additionally, technology and timing of the pandemic made any large group discussion related to the final consensus prohibitive. Therefore, we were unable to assemble the collective group of experts for a final discussion of ratings and recommendations. However, in Round 5, we report a large degree of agreement among participants for the final recommendations.

Conclusions

This modified Delphi study reports expert panel recommendations of clinical and operational gaps in prehospital EBGs that, if prioritized for prehospital EBG development and research funding, would be expected to have the greatest impact on prehospital clinical care and care delivery. Clinical priorities identified were airway management, care of pediatric patients, and management of behavioral health emergencies. Operational priorities identified were defining and measuring the impact of EMS care on patient outcomes, practitioner wellness, and practitioner safety. Future research and EBG efforts addressing these topics would be expected to have the greatest impact on advancing evidence-based prehospital care.

Author Contributions

CTR, REC, MRK, KMB, CMG, ARP conceived and designed the study. CTR, REC, MRK, ARP acquired data. CTR, JNF, REC, MKR, ARP performed analysis and interpretation of the data. JNF, REC, MKR, ARP provided statistical expertise. CTR, JNF, REC, MKR, CMG, ARP drafted the manuscript. All authors provided critical manuscript revision for important intellectual content.

Declaration of Interest Statement

CTR reports grant money to University of Cincinnati to conduct research conceived and written by S. Prabhakaran from University of Chicago (AHRQ R18-HS-025359) and funding for conference speaker travel reimbursement from American Heart Association, American College of Emergency Physicians, and Illinois EMT Association. All other authors report no conflicts of interest.

Presentations

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References

1. Institute of Medicine (U.S.). Committee on the Future of Emergency Care in the United States Health System. Emergency medical services at the crossroads. Washington, D.C.: National Academies Press; 2007.
2. Lugtenberg M, Burgers JS, Westert GP. Effects of evidence-based clinical practice guidelines on quality of care: A systematic review. Qual Saf Health Care. 2009;18(5):385–92. doi: 10.1136/qshc.2008.028043. PMID,
3. Martin-Gill C, Gaither JB, Bigham BL, Myers JB, Kupas DF, Spaite DW. National prehospital evidence-based guidelines strategy: A summary for EMS stakeholders. Prehosp Emerg Care. 2016;20(2):175–83. doi:10.3109/10903127.2015.1102995. PMID,
4. Turner S, Lang ES, Brown K, Franke J, Workun-Hill M, Jackson C, Roberts L, Leyton C, Bulger EM, Censullo EM, et al. Systematic review of evidence-based guidelines for prehospital care. Prehosp Emerg Care. 2021;25(2):221–234. doi:10.1080/10903127.2020.1754978.
5. Perina DG, Pons PT, Blackwell TH, Bogucki S, Brice JH, Cunningham CA, Delbridge TR, Gausche-Hill M, Gerard WC, Gratton MC, American Board of Emergency Medicine, et al. The core content of emergency medical services medicine. Prehosp Emerg Care. 2012;16(3):309–22. doi:10.3109/10903127.2011.653517.
6. Delbridge TR, Dyer S, Goodloe JM, Mosesso VN, Perina DG, Sahni R, Pons PT, Rinnert KJ, Isakov AP, Kupas DF, et al. The 2019 core content of emergency medical services medicine. Prehosp Emerg Care. 2020;24(1):32–45. doi:10.1080/10903127.2019.1603560.
7. Dalkey N, Helmer O. An experimental application of the Delphi method to the use of experts. Manage Sci. 1963;9(3):458–67. doi: doi:10.1287/mnsc.9.3.458.
8. McKenna HP. The Delphi technique: A worthwhile research approach for nursing? J Adv Nurs. 1994;19(6):1221–5. doi:10.1111/j.1365-2648.1994.tb01207.x.
9. Hasson F, Keeney S, McKenna H. Research guidelines for the Delphi survey technique. J Adv Nurs. 2000;32(4):1008–15. doi:10.1046/j.1365-2648.2000.t01-1-01567.x.
10. Burnette D, Morrow-Howell N, Chen LM. Setting priorities for gerontological social work research: A national Delphi study. Gerontologist. 2003;43(6):828–38. doi:10.1093/geront/43.6.828.

