Global Emergency Medicine: A Review of the Literature From 2019

Indi Trehan, MD, MPH, DTM&H[1], Sean M. Kivlehan, MD, MPH[2,3], Kamna S. Balhara, MD, MA[4], Braden J. Hexom, MD[5], Amelia Y. Pousson, MD, MPH[4], Nana Serwaa A. Quao, MD[6], Megan M. Rybarczyk, MD, MPH[2], Anand Selvam, MD, MSc, DTM&H[7], Joseph Bonney, MBChB, MPH, MScDM[8], Nidhi Bhaskar[9], Torben K. Becker, MD, PhD[10], and The Global Emergency Medicine Literature Review (GEMLR) Group

ABSTRACT

Objective: The annual systematic search of the peer-reviewed and gray literature relevant to global emergency medicine (EM) was conducted by the Global Emergency Medicine Literature Review (GEMLR) to screen, evaluate, and review the most rigorously conducted and relevant research in global EM published in 2019.

Methods: After a broad search of PubMed and websites of organizations publishing relevant gray literature, all articles that were deemed relevant to the fields of disaster and humanitarian response, emergency care in resource-limited settings, and EM development by at least one reviewer, an editor, and the managing editors were then scored by two different reviewers using a 20-point scoring template relevant to either original research (OR) or review (RE) articles. This scoring system rates articles on their clarity, research design, ethics, importance to global EM, and breadth of impact. Articles that then scored in the top 5% were then critiqued in depth.

Results: A total of 23,321 article titles and abstracts were screened by 22 reviewers with a wide swath of clinical and research experience in global EM. From these, a total of 356 articles underwent full-text review and scoring on the 20-point scale; 26% were categorized as disaster and humanitarian response, 58% as emergency care in resource-limited settings, and 15% as EM development. Of these 356 articles, 276 (77.5%) were OR articles and 80 (22.5%) were RE articles. The 16 articles that scored in the top 5% (>17.5 of 20 points) received full in-depth narrative summaries.

Conclusions: In 2019, the overall number of studies relevant to global EM that were identified by our search decreased from the prior year, but more high-scoring articles related to the development of EM clinical practice and as a specialty in resource-constrained settings were identified.

From the [1]Departments of Pediatrics and Global Health, University of Washington, Seattle, WA; the [2]Department of Emergency Medicine, Brigham and Women's Hospital, Boston, MA; the [3]Harvard Humanitarian Initiative, Cambridge, MA; the [4]Department of Emergency Medicine, Johns Hopkins University, Baltimore, MD; the [5]Department of Emergency Medicine, Rush University Medical Center, Chicago, IL; the [6]Department of Emergency Medicine, Korle Bu Teaching Hospital, Accra, Ghana; the [7]Department of Emergency Medicine, Yale University, New Haven, CT; the [9]Department of Emergency Medicine, Komfo Anokye Teaching Hospital, Kumasi, Ghana; the [9]Brown University, Providence, RI; and the [11]Department of Emergency Medicine, University of Florida, Gainesville, FL.
Received June 21, 2020; revision received August 2, 2020; accepted August 5, 2020.
Presented at the SAEM20 Virtual Meeting, May 2020.
The authors have no relevant financial information or potential conflicts to disclose.
Global Emergency Medicine Literature Review (GEMLR) Group members are listed in Appendix A.
Author contributions: study concept and design—IT, SMK, and TKB; acquisition of data—NB; analysis and interpretation of data—IT, SMK, KSB, BJH, AYP, NSAQ, MMR, AS, and JB; drafting of the manuscript—IT; critical revision of the manuscript for important intellectual content—IT, SMK, KSB, BJH, AYP, NSAW, MMR, AS, JB, NB, and TKB; statistical analyses—IT; acquisition of funding—none.
Supervising Editor: Michael Runyon, MD.
Address for correspondence and reprints: Indi Trehan, MD, MPH, DTM&H; e-mail: indi@alum.berkeley.edu.
ACADEMIC EMERGENCY MEDICINE 2021;28:117–128

doi: 10.1111/acem.14107
ISSN 1553-2712

The Global Emergency Medicine Literature Review (GEMLR) has been actively working since 2005 to improve the clinical practice of emergency medicine (EM) worldwide by identifying and disseminating the most current and important EM research from global settings where EM is still developing as a mature domain of medicine.[1–14] Given the overwhelming amount of medical literature that is published daily, the GEMLR team attempts to identify, screen, evaluate, and consolidate the literature relevant to global EM in a format that can be easily digested by clinicians and researchers. A diverse panel of reviewers, editors, and advisors with varied experience in global EM works together to produce this annual review, starting with a systematic electronic and manual search of the published literature. We use a working definition of global EM that emphasizes the practice and development of EM in settings without robust or mature EM systems, with a heavy concentration on resource-limited settings.[15]

By highlighting groundbreaking and rigorously conducted research, new and improved clinical practices, and novel methods of implementing advances in EM, we hope to advance EM as a distinct and valued clinical specialty worldwide, all with the ultimate goal of improving acute care, especially for marginalized populations. Domains covered include disaster and humanitarian response, emergency care in resource-limited settings, and the development of EM practice worldwide.

Recognizing that global morbidity and mortality is in many ways shifting away from acute infectious conditions to chronic diseases and emergency conditions,[16] we aim to provide a platform that recognizes publications that directly improve patient care in the acute setting, especially in areas with limited medical resources. Given the diversity of topics covered, we do not attempt a formal systematic review or meta-analysis in this current review but do evaluate specific topics in separate systematic reviews.[17–19]

In addition to the published peer-reviewed literature, GEMLR also includes an extensive manual search of the gray literature produced by a variety of think tanks, academic organizations, and nongovernmental organizations. Written to be more immediately applicable to clinicians and policy-makers in the field, gray literature has the potential to make an important contribution to systematic reviews such as GEMLR.[20]

As in past years, we hope that this resource will aid our colleagues worldwide filter through the vast number of published research and gray literature articles to identify the pearls of wisdom that can improve their own clinical practice, research, teaching, and advocacy.

