State of the Evidence for Emergency Medical Services (EMS) Care: The Evolution and Current Methodology of the Prehospital Evidence-Based Practice (PEP) Program

État des données pour les services médicaux d'urgence (SMU) : évolution et méthodologie actuelle du programme de Soins préhospitaliers fondés sur les preuves (PEP)

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Abstract

Background: Emergency medical services (EMS) leaders and clinicians need to incorporate evidence into safe and effective clinical practice. Access to high-quality evidence, and the time to synthesize it, can be barriers to evidence-based practice. The Prehospital Evidence-Based Practice (PEP) program is an online, freely accessible, repository of critically appraised evidence specific to EMS. This paper describes the evolution and current methodology of the PEP program.

Methods/design: The purpose of PEP is to identify, catalog and critically appraise relevant studies. Following regular systematic searches, two trained appraisers critically appraise included studies and assign a score on three-point level of evidence (LOE) and direction of evidence (DOE) scales. Each clinical intervention is plotted on a 3 × 3 (LOE × DOE) evidence matrix, which provides a summary recommendation.

Discussion: The PEP program is a unique knowledge translation tool, specific to EMS. End-users can easily identify which clinical interventions are, or are not, supported by evidence.

Résumé

Contexte : Les chefs et cliniciens des services médicaux d'urgence (SMU) doivent incorporer des données à une pratique clinique sécuritaire et efficace. L'accès aux données de haute qualité, et le temps nécessaire pour les synthétiser, peuvent être des obstacles à une pratique fondée sur les données probantes. Le programme de Soins préhospitaliers fondés sur les preuves (PEP) est un dépôt, en ligne et gratuit, de données propres aux SMU et évaluées de façon critique. Cet article décrit l'évolution et la méthodologie actuelle du programme PEP.

Méthodes/concept : L'objet du PEP est de repérer et d'évaluer de façon critique les études pertinentes. Suites aux recherches systématiques régulières, deux évaluateurs formés évaluent de façon critique les études incluses et leur attribuent des notes, selon une échelle à trois niveaux, pour le niveau des données (LOE) et pour la direction des données (DOE). Chaque intervention clinique est répartie sur une matrice de données 3 × 3 (LOE × DOE), qui fournit une recommandation sommaire.

Discussion : Le programme PEP est un outil unique pour la transposition des données, propres aux SMU. Les utilisateurs finaux peuvent facilement repérer quelles interventions cliniques sont, ou ne sont pas, appuyées par des données probantes.

Background

As with other parts of the healthcare system, emergency medical services (EMS) leaders, medical directors, and clinicians strive to deliver high-quality, safe care consistent with best practice. This is dependent on easily accessible and accurate guidelines that are grounded on the best quality relevant evidence available. This is based on the principles of evidence-based medicine (EBM), which provides a framework for clinicians to determine whether interventions are effective and suitable for use in their practice (Sackett et al. 1998). The theory of EBM can guide the development and implementation of structures and processes to access, appraise, and integrate research evidence into practice (Sackett et al. 1998).

Barriers to effective EBM are present in EMS, as they are in other parts of healthcare. These include: accessing and using the most up-to-date evidence at the point of care is often challenging for clinicians; and there are limited resources dedicated to EBM and knowledge translation (KT), including organizational capacity to collect and appraise research (Ellen et al. 2014). There are several barriers that are highlighted in the EMS setting, including: many EMS patient interactions are of an urgent nature, limiting opportunity for EMS clinicians to search for or refer to resources; wading through the growing body of research and determining what is relevant to EMS can be challenging and time-consuming; EMS clinicians often have limited training on literature searching and evidence appraisal; the evidence base for EMS is still maturing, making the synthesis and application more challenging (Cone 2007). Clinical interventions used in the EMS setting are frequently the result of studies conducted in other settings such as emergency departments, operating rooms and intensive care units (Bigham and Welsford 2015, Cone 2007). Finally, operationalizing the relevant evidence into EMS can be a challenge. Factors such as system design, scope of practice, logistics of deployment, and of course cost, can delay *knowledge to action* (Graham et al. 2006; Jensen et al. 2013).

The Prehospital Evidence-Based Practice (PEP) program strives to overcome these barriers by ensuring access to an online, freely available, continuously updated EMS evidence synthesis repository (Jensen et al. 2009). The primary objective of PEP is to systematically identify, catalog and appraise relevant studies, then provide a general recommendation level for each EMS clinical intervention. The evidence-based recommendation levels can be used to guide changes in EMS practice and in the development of clinical practice guidelines (CPGs) or protocols