11. Hsu CC, Sandford BA. The Delphi technique: Making sense of consensus. Practical Assessment, Research, and Evaluation. 2007;12:1–8. doi:10.7275/pdz9-th90.
12. Jurkovich GJ, Rivara FP, Johansen JM, Maier RV. Centers for Disease Control and Prevention injury research agenda: Identification of acute care research topics of interest to the Centers for Disease Control and Prevention-National Center for Injury Prevention and Control. J Trauma. 2004;56(5): 1166–70. doi:10.1097/01.ta.0000127764.98514.99.
13. McMurray AR. Three decision-making aids: Brainstorming, nominal group, and Delphi technique. J Nurs Staff Dev. 1994;10(2):62–5.
14. Nathens AB, Cook CH, Machiedo G, Moore EE, Namias N, Nwariaku F. Defining the research agenda for surgical infection: A consensus of experts using the Delphi approach. Surg Infect (Larchmt)). 2006;7(2):101–10. doi:10.1089/sur.2006.7.101.
15. Ota S, Cron RQ, Schanberg LE, O'Neil K, Mellins ED, Fuhlbrigge RC, Feldman BM. Research priorities in pediatric rheumatology: The Childhood Arthritis and Rheumatology Research Alliance (CARRA) consensus. Pediatr Rheumatol Online J. 2008;6:5 doi:10.1186/1546-0096-6-5. PMID: PMC2330140.
16. Panchal AR, Cash RE, Crowe RP, Coute R, Way D, Aufderheide T, Merchant RM. Delphi analysis of science gaps in the 2015 American Heart Association cardiac arrest guidelines. J Am Heart Assoc. 2018;7(13):1–8. PMID: 6064902. doi:10.1161/JAHA.118.008571.
17. Mitzman J, Bank I, Burns RA, Nguyen MC, Zaveri P, Falk MJ, Madhok M, Dietrich A, Wall J, Waseem M, et al. A modified Delphi study to prioritize content for a simulation-based pediatric curriculum for emergency medicine residency training programs. AEM Educ Train. 2020;4(4):369–78. doi:10.1002/aet2.10412. PMID: PMC7592831.
18. Schmidt RC. Managing Delphi surveys using nonparametric statistical techniques. Decision Sciences. 1997;28(3):763–74. doi:10.1111/j.1540-5915.1997.tb01330.x.
19. Dillman DA, Smyth JD, Christian LM. Internet, mail, and mixed-mode surveys: The tailored design method. 3rd ed. Hoboken, N.J.: Wiley & Sons; 2009.
20. National Association of State EMS Officials. National model EMS clinical guidelines. In: NASEMSO Medical Directors Council; 2019.
21. Witkin BR, Altschuld JW. Planning and conducting needs assessments: A practical guide. Thousand Oaks, CA: SAGE Publications; 1995.
22. National Association of State EMS Officials. National emergency medical services assessment 2020. In: NASEMSO Medical Directors Council; 2020.
23. Shah MN, Cushman JT, Davis CO, Bazarian JJ, Auinger P, Friedman B. The epidemiology of emergency medical services use by children: An analysis of the National Hospital Ambulatory Medical Care Survey. Prehosp Emerg Care. 2008;12(3):269–76. PMID: PMC5237581. doi:10.1080/10903120802100167.
24. Fleischman RJ, Yarris LM, Curry MT, Yuen SC, Breon AR, Meckler GD. Pediatric educational needs assessment for urban and rural emergency medical technicians. Pediatr Emerg Care. 2011;27(12):1130–5. doi:10.1097/PEC.0b013e31823a3e73. PMID: PMC3237926.
25. Glaeser PW, Linzer J, Tunik MG, Henderson DP, Ball J. Survey of nationally registered emergency medical services providers: Pediatric education. Ann Emerg Med. 2000;36(1): 33–8. doi:10.1067/mem.2000.107662.
26. Hansen M, Lambert W, Guise JM, Warden CR, Mann NC, Wang H. Out-of-hospital pediatric airway management in the United States. Resuscitation. 2015; 90:104–10. doi:10.1016/j.resuscitation.2015.02.018. PMID: PMC4405105.
27. Prekker ME, Delgado F, Shin J, Kwok H, Johnson NJ, Carlbom D, Grabinsky A, Brogan TV, King MA, Rea TD. Pediatric intubation by paramedics in a large emergency medical services system: Process, challenges, and outcomes. Ann Emerg Med. 2016;67(1):20–9 e24. doi:10.1016/j.annemergmed.2015.07.021.
28. Pajonk FG, Schmitt P, Biedler A, Richter JC, Meyer W, Luiz T, Madler C. Psychiatric emergencies in prehospital emergency medical systems: A prospective comparison of two urban settings. Gen Hosp Psychiatry. 2008;30(4):360–6. doi:10.1016/j.genhosppsych.2008.03.005.
29. Patterson PD, Higgins JS, Weiss PM, Lang E, Martin-Gill C. Systematic review methodology for the fatigue in emergency medical services project. Prehosp Emerg Care. 2018;22(sup1): 9–16. doi:10.1080/10903127.2017.1380096.
30. Patterson PD, Higgins JS, Van Dongen HPA, Buysse DJ, Thackery RW, Kupas DF, Becker DS, Dean BE, Lindbeck GH, Guyette FX, et al. Evidence-based guidelines for fatigue risk management in emergency medical services. Prehosp Emerg Care. 2018;22(sup1):89–101. doi:10.1080/10903127.2017.1376137.
31. Fishe JN, Crowe RP, Cash RE, Nudell NG, Martin-Gill C, Richards CT. Implementing prehospital evidence-based guidelines: A systematic literature review. Prehosp Emerg Care. 2018;22(4):511–519. doi:10.1080/10903127.2017.1413466.