METHODS

This current 2019 GEMLR was conducted using an updated methodology from last year's 2018 GEMLR review, most notably with more clear and granular "impact" criteria.[14] The complete methods are available in the GEMLR procedure manual, available as Data Supplement S1, Appendix S1 (available as supporting information in the online version of this paper, which is available at http://onlinelibrary.wiley.com/doi/10.1111/acem.14107/full). All participants in the review are unpaid volunteers selected based on their experience providing frontline emergency care and education around the world. This year's team consisting of an editor-in-chief, a managing editor, an assistant managing editor, a technical editor, six editors, one assistant editor, 22 reviewers, and six assistant reviewers included emergency physicians and trainees with primary practices in Australia, Canada, England, the Gambia, Ghana, Scotland, and the United States. The full list of participants and affiliations is available in Appendix A.

Peer-reviewed Literature Search

Two separate PubMed searches were conducted: the first search block covered publications from January 1 to August 31, 2019; the second included September 1 to December 31, 2019. These dates reflect when the article was first added to Medline; thus some articles identified were actually published in their final form in 2018 while others were finalized in 2020 due to varying dates that the database is updated depending on the journal of publication. Original research (OR) and review (RE) articles were identified if they matched at least one "emergency medicine" search term as well as one "global" search term; the full list of these terms is available in Data Supplement S1, Appendix S2. Based on the language proficiencies of this year's GEMLR team, we only included articles published in English, French, and Spanish. Additionally, we initially also included *all* articles published in 2019 from a select set of journals that have a track record of publishing a significant number of articles relevant to global EM articles to ensure that no relevant articles from these journals were missed by the PubMed search.

The journals in this year's comprehensive "hand" search were: *Academic Emergency Medicine*, *African Journal of Emergency Medicine*, *Bulletin of the World Health Organization*, *The Lancet*, and *Prehospital and Disaster Medicine*. Because of our interest in studies with direct clinical or programmatic application, studies were limited to human subjects only. Narrative publications such as case reports, commentaries, editorials, letters to the editor, and news briefings were specifically excluded.

Gray Literature Search

The working list of academic, government, nongovernmental, think tank, and United Nations organizations known to publish significant work relevant to global EM that was queried for gray literature was the same as in 2018 and is available in Data Supplement S1, Appendix S3. The websites of these organizations were manually searched by two reviewers and then reviewed by an editor for new publications and reports appearing in 2019. Any work relevant to global EM was identified, including (but not limited to) conference proceedings, evaluation reports, needs assessments, program monitoring, topic reviews, and white papers.

Article Screening

The titles and abstracts identified by these search strategies were compiled and distributed among the reviewers for initial screening for relevance to global EM. Reviewers were asked to screen in relevant OR and RE articles; articles screened in by reviewers were further reviewed by an editor, the assistant managing editor, and managing editor to ensure that they met inclusion criteria. Publications identified through this screening process were then advanced to full-text scoring.

Article Scoring

Publications that reached the full-text scoring stage were then classified on two independent dimensions: the first was classifying their design as either OR or RE articles; the second was categorizing their content as being most relevant to disaster and humanitarian response, emergency care in resource-limited settings, or EM development, acknowledging that there may be significant overlap in an individual paper. Disaster and humanitarian response articles focus on the care of civilian populations in conflict; disaster migration, assessment, and response; and the health care of refugees and internally displaced people. Articles classified as emergency care in resource-limited settings emphasize research to improve our understanding or management of acute conditions in resource-limited settings. EM development articles cover research on the development of EM as a specialty, EM training programs, and emergency medical care systems in countries without advanced health care systems or fully developed EM systems.

Full-text articles were independently scored by two reviewers using a standardized template that assesses each article's clarity, design, ethics, importance, and impact. These criteria aim to assess both methodologic soundness as well as impactful research in global EM. Two different templates are used, one for OR and one for RE, given that the design of the studies is so different. Each parameter is scored independently, providing a total final score between 0 and 20. Up to 20 total points are awarded among four categories, each with a potential maximum score of 4 to 6. These categories include the following: the *clarity* of the purpose and rationale for RE articles, rigor of study *design* for both RE articles and OR articles, adherence to strict research *ethics* for OR articles, the *importance* of the results as related to generalizability and relevance to global EM for both types of articles, and the potential *impact* of both types of articles in terms of feasible intervention across a variety of settings. Complete details of the scoring templates are provided in Data Supplement S1, Appendix S4.

After all articles were scored by two reviewers, the absolute difference between reviewer scores for each article was calculated. The median of these differences was then calculated for all scored article. Articles whose score difference were greater than two standard deviations from the median difference in all articles' scores were then given a third score by an editor using the same template; the arithmetic mean of these three scores was then used as the final score.

Full-text Article Summaries

After scoring was complete, up to the top 5% of articles were formally summarized as the last step in the GEMLR process. Single-page summaries of the articles were prepared by reviewers that included highlights of the study design, key findings, and a critique of the results. These summaries were subsequently edited for style, content, and objectivity by an editor and the managing editor in an effort to make them practical and approachable for readers and practitioners so they

can interpret and implement these findings into their own practice.

RESULTS

The Medline search retrieved 17,831 total articles; the comprehensive retrieval process of select journals identified 5,441 additional articles; 49 additional articles were identified by the gray literature search (Data Supplement S1, Appendix S5). Among these, 13 were in French and 51 in Spanish. From these, 365 were screened in for relevance to global EM; after removal of duplicates, a total of 356 articles underwent full scoring (Table 1; Data Supplement S2).

Weighted Cohen's kappa[21,22] values were calculated to assess the inter-rater reliability for these scores. The weighted Cohen's kappa was 0.437 (95% confidence interval [CI] = 0.382 to 0.491), generally considered moderate reliability.[23] When excluding the most variable components of the reviewer scoring, the "importance" and "impact" scores (Data Supplement S1, Appendix S4), the weighted Cohen's kappa increased to 0.582 (95% CI = 0.527 to 0.637).