Appendices

Table A1. List of Delphi panel participants

Name	Position/Title	Other Reported Disclosures
Roy L. Alson, PhD, MD, FACEP, FAEMS	Professor Emeritus, Emergency Medicine, Section of Prehospital and Disaster Medicine, Wake Forest School of Medicine	None
Eileen M. Censullo MBA, FAARC, RRT	Director of Network Relations and Volunteer Education for Healthcare Business Solutions, American Heart Association	None
Nathan A.M. Christopherson, DNP, MBA, MSN, RN, EMT-P	Liaison, Society of Trauma Nurses; Assistant Professor of Surgery, Donald and Barbara Zucker School of Medicine at Hofstra/Northwell	None
Angus M. Jameson, MD, MPH, FACEP, FAEMS	Medical Director, Pinellas County EMS; Affiliate Assistant Professor, USF Health-Morsani College of Medicine	None
Seth M. Kelly, MD	EMS Fellow, University of Pittsburgh Medical Center	None
Gordon A. Kokx, PhD, NREMT-P	Assistant Director for Accreditation Services, CoAEMSP	None
Eddy S. Lang, MDCM, CCFP(EM), CSPQ	Professor and Department Head for Emergency Medicine, Cumming School of Medicine, University of Calgary	None
William J. Leggio, EdD, NRP	Clinical Practices and Standards Coordinator, Office of the Medical Director, Austin, Texas	None
David Markenson, MD, MBA, FCCM, FAAP, FACEP, FACHE	Chief Medical Officer, American Red Cross	None
P.S. Martin, MD, FACEP, FAEMS	Associate Professor, Emergency Medicine WVU School of Medicine; Director, WVU Division of Prehospital Medicine; Associate Medical Director, HealthNet	None
Robert W. McClintock, BSBA, NRP	Deputy Director of Fire and EMS Operations, International Association of Firefighters	None
Mike McEvoy, PhD, NRP, RN, CCRN	EMS Coordinator, Saratoga County, NY; EMS Section Chair, International Association of Fire Chiefs	None
Jason McMullan, MD MS FAEMS	Director, Division of EMS, Department of Emergency Medicine, University of Cincinnati	None
Nick Nudell, MS, NRP, FACPE	Chief Data Officer, The Paramedic Foundation; President, American Paramedic Association	None
Jules K. Scadden, PM	National Volunteer Fire Council, EMS/ Rescue Section	None
Joan Somes, PhD, RN-BC, CEN, CPEN, FAEN, NRP	Critical Care Educator, Regions EMS	None
David F. E. Stuhlmiller, MD, FACEP, FAEMS, CMTE	Physician Medical Director and Physician Advisor, Air Methods; Member, Board of Directors, Commission on Accreditation of Medical Transport Services	None
Lance Stuke, MD, MPH, FACS	Professor of Clinical Surgery, Department of Surgery, Louisiana State University	None
Peter P. Taillac, MD, FACEP	Clinical Professor, Division of Emergency Medicine, University of Utah School of Medicine	None
Christopher Tardif	International Association of Firefighters	None
Mark Terry, MPA, NRP	Chief Certification Officer, National Registry of EMTs	None
Hashim Q. Zaidi, MD	Assistant Professor of Emergency Medicine, UT Health McGovern Medical School	None
Posthumous (1)		

TABLE A2. Gaps in prehospital clinical EBGs identified through thematic analysis, with mean importance score (mean of Likert scores in Round 3), frequency of rankings in Round 4, and relative order of gaps presented for final consensus in Round 5

Abstracted Clinical Prehospital EBG Gap	Description	Mean Importance Score from Round 3 ("Rating Round")	Frequency of Rankings in Round 4 ("Ranking Round")										Relative Order Presented in Round 5		
			1	2	3	4	5	6	7	8	9	10	Set A Order	Set B Order	Set C Order
Airway Management in Adult and Pediatric Patients	Guidelines for basic and advanced prehospital airway management for adult and pediatric patients are needed. Additional focus on interventions that improve patient outcomes and address strategies for each practitioner level.	4.73	11	0	2	0	1	0	0	0	0	0	1	1	1
Care of the Pediatric Patient	Concerning the high stress and low frequency of acute pediatric cases, a focus on improving overall pediatric care is important. Prehospital EBGs concerning the best practices for pediatrics are lacking. Included in this are better methods to mitigate pediatric medication errors and improve management of pediatric respiratory diseases.	4.13	0	4	2	2	1	0	1	4	0	0	2	2	3
Management of Prehospital Behavioral Health Emergencies	There is an increased frequency of patients presenting with behavioral health emergencies in prehospital setting. These patients may pose risk to themselves as well as practitioners and improved education and training for de-escalation skills are important. Further, there are associated risks of polypharmacy and comorbid conditions which are poorly defined in this population, thus there is a need for medical management.	4.07	1	3	1	2	1	1	3	1	1	0	3		2
Managing Medically Complicated, High Acuity Patients	High acuity patients often present with multiple active clinical issues that all need to be addressed. Improved guidance on prioritization of conditions and development of differential diagnoses may improve patient outcomes.	4.00	0	3	2	2	1	2	2	2	0	0		3	
Importance of Prehospital Pain Management Strategies	Pain management in the prehospital setting tends to follow non-evidence-based approaches for pain control, leading to pain assessment being subjective as there are no established measuring criteria. Guidance on prehospital pain management particularly in the era of the opioid epidemic is important to improve consistent care.	3.93	1	1	0	2	1	2	2	1	1	3			
Sepsis and Septic Shock		3.93	1	0	0	2	1	3	1	2	3	1			

(*Continued*)

Table A2. (*Continued*).

Abstracted Clinical Prehospital EBG Gap	Description	Mean Importance Score from Round 3 ("Rating Round")	Frequency of Rankings in Round 4 ("Ranking Round")										Relative Order Presented in Round 5		
			1	2	3	4	5	6	7	8	9	10	Set A Order	Set B Order	Set C Order
	Early recognition of patients with sepsis and septic shock, and management using prehospital antibiotics may improve patient outcomes. Limited research and EBGs exist for consistent care.														
Prehospital Stroke Management	There is a need for clear prehospital stroke guidelines due to lack of clarity from existing research, inconsistent practice patterns, and importance of transport decisions for patients showing signs of severe stroke.	3.93	0	1	0	0	3	3	2	2	2	1			
Care of the Geriatric Patient	Overall lack of research and EBGs involving the care of the aging population: may have unique medical and psychosocial needs as well as different treatment goals.	3.73	0	1	2	1	2	1	3	1	1	2			
Individualized management of Cardiac Arrest	Significant effort has focused on improving cardiac arrest management as a uniform protocol. However, more individualized and disease specific interventions to optimize resuscitation are lacking.	3.73	0	1	2	1	1	0	0	1	4	4			
Trauma Resuscitation and Blood Product Use	Lack of research, EBGs, and standardized strategies for prehospital trauma resuscitation including use of blood products and invasive procedures.	3.73	0	0	3	2	2	2	0	0	2	3			
Use of Sedation in the Prehospital Environment	Evidence is needed on the best practices for patients requiring sedation for procedures, including chemical restraint usage for behavioral emergencies.	3.53													
Management of Special Populations (Adult and Pediatric)	There are individuals within all communities that have specific clinical requirements yet there are few guidelines on how prehospital practitioners should assist, care and transport. This is an area where evidenced based guidelines on all aspects of responding to special populations including special healthcare needs would improve prehospital response and care.	3.47													
Substance Abuse Care	Prehospital practitioners care for many patients with substance use. However, there is conflicting information on the best practices for management of drug addiction/substance abuse in prehospital setting.	3.40													

(*Continued*)

Table A2. (*Continued*).