Sixteen articles achieved a score of higher than 17.5, which was the threshold needed so that at most 5% of articles would receive full narrative summaries. Among these 16 articles, one (6%) was categorized as disaster and humanitarian response, 11 (69%) as emergency care in resource limited settings, and 4 (25%) as EM development. In a significant shift from last year's highest-scoring articles, 13 (81%) were OR articles while three (19%) were RE articles (Table 2). The gray literature search, screening, and scoring process did not identify any documents that achieved the threshold score for full review this year. Full narrative summaries of these 16 top-scoring global EM articles of 2019 identified by our search are available as Data Supplement S1, Appendix S6.

DISCUSSION

Relative to the 2018 GEMLR,[14] the number of articles identified by our automated and manual search processes increased by 22%, but the number ultimately screened in by our reviewers' and editors' detailed assessment of titles and abstracts decreased by 45%. This likely reflects our increased attention to relevance of the published works to global EM and strict adherence to inclusion and exclusion criteria. This is also reflected in the significant increase in inter-rater reliability this year, because there was greater consensus on the quality of articles and their direct importance and impact to the practice and development of global EM. It may also reflect the updates to our scoring system this year that was based on several months of technical review evaluating past searches and scoring. At the same time, while we recognize that the inter-rater reliability is far from perfect, we genuinely seek reviewers and editors from a diversity of backgrounds and are comfortable with differing opinions about which articles are likely to be most impactful in global EM.

Unlike last year's review, the highest scoring articles this year were mostly OR studies. Consistent with most other years' reviews, the top-scoring articles were predominantly those in the emergency care in resource-limited settings domain, once again accentuating the challenges in conducting high-quality studies in the disaster and humanitarian response and EM development domains. These latter two do not as readily lend themselves to traditional case–control studies or randomized controlled trials and thus tend not to score as highly in our current scoring system.

Table 1
Summary Statistics for Article Scoring

	Scores					
	Number (%)	Minimum	25th Percentile	Median	75th Percentile	Maximum
Total	356 (100)	6	11.5	13.7	15.5	20
Article category						
Disaster and humanitarian response	93 (26.1)	6	10	13	14.5	18
Emergency care in resource-limited settings	208 (58.4)	6	12.5	14	16.1	20
EM development	55 (15.4)	7.5	12	14	15.8	19
Type of research article						
OR article	276 (77.5)	6	12	13.7	15.5	20
RE article	80 (22.5)	6	10.6	14	15.5	19

OR = original research; RE = review.

Table 2
Top-Scoring GEMLR 2019 Articles

Category	First Author	Title	Journal	OR or RE	Summary
Disaster and humanitarian response	Snider[24]	Immunogenicity of full and fractional dose of inactivated poliovirus vaccine for use in routine immunisation and outbreak response: an open-label, randomised controlled trial	*Lancet*	OR	A dose-sparing strategy using fractional inactivated poliovirus vaccine offers a useful approach to mass vaccination in emergency polio outbreak response settings.
Emergency care in resource-limited settings	Alam[27]	Randomised trial showed that rapid rehydration of severely malnourished children with dehydrating diarrhoea was as safe and effective as slow rehydration	*Acta Paediatr*	OR	In the first randomized control trial comparing rapid versus slow fluid resuscitation of severely dehydrated children with severe malnutrition and acute diarrhea, there appeared to be no difference in safety or efficacy between the two approaches.
	Bjorklund[30]	Use of a modified bubble continuous positive airway pressure (bCPAP) device for children in respiratory distress in low- and middle-income countries: a safety study	*Paediatr Int Child Health*	OR	A low-cost modified bubble CPAP device proved to be safe for respiratory support for children in low resource settings in this prospective observational study.
	Champagne[35]	The effectiveness of ultrasound in the detection of fractures in adults with suspected upper or lower limb injury: a systematic review and subgroup meta-analysis	*BMC Emerg Med*	RE	This systematic review showed that ultrasound can be considered for the diagnosis of adult extremity fractures, particularly in low-resource settings. While ultrasound is reasonably sensitive and specific, with stronger performance for upper limb fractures than lower limb fractures, it is not quite as good as gold standard diagnostics including x-ray, CT, and MRI.
	CRASH-3 Trial Collaborators[36]	Effects of tranexamic acid on death, disability, vascular occlusive events and other morbidities in patients with acute traumatic brain injury (CRASH-3): a randomised, placebo-controlled trial	*Lancet*	OR	This multicenter randomized controlled trial was conducted in 29 countries and 175 different sites to evaluate the mortality benefit of TXA compared to placebo in TBI patients. The study found that TXA given within 3 hours of injury reduced the risk of death due to head injury in patients with mild-to-moderate head injuries.
	Dysoley[39]	The tolerability of single low dose primaquine in glucose-6-phosphate deficient and normal falciparum-infected Cambodians	*BMC Infect Dis*	OR	This small randomized trial evaluated the safety of a single low-dose of primaquine as an adjunct therapy to malaria treatment in Cambodia, where a moderately severe variant of G6PD deficiency is prevalent, finding no increase in severe anemia.
	Gallagher[32]	The predictive performance of a pneumonia severity score in human immunodeficiency virus-negative children presenting to hospital in 7 low- and middle-income countries	*Clin Infect Dis*	OR	This five-strata pneumonia severity score performed moderately well in predicting mortality in HIV-negative children with pneumonia, but the number of WHO pneumonia danger signs had the highest discrimination in predicting death.
	Goldstein[34]	The cost of time: a randomised, controlled trial to assess the economic impact of upfront, point-of-care blood tests in the emergency centre	*Afr J Emerg Med*	OR	This randomized trial showed that point-of-care blood testing prior to medical assessment was both timesaving and cost-effective when compared to standard management in a South African ED.
	Houston[28]	Gastroenteritis aggressive versus slow treatment for rehydration (GASTRO): a phase II rehydration trial for severe dehydration: WHO plan C versus slow rehydration	*BMC Med*	OR	A pilot, Phase II, open, randomized trial demonstrated no increase in serious adverse events when a simplified IV rehydration strategy of 100 mL/hourr for 8 hours for all ages was used to treat severe pediatric dehydration, compared to the more complicated, aggressive WHO guidelines.

(Continued)

Table 2 (continued)

Category	First Author	Title	Journal	OR or RE	Summary
	Keitel[33]	Safety and efficacy of C-reactive protein-guided antibiotic use to treat acute respiratory infections in Tanzanian children: a planned subgroup analysis of a randomized controlled noninferiority trial evaluating a novel electronic clinical decision algorithm (ePOCT)	*Clin Infect Dis*	OR	This randomized trial compares two algorithmic approaches for the diagnosis of pneumonia in children. A two-step approach incorporating a CRP level resulted in significantly lower rates of clinical failure and lower use of antibiotics.
	McCollum[31]	Bubble continuous positive airway pressure for children with high-risk conditions and severe pneumonia in Malawi: An open label, randomised, controlled trial	*Lancet Respir Med*	OR	A randomized, controlled study of bubble continuous positive airway pressure (bCPAP) for the treatment of children with severe pneumonia in Malawi demonstrated no benefit and potential harms. The study provides an important caution against the indiscriminate use of bubble CPAP outside highly monitored settings.
	Taylor[38]	Short-course primaquine for the radical cure of Plasmodium vivax malaria: a multicentre, randomised, placebo-controlled non-inferiority trial	*Lancet*	OR	Although the current standard of care for the radical cure of *Plasmodium vivax* malaria is a 14-day regimen of primaquine, there is often poor adherence. This study demonstrated that a 7-day, higher-dose regimen may be a reasonable substitute in patients without G6PD deficiency, although patients had a higher incidence of significant gastrointestinal side effects.
EM development	Dekker-Boersema[40]	Triage conducted by lay-staff and emergency training reduces paediatric mortality in the emergency department of a rural hospital in northern Mozambique	*Afr J Emerg Med*	OR	In rural hospital settings, a color-coded triage system at emergency centers can reduce pediatric mortality, even when utilized by nonclinical staff.
	Tran[43]	Putting culture into prehospital emergency care: a systematic narrative review of literature from lower middle-income countries	*Prehosp Disaster Med*	RE	Culture is part of people's understanding of health, illness, and their willingness to access care. This systematic review uses established frameworks to explore the ways culture must be incorporated into efforts to have people utilize and access prehospital emergency medical systems effectively.
	Versantvoort[42]	Helping Babies Breathe and its effects on intrapartum-related stillbirths and neonatal mortality in low-resource settings: a systematic review	*Arch Dis Child*	RE	This systematic review found the Helping Babies Breathe training and resuscitation method to be effective in reducing intrapartum and neonatal mortality measures within the first week of life.
	Wangara[41]	Implementation and performance of the South African Triage Scale at Kenyatta National Hospital in Nairobi, Kenya	*Int J Emerg Med*	OR	Introduction of the South African Triage Scale (SATS) in a large East African ED is feasible and effective in determining patient disposition with good inter-rater reliability.

G6PD = glucose-6-phosphate dehydrogenase; GEMLR = Global Emergency Medicine Literature Review; OR = original research article; RE = review article; TBI = traumatic brain injury; TXA = tranexamic acid.

Having recognized this limitation, our GEMLR technical committee is working to modernize and expand our scoring system for 2020 such that qualitative articles have their own set of scoring criteria in future reviews that will attempt to recognize and reward the rigor and utility of these studies as well.

The GEMLR team has developed a formal structure and methods for this review that has been refined over these past 15 years of annual reviews. We recognize that this is an inherently subjective process, even with structured screening and scoring methods, but one that benefits from constant reevaluation between annual reviews and incorporation of diverse members onto the GEMLR team with multiple layers of feedback and internal validation.

The studies that scored highest (Table 2) include a diverse array of clinical themes and investigational methods and settings that reflect the wide diversity of clinical, operational, and educational challenges faced by emergency providers around the world. In addition to the full narrative reviews (Data Supplement S1, Appendix S6), we highlight some key features and themes of these top 16 articles below.

Disaster and Humanitarian Response

The one study in this category that was among the top 5% of all global EM articles identified this year reflects this very theme of diverse responsibilities in emergency care. Snider and colleagues[24] found a novel approach for mass polio immunization to be safe and effective; their dose-sparing strategy used fractional doses of inactivated polio vaccine to effectively achieve immunogenicity among infants in Bangladesh. While most emergency clinicians are not directly involved in routine childhood vaccination programs, this study provides strong evidence for this approach to be used in outbreak responses and humanitarian settings when large-scale immunization may be necessary as a means of resource conservation.

Emergency Care in Resource-limited Settings

Given the extremely large contribution of pediatric infections to global years of life lost,[25] a large proportion of articles identified in this year's review studied improved methods of case management for children critically ill due to a variety of acute infections. Since the world of fluid resuscitation was upended by the FEAST trial[26] nearly a decade ago, active investigation and debate into optimal fluid resuscitation strategies continues. Alam and colleagues[27] conducted a randomized trial of rapid versus slow rehydration of severely malnourished children with diarrhea and dehydration and concluded that—contrary to long-standing dogma—rapid rehydration was safe, thereby possibly saving staff time and resources in places where both are often in short supply. The study was limited by a relatively small sample size (n = 208, combined in both groups) and was only conducted in Bangladesh, so it needs to be replicated and expanded to include other settings, but it provides a promising lead for a potentially very impactful new approach. Houston and colleagues[28] also conducted an innovative trial in East Africa that randomized children to the usual WHO fluid resuscitation regimen versus a simplified slower protocol of 100 mL/hr of fluid for 8 hours for children of all ages. This also was a small pilot study (n = 122) that, if verified in larger trials, has significant potential for simplifying care for these children in a wide variety of settings worldwide. Moreover, this study focused on adverse events (serious adverse event risk ratio [RR] for slower protocol of 0.67 [95% CI = 0.12 to 3.85]), and thus the emphasis in a larger trial would need to be on actual clinical improvement as well.