Abstracted Clinical Prehospital EBG Gap	Description	Mean Importance Score from Round 3 ("Rating Round")	Frequency of Rankings in Round 4 ("Ranking Round")										Relative Order Presented in Round 5		
			1	2	3	4	5	6	7	8	9	10	Set A Order	Set B Order	Set C Order
Multiple Casualty Triage	Improved guidance on the best clinical practices on the clinical aspects of assessing and triage of multiple casualties is needed.	3.33													
EMS Management of Abuse / Non-accidental Trauma	EMS practitioners often encounter cases of domestic, sexual, elder and child abuse. There is a lack of research/guidelines for management and care of these patients leading to inconsistent care for this vulnerable population.	3.27													
Management of Prehospital Communicable Disease	Outbreaks EMS role in the management of communicable disease outbreaks including recognition and safety precautions for healthcare practitioners.	3.20													
Unique Role of EMS in the Healthcare System and Community	The role of the EMS practitioner is changing as result of interface with the public safety and public health sectors and the overall needs of many communities. Included in this is the different roles that EMS practitioners can fulfill (e.g., community paramedicine).	3.20													
Use of Spinal Motion Restriction for Trauma	Evidence and position statements demonstrate that spinal motion restriction goes beyond only applying a backboard, but EMS personnel struggle with making decisions on SMR and may be misapplying prior guidelines and research. Communicating clear, updated EBGs is necessary.	3.20													
Prehospital Care of the Bariatric Patient	As medical emergencies for bariatric patient population increase, it is important for prehospital practitioners to recognition the special needs, including physiological, of these patients. EBG on the assessment and care of this group of patients are lacking.	2.87													
Palliative Care in the Prehospital Setting	Many patients visit the ED through the EMS system within their last 6 months of life. However, limited guidance exists concerning end of life care and best practices for EMS practitioners to manage these situations.	2.73													
Renal Emergencies	EMS is experiencing increased calls to individuals with renal emergencies, including patients with dialysis and transplants. There are no specific guidelines	2.67													

(*Continued*)

Table A2. (*Continued*).

Abstracted Clinical Prehospital EBG Gap	Description	Mean Importance Score from Round 3 ("Rating Round")	Frequency of Rankings in Round 4 ("Ranking Round")										Relative Order Presented in Round 5		
			1	2	3	4	5	6	7	8	9	10	Set A Order	Set B Order	Set C Order
	for education on assessment and treatment for these patients and the initial education of EMS practitioners in this area is limited.														
Compartment Syndrome Management	There is limited evidence on the management of compartment syndrome in the prehospital setting.	2.64													
Prehospital Ultrasound	Ultrasound is a rapidly expanding technology with decreasing costs, yet the utility of its use in routine prehospital care is unknown.	2.27													

Legend: EBGs – evidence-based guidelines, EMS – emergency medical services, SMR – spinal motion restriction, ED – emergency department.

TABLE A3. Gaps in prehospital operational EBGs identified through thematic analysis, with mean importance score (mean of Likert scores in Round 3), frequency of rankings in Round 4, and relative order of gaps presented for final consensus in Round 5