Contributing even more to global child mortality than diarrhea and dehydration is pneumonia and respiratory failure, for whom bubble CPAP has emerged in recent years as an affordable technology for children with respiratory failure in acute and critical care settings around the world.[29] Two trials of bubble CPAP were among the highest-scoring articles for GEMLR this year. Bjorklund and colleagues[30] conducted a prospective observational study of a low-cost modified bubble CPAP device and showed that children who needed advanced respiratory support improved significantly within 2 hours. This study was limited by not being a randomized trial and used historical controls instead and was relatively underpowered to show a mortality benefit. This study is also especially important because the authors studied older children and not just the neonatal age group that is usually the focus of such studies. In contrast, McCollum and colleagues[31] conducted a more pragmatic trial of bubble CPAP in a rural Malawian non–tertiary care hospital. In this setting, without access to an ICU or round-the-clock physician supervision, bubble CPAP actually showed *increased* mortality, both overall (RR = 1.52 [95% CI, = 1.02 to 2.27]) as well as across multiple prespecified subgroups. This study provides a harsh

reminder that the implementation of novel technologies in global emergency care needs to be context-specific and may not work universally.

In addition to bubble CPAP, two additional studies focused on improving the triage and management of children with pneumonia. Gallagher and colleagues[32] tested various scoring systems to identify HIV-negative children with pneumonia who are at the highest risk of mortality at the time of presentation. Emergency clinicians have a long history of developing algorithms and triage scores that help best balance available resources. The care for children with pneumonia can take significant amounts of staff, oxygen, fluids, antibiotics, and feeding tubes, so early risk stratification can be very helpful in balancing resource utilization. The new scoring system they tested performed moderately well, but did not work any better than the well-established WHO danger signs, which remain readily available and easy to perform early in the triage process. Keitel and colleagues[33] took a different approach to developing diagnosis and treatment algorithms in pediatric pneumonia. They conducted a secondary analysis from a larger randomized trial where children were randomized to either routine care or a two-step algorithm consisting of CRP and age- and temperature-adjusted respiratory rate. They found that this novel "ePOCT" algorithm had a slightly lower treatment failure rate (RR = 0.60 [95% CI = 0.37 to 0.98]) and significantly lower rates of antibiotic use (RR = 0.06 [95% CI = 0.04 to 0.09]) and readmission (RR = 0.30 [95% CI = 0.10 to 0.93]). This may be challenging to implement without the rapid availability of CRP testing and clear guidelines on how to implement the algorithm (for example, they used tablet computers), but as these technologies become more available, this approach has great potential to improve care and assist with decreasing antibiotic use for this common illness.

In another attempt to improve emergency department (ED) throughput with more efficient triage, Goldstein[34] and colleagues evaluated cost-effectiveness, including time in the ED and emergency physician time, in a randomized trial where some patients had a CBC performed and some patients had CBC plus iSTAT performed prior to being evaluated by a physician, compared to routine care where the physician would see the patient before labs are ordered. Conducted in South Africa, they found that obtaining a CBC plus iSTAT prior to physician evaluation was indeed cost-effective in terms of throughput (31 minutes faster per patient) and overall financial cost (US $14.96 per patient). However, radically modifying the workflow to universally obtain these labs is a step that needs to be taken carefully, because no assessment was made (or could be made using their methods) as to how often the lab results actually changed patient management decisions or whether any patient-centered clinical outcomes were actually improved.

Continued research into the utility of bedside ultrasound in resource-limited settings remains an active area of investigation. Champagne and colleagues[35] conducted an extensive review of ultrasound for detecting fractures in upper and lower extremities, in comparison to traditional imaging modalities (x-ray, CT, MRI). Ultrasound showed quite good sensitivity and specificity (>90%) for upper extremity and slightly lower sensitivity (82%) for lower-extremity fractures. This review provides useful evidence that ultrasound, following appropriate training, can be very useful in a variety of resource-limited settings to quickly and accurately diagnose fractures at the bedside.

Among treatment articles, the CRASH-3 Investigators conducted a large (n = 12,737) multicenter (175 hospitals in 29 countries) randomized trial of tranexamic acid (TXA) for adults with traumatic brain injury (TBI).[36] They were able to demonstrate a mortality benefit in mild-to-moderate TBI (RR = 0.78 [95% CI = 0.64 to 0.95]) but not in severe TBI (RR = 0.99 [95% CI = 0.91 to 1.07]). This was a rigorous trial and made appropriate and logical use of subgroup analyses for various clinically relevant subgroups. Given the lack of neurosurgical care and intensive care units in many parts of the world, TXA could be a game-changer for TBI management, just as it has for other significant causes of bleeding such as postpartum hemorrhage.[37]

Finally, two trials shed new light on the role of primaquine in the treatment of malaria. The traditional use of primaquine as a 14-day course for radical cure of vivax and ovale malaria has always been challenging due to the long duration of treatment needed. Taylor and colleagues[38] thus conducted a large multicenter trial (n = 2,336 in four countries) of short-course, high-dose treatment instead, doubling the daily dose but cutting the duration to 7 days. They showed that the 7-day course was as effective as the traditional 14-day course in achieving radical cure for vivax malaria among those without glucose-6-phosphate dehydrogenase (G6PD) deficiency (difference of 0.02 recurrences per person-year [95% CI = −0.02 to 0.05]). If recommended by the WHO, this shorter course may improve adherence and real-world effectiveness and would be an

important change in the way emergency clinicians prescribe this medication. Dysoley and colleagues[39] conducted a small randomized trial of low-dose primaquine as an adjunct to standard of care for falciparum malaria, an indication for which primaquine is not typically considered. The trial was limited by a small sample size (n = 109) and relatively healthy baseline population, so it may not be fully generalizable, but has already led to a policy change in Cambodia as artemisinin resistance increases.

EM Development

Developing effective and efficient triage systems as EDs develop remains an important area of investigation. In Mozambique, Dekker-Boersema and colleagues[40] showed that a simple three-tiered color-coded triage system proved easy to learn for nonclinicians, who gave similar triage scores as experienced nurses. This new system also significantly decreased wait times for the sickest children, in addition to decreasing mortality (RR = 0.55 [95% CI = 0.38 to 0.81]). However, this intervention was combined with educational interventions and improved supply chains, so it is not entirely clear whether this triage system alone would have been sufficient, but the study provides an important start for peripheral hospital settings that may not have enough trained clinicians to perform triage at all times. Wangara and colleagues[41] tested the South African Triage Scale as a replacement for a nursing gestalt triage system (red, yellow, green) in Nairobi. They demonstrated that it was indeed possible to implement standardized triage systems as EM develops and formalizes across Africa. Their study only included adolescents and adults, so it remains to be seen whether this would work with younger children. A key finding was that they were able to triage patients who ultimately died with high sensitivity, while still decreasing the rate of overtriage, potentially helping better balance staff resources in a busy ED.

Many articles have been written over the years about the Helping Babies Breathe program that aims to improve neonatal resuscitation in resource-limited settings, but little assessment has been made about its effectiveness in improving neonatal outcomes. To address this, Versantvoort and colleagues[42] conducted a narrative review that suggests that the program does indeed decrease mortality for infants during the first week of life, as might be expected for immediate perinatal causes of mortality. A similar benefit was not seen beyond the first week of life, where the causes of death are not addressed by this training program. There was, however, some heterogeneity across the study designs and outcomes; further, not all of the studies identified for their review all showed beneficial effects.

Finally, Tran and colleagues[43] conducted a systematic review of the qualitative literature on the sociocultural frameworks that people in low- and middle-income countries use to view prehospital emergency medical services (EMS). This is an important contribution to the EMS literature, which has traditionally focused on clinical measures of care provided rather than society's greater perceptions of EMS and care-seeking behavior. If these issues are not considered carefully as EMS systems are developed, there is a danger of distrust, and EMS may be underused, thereby becoming wasteful of health resources. Conversely, misperceptions about the appropriate use of EMS may also lead to inefficient and/or excessive use. As increased emergency care is advocated for worldwide, this review provides a humbling reminder that we must always consider society's perceptions of this care and involve beneficiaries in careful planning about what services are provided and in what form.

CONCLUSIONS

The annual Global Emergency Medicine Literature Review has again identified hundreds of peer-reviewed and gray literature studies examining many domains of global EM. This continues to be an active area of investigation, with additional efforts to conduct systematic reviews and adapt traditional EM practice to resource-limited settings where the burden of disease is often quite different. Research in global EM remains active and vigorous, with robust efforts to adapt traditional clinical trial designs to austere settings and overcome a wider array of barriers to research.[44] Given the significant challenges in simply providing direct clinical care, implementing consistent systems of care, and training frontline staff, these researchers are all to be commended for taking the extra step of advancing patient care through such well-designed and -conducted clinical trials and reviews.

REFERENCES

1. Levine AC, Gadiraju S, Goel A, Johar S, King R, Arnold K. International emergency medicine: a review of the literature. Acad Emerg Med 2007;14:182–3.