Abstracted Operational Prehospital EBG Gap	Description	Mean Importance Score from Round 3 ("Rating Round")	Frequency of Rankings in Round 4 ("Ranking Round")										Relative Order Presented in Round 5		
			1	2	3	4	5	6	7	8	9	10	Set X Order	Set Y Order	Set Z Order
Define and Measure the Impact of EMS Care on Patient Outcomes	EMS care is increasingly recognized as critically important to the clinical outcomes of patients in prehospital setting. However, mechanisms to define the impact of prehospital care on overall outcomes are limited.	4.40	9	0	1	1	2	1	0	0	0	0	1	1	1
Practitioner Wellness	Awareness of the effect of stress on the prehospital practitioner, manifest as burnout, compassion fatigue, PTSD, substance abuse, divorce, and suicide, is increasing. Guidance is limited regarding effective implementation of strategies to recognize and mitigate the effect of stress on EMS practitioners, as well as improving mental and physical health of EMS practitioners.	4.27	4	3	2	2	1	1	1	0	0	0	2	2	3
Challenges in Data Sharing between Healthcare Organizations	Linking hospital outcomes with prehospital care has the potential for improved patient care, but integration between hospital and EMS records is typically quite challenging. Guidelines are limited directing optimal integration of EMS and hospital records.	4.14	1	2	4	2	1	1	0	2	0	1		3	
Practitioner Safety in the Field	Guidance regarding scene safety, escape maneuvers, de-escalation techniques for violent patients, ballistic vests and helmets, and lifting and moving techniques.	4.13	0	4	1	2	3	2	2	0	0	0	3		2
Improved Ambulance Safety	Limited guidelines exist regarding ambulance safety, including compartment safety and passenger restraints for EMS personnel and patients.	3.87	0	0	1	2	2	2	2	0	3	2			
Role of the EMS Medical Director	Variable engagement, training, and guidance of EMS medical directors exist. Evidence based guidelines for the optimal EMS medical director role is limited.	3.87	0	0	0	1	0	2	3	3	2	3			
Initial and Continued Practitioner Training	Inconsistent recommendations exist regarding prerequisite educational requirements for EMS personnel prior to initial training. Additionally, ongoing education for EMS practitioners can overlap with non-medical training, including fireground training for	3.80	0	1	4	0	1	0	3	1	3	1			

(*Continued*)

TABLE A3. (*Continued*).

Abstracted Operational Prehospital EBG Gap	Description	Mean Importance Score from Round 3 ("Rating Round")	Frequency of Rankings in Round 4 ("Ranking Round")										Relative Order Presented in Round 5		
			1	2	3	4	5	6	7	8	9	10	Set X Order	Set Y Order	Set Z Order
	fire-based EMS practitioners. Guidelines are limited to guide optimal initial and ongoing education for EMS practitioners.														
Best Practices for Quality Assessment Activities in EMS	Continuous ongoing quality improvement is a critically important aspect of EMS medical direction and EMS system operations, however guidelines addressing the optimal approach to developing and executing quality improvement in EMS is limited.	3.80	0	3	1	2	0	2	3	1	0	2			
EMS Response to Active Assailant	EMS practitioners are encountering increasing numbers of active assailant and mass shooting incidents. There is variation in practice and little evidence regarding optimal EMS scene response. Equipment used by responding EMS practitioners and training with other first responders are topics of particular importance.	3.67	0	0	0	0	3	0	0	1	5	5			
Concerns with Workforce Shortage and Allocation	Concerns exist regarding human capital, resource utilization, and workforce distribution in response to a perceived workforce shortage. Guidance is limited.	3.60	0	1	0	2	1	3	0	6	1	0			
Professional Ethics in EMS	Often, EMS training programs omit professional oaths and codes of ethics. However, this may have detrimental impact on the perception of the EMS profession. Guidelines regarding professional and ethical obligations in prehospital care are limited.	3.43													
Operational Metrics for Evaluation of Clinical Care	Operational metrics, such as scene response times, are commonly used to evaluate EMS system performance. However, little evidence-based guidance exists regarding the proper role of operational metrics in EMS system performance evaluation, including using operational metrics in the place of clinical outcomes for determination of quality of care.	3.40													
Optimization of Dispatch Systems	Limited guidance exists to inform dispatchers regarding key operational metrics, such as time spent with the caller and priority of response. Limited evidence exists regarding the impact of the dispatcher-caller interaction on patient outcomes.	3.33													

(*Continued*)

Table A3. (*Continued*).

Abstracted Operational Prehospital EBG Gap	Description	Mean Importance Score from Round 3 ("Rating Round")	Frequency of Rankings in Round 4 ("Ranking Round")										Relative Order Presented in Round 5		
			1	2	3	4	5	6	7	8	9	10	Set X Order	Set Y Order	Set Z Order
Transport Decisions and Alternative Care Destinations	Increasingly, destinations other than traditional emergency departments are being considered as appropriate destinations to which EMS can transport patients, as well as a recognition that EMS practitioners deliver on-scene care for patients not transported to the hospital. Guidelines are limited with respect to EMS transport to non-emergency department destinations, treat and release protocols, and specialty patient transport/system of care patient transport.	3.29													
Prehospital Practitioner Roles in Research	With increasing research areas focused on the prehospital setting, guidelines are limited with respect to EMS practitioners' education about research concepts and role in prehospital research.	3.20													
Mass Casualty Management Logistics	National Incident Management System (NIMS) is a commonly taught framework for EMS practitioners to follow when responding to a mass casualty incident. However, there is limited evidence for best practices for the operation aspects of MCI management, and inconsistent application of NIMS education and implementation.	3.13													
Developing Cost-effective EMS systems	Guidance for evaluating and incorporating finances in EMS system operations, including financing structure and cost effectiveness evaluations.	3.13													
Community Paramedicine / MIHC	Community paramedicine/mobile integrated health care initiatives have become increasingly prevalent and aim to leverage the advantages of EMS practitioners to provide formal non-acute care in the out-of-hospital setting. However, guidelines regarding clear and uniform scope of practice, program sustainability, and disposition are limited.	3.13													
Patient Education	Patients accessing care via EMS have variable levels of health literacy and the prehospital environment is often a time-sensitive environment where patient and family education can be critically important.	3.00													

(*Continued*)

TABLE A3. (*Continued*).

Abstracted Operational Prehospital EBG Gap	Description	Mean Importance Score from Round 3 ("Rating Round")	Frequency of Rankings in Round 4 ("Ranking Round")										Relative Order Presented in Round 5		
			1	2	3	4	5	6	7	8	9	10	Set X Order	Set Y Order	Set Z Order
	However, guidelines regarding strategies and scope of EMS practitioner education of patients and families is limited.														
Infectious Disease Control and Surveillance	EMS is the front line in disease surveillance in many areas around the county, yet guidelines regarding recognition of patterns or notification of public health emergencies, such as infectious disease outbreaks, are limited. Additionally, evidence-based guidelines for infection control precautions and PPE in the prehospital environment are limited.	2.93													
EMS System Design	Limited guidelines pertaining to optimal EMS system response structure exist, specifically regarding tiered vs non-tiered response, crew structure (paramedic/EMT/mixed), and response acuity (use of red lights and sirens).	2.80													
EMS Engagement in Social/Public Health of the Community	EMS practitioners have a unique role in the community, being able to treat individuals in their home in the community. Additionally, EMS practitioners are on the front lines of treating patients with challenging social circumstances and extensive psychosocial needs. How EMS can engage such patients can be very important for both patient care and EMS practitioner wellness. Guidelines for optimal EMS engagement in social prehospital emergency medicine are limited.	2.80													
EMS Physician Field Response	Guidelines regarding EMS physician scene response as part of a formal EMS system response is limited.	2.80													
Event Medicine Planning and Preparation	EMS is commonly involved in mass gathering events and medical operations, including planning, training, and communications. However, evidence-based guidelines regarding optimal event medical planning are lacking.	2.73													
		2.73													

(*Continued*)

TABLE A3. (*Continued*).

Abstracted Operational Prehospital EBG Gap	Description	Mean Importance Score from Round 3 ("Rating Round")	Frequency of Rankings in Round 4 ("Ranking Round")										Relative Order Presented in Round 5		
			1	2	3	4	5	6	7	8	9	10	Set X Order	Set Y Order	Set Z Order
Medicolegal Concerns in Prehospital care	Several perceived medicolegal concerns exist in EMS, and laws pertaining to EMS care are generally scoped at the state and local levels. Guidelines are limited to inform prehospital care practitioners and medical directors regarding areas of potential medicolegal liability, including refusals and decision-making capacity determination.														
Hazardous Materials Management	Evidence and guidance regarding optimal response to hazardous material incident response is limited.	2.47													
Evidence Preservation	Guidelines regarding the optimal approach to preserving evidence, including at potential crime scenes, are lacking.	2.33													
Standardization of Care during Rescue Operations	The approach to EMS operations during rescue operations has limited guideline recommendations.	2.33													

Legend: EBGs – evidence-based guidelines, EMS – emergency medical services, PTSD – post-traumatic stress disorder, NIMS – National Incident Management System, MCI – mass casualty incident, MIHC – mobile integrated health care, PPE – personal protective equipment, EMT – emergency medical technician..