2. Levine AC, Goel A, Keay CR, et al. International emergency medicine: a review of the literature from 2006. Acad Emerg Med 2007;14:1190–3.
3. Levine AC, Becker J, Lippert S, Rosborough S, Arnold K, Emergency Medicine Resident Association International Emergency Medicine Literature Review Group. International emergency medicine: a review of the literature from 2007. Acad Emerg Med 2008;15:860–5.
4. Lippert S, Levine AC, Becker J, et al. International emergency medicine: a review of the literature from 2008. Acad Emerg Med 2009;16:1335–40.
5. Foran M, Levine A, Lippert S, et al. International emergency medicine: a review of the literature from 2009. Acad Emerg Med 2011;18:86–92.
6. Aschkenasy M, Arnold K, Foran M, et al. International emergency medicine: a review of the literature from 2010. Acad Emerg Med 2011;18:872–9.
7. Schroeder ED, Jacquet G, Becker TK, et al. Global emergency medicine: a review of the literature from 2011. Acad Emerg Med 2012;19:1196–203.
8. Jacquet GA, Foran M, Bartels S, et al. Global emergency medicine: a review of the literature from 2012. Acad Emerg Med 2013;20:835–43.
9. Becker TK, Jacquet GA, Marsh R, et al. Global emergency medicine: a review of the literature from 2013. Acad Emerg Med 2014;21:810–7.
10. Becker TK, Bartels S, Hansoti B, et al. Global emergency medicine: a review of the literature from 2014. Acad Emerg Med 2015;22:976–84.
11. Becker TK, Hansoti B, Bartels S, et al. Global emergency medicine: a review of the literature from 2015. Acad Emerg Med 2016;23:1183–91.
12. Becker TK, Hansoti B, Bartels S, et al. Global emergency medicine: a review of the literature from 2016. Acad Emerg Med 2017;24:1150–60.
13. Becker TK, Trehan I, Hayward AS, et al. Global emergency medicine: a review of the literature from 2017. Acad Emerg Med 2018;25:1287–98.
14. Trehan I, Osei-Ampofo M, Balhara KS, et al. Global emergency medicine: a review of the literature from 2018. Acad Emerg Med 2019;26:1186–96.
15. Hansoti B, Aluisio AR, Barry MA, et al. Global health and emergency care: defining clinical research priorities. Acad Emerg Med 2017;24:742–53.
16. Razzak J, Usmani MF, Bhutta ZA. Global, regional and national burden of emergency medical diseases using specific emergency disease indicators: analysis of the 2015 Global Burden of Disease study. BMJ Glob Health 2019;4:e000733.
17. Balhara KS, Silvestri DM, Tyler Winders W, et al. Impact of nutrition interventions on pediatric mortality and nutrition outcomes in humanitarian emergencies: a systematic review. Trop Med Int Health 2017;22:1464–92.
18. Balhara KS, Bustamante ND, Selvam A, et al. Bystander assistance for trauma victims in low- and middle-income countries: a systematic review of prevalence and training interventions. Prehosp Emerg Care 2019;23:389–410.
19. Winders WT, Bustamante ND, Garbern SC, et al. Establishing the effectiveness of interventions provided to first responders to prevent and/or treat mental health effects of response to a disaster: a systematic review. Disaster Med Public Health Prep 2020 [online ahead of print]. https://doi.org/10.1017/dmp.2019.140
20. Paez A. Gray literature: an important resource in systematic reviews. J Evid Based Med 2017;10:233–40.
21. Cohen J. Weighted kappa: nominal scale agreement with provision for scaled disagreement or partial credit. Psychol Bull 1968;70:213–20.
22. Maclure M, Willett WC. Misinterpretation and misuse of the kappa statistic. Am J Epidemiol 1987;126:161–9.
23. Kundel HL, Polansky M. Measurement of observer agreement. Radiology 2003;228:303–8.
24. Snider CJ, Zaman K, Estivariz CF, et al. Immunogenicity of full and fractional dose of inactivated poliovirus vaccine for use in routine immunisation and outbreak response: an open-label, randomised controlled trial. Lancet 2019;393:2624–34.
25. United Nations Inter-agency Group for Child Mortality Estimation (UN IGME). Levels and Trends in Child Mortality 2019: Estimates Developed by the Un inter-agency Group for Child Mortality Estimation. New York: United Nations Children's Fund, 2019.
26. Maitland K, Kiguli S, Opoka RO, et al. Mortality after fluid bolus in African children with severe infection. N Engl J Med 2011;364:2483–95.
27. Alam NH, Ashraf H, Ahmed T, Jahan N, Gyr N. Randomised trial showed that rapid rehydration of severely malnourished children with dehydrating diarrhoea was as safe and effective as slow rehydration. Acta Paediatr 2020;109:1473–84.
28. Houston KA, Gibb J, Olupot-Olupot P, et al. Gastroenteritis aggressive versus slow treatment for rehydration (GASTRO): a phase II rehydration trial for severe dehydration: WHO plan C versus slow rehydration. BMC Med 2019;17:122.
29. Won A, Suarez-Rebling D, Baker AL, Burke TF, Nelson BD. Bubble CPAP devices for infants and children in resource-limited settings: review of the literature. Paediatr Int Child Health 2019;39:168–76.
30. Bjorklund AR, Odongkara Mpora B, Steiner ME, Fischer G, Davey CS, Slusher TM. Use of a modified bubble continuous positive airway pressure (bCPAP) device for children in respiratory distress in low- and middle-income countries: a safety study. Paediatr Int Child Health 2019;39:160–7.
31. McCollum ED, Mvalo T, Eckerle M, et al. Bubble continuous positive airway pressure for children with high-risk

conditions and severe pneumonia in Malawi: an open label, randomised, controlled trial. Lancet Respir Med 2019;7:964–74.
32. Gallagher KE, Knoll MD, Prosperi C, et al. The predictive performance of a pneumonia severity score in human immunodeficiency virus-negative children presenting to hospital in 7 low- and middle-income countries. Clin Infect Dis 2020;70:1050–7.
33. Keitel K, Samaka J, Masimba J, et al. Safety and efficacy of C-reactive protein-guided antibiotic use to treat acute respiratory infections in Tanzanian children: a planned subgroup analysis of a randomized controlled noninferiority trial evaluating a novel electronic clinical decision algorithm (ePOCT). Clin Infect Dis 2019;69:1926–34.
34. Goldstein LN, Wells M, Vincent-Lambert C. The cost of time: a randomised, controlled trial to assess the economic impact of upfront, point-of-care blood tests in the emergency centre. Afr J Emerg Med 2019;9:57–63.
35. Champagne N, Eadie L, Regan L, Wilson P. The effectiveness of ultrasound in the detection of fractures in adults with suspected upper or lower limb injury: a systematic review and subgroup meta-analysis. BMC Emerg Med 2019;19:17.
36. CRASH-3 Trial Collaborators. Effects of tranexamic acid on death, disability, vascular occlusive events and other morbidities in patients with acute traumatic brain injury (CRASH-3): a randomised, placebo-controlled trial. Lancet 2019;394:1713–23.
37. Phillips JM, van den Anker JN, Ahmadzia HK. Next generation medical management of postpartum hemorrhage. Curr Pharm Des 2019;25:549–55.
38. Taylor WR, Thriemer K, von Seidlein L, et al. Short-course primaquine for the radical cure of Plasmodium vivax malaria: a multicentre, randomised, placebo-controlled non-inferiority trial. Lancet 2019;394:929–38.
39. Dysoley L, Kim S, Lopes S, et al. The tolerability of single low dose primaquine in glucose-6-phosphate deficient and normal falciparum-infected Cambodians. BMC Infect Dis 2019;19:250.
40. Dekker-Boersema J, Hector J, Jefferys LF, et al. Triage conducted by lay-staff and emergency training reduces paediatric mortality in the emergency department of a rural hospital in northern Mozambique. Afr J Emerg Med 2019;9:172–6.
41. Wangara AA, Hunold KM, Leeper S, et al. Implementation and performance of the South African Triage Scale at Kenyatta National Hospital in Nairobi, Kenya. Int J Emerg Med 2019;12:5.
42. Versantvoort JM, Kleinhout MY, Ockhuijsen HD, Bloemenkamp K, de Vries WB, van den Hoogen A. Helping Babies Breathe and its effects on intrapartum-related stillbirths and neonatal mortality in low-resource settings: a systematic review. Arch Dis Child 2020;105:127–33.
43. Tran TT, Lee J, Sleigh A, Banwell C. Putting culture into prehospital emergency care: a systematic narrative review of literature from lower middle-income countries. Prehosp Disaster Med 2019;34:510–20.
44. Levine AC, Barry MA, Agrawal P, et al. Global health and emergency care: overcoming clinical research barriers. Acad Emerg Med 2017;24:484–93.

Appendix A

Global Emergency Medicine Literature Review (GEMLR) Group members (in alphabetical order):

Kamna S. Balhara, MD, MA, Department of Emergency Medicine, Johns Hopkins University, Baltimore, MD

N. Shakira Bandolin, MD, Department of Emergency Medicine, University of California, Davis, Sacramento, CA

Holly Bannon-Murphy, MBBS, BA, Emergency and Trauma Centre, Alfred Health, Melbourne, Australia

Torben K. Becker, MD, PhD, Department of Emergency Medicine, University of Florida, Gainesville, FL

Nidhi Bhaskar, Brown University, Providence, RI

Joseph Bonney, MBChB, MPH, MScDM, Department of Emergency Medicine, Komfo Anokye Teaching Hospital, Kumasi, Ghana

Andrew D. I. Charlton, MBChB, MRCEM, DTM&H, Bradford Royal Infirmary, Bradford Teaching Hospitals Trust, Bradford, UK

Daniel K. Cho, Brown University, Providence, RI

Jolene Cook, MD, Department of Emergency Medicine, Dalhousie University, Halifax, Canada, Médecins Sans Frontières, and Emergency Health Services, Government of Nova Scotia

Amin Coker, MD, Emergency Medicine Directorate, Greater Accra Regional Hospital, Accra, Ghana

Amanda T. Collier, MD, DTM&H, Department of Emergency Medicine, Queen's University, Kingston, Canada

Jonathan W. Dyal, MD, MPH, Department of Emergency Medicine, Brigham and Women's Hospital, Boston, MA

Katelyn E. Flaherty, University of Florida, Gainesville, FL

Emily A. Hartford, MD, MPH, Department of Pediatrics, University of Washington, Seattle, WA

Alison S. Hayward, MD, MPH, Department of Emergency Medicine, Brown University, Providence, RI

Braden J. Hexom, MD, Department of Emergency Medicine, Rush University Medical Center, Chicago, IL

Carolyn Hunter, MB, BCh, BAO, BSc, DTMH, NHS Scotland, Glasgow, UK

Anjni P. Joiner, DO, MPH, Department of Surgery, Duke University, Durham, NC

Jennifer E. Jones, MBBS, Louisiana State University Shreveport, Shreveport, LA

Sean M. Kivlehan, MD, MPH, Department of Emergency Medicine, Brigham and Women's Hospital, Boston, MA, and Harvard Humanitarian Initiative, Cambridge, MA

Joseph Leanza, MD, Department of Emergency Medicine, University of Pennsylvania, Philadelphia, PA

Elizabeth Ledger, BM, BCh, DTM&H, MRCPCH, MSc, Bristol Royal Hospital for Children, Bristol, UK, and Medical Research Council Unit The Gambia at LSHTM, Fajara, The Gambia

J. Austin Lee, MD, MPH, Department of Emergency Medicine, University of Virginia, Charlottesville, VA

Adam C. Levine, MD, MPH, Department of Emergency Medicine, Brown University, Providence, RI

Richard Lowsby, MBChB, FRCEM, DTMH, Emergency Department, Mid Cheshire Hospitals NHS Foundation Trust, Crewe, UK

Katelyn R. Moretti, MD, Department of Emergency Medicine, Brown University, Providence, RI

Benjamin D. Nicholson, MD, Department of Emergency Medicine, Virginia Commonwealth University, Richmond, VA

Gerard M. O'Reilly, MBBS, FACEM, MPH, MBiostat, PhD, Emergency and Trauma Centre, The Alfred, Melbourne, Australia, and School of Public Health and Preventive Medicine, Monash University, Melbourne, Australia

Amelia Y. Pousson, MD, MPH, Department of Emergency Medicine, Johns Hopkins University, Baltimore, MD

Nana Serwaa A. Quao, MD, Department of Emergency Medicine, Korle Bu Teaching Hospital, Accra, Ghana

Chris A. Rees, MD, MPH, Division of Emergency Medicine, Boston Children's Hospital, Boston, MA

Charlotte M. Roy, MD, Department of Emergency Medicine, Columbia University, New York, NY

Megan M. Rybarczyk, MD, MPH, Department of Emergency Medicine, Brigham and Women's Hospital, Boston, MA

Anand Selvam, MD, MSc, DTM&H, Department of Emergency Medicine, Yale University, New Haven, CT

Kimberly A. Stanford, MD, MPH, Section of Emergency Medicine, University of Chicago, Chicago, IL

Jonathan M. Strong, MD, MPH, Brigham and Women's Hospital, Boston, MA

Indi Trehan, MD, MPH, DTM&H, Departments of Pediatrics and Global Health, University of Washington, Seattle, WA

Lara D. Vogel, MD, MBA, Department of Emergency Medicine, North Shore Medical Center, Salem, MA

Alex H. Wang, MD, Department of Emergency Medicine, University of Connecticut, Hartford, CT

Katherine M. Wegman, MD, Department of Emergency Medicine, Boston University Medical Center, Boston, MA

Supporting Information

The following supporting information is available in the online version of this paper available at http://onlinelibrary.wiley.com/doi/10.1111/acem.14107/full

Data Supplement S1. Supplemental material.

Data Supplement S2. Complete database of all 356 identified global EM articles 2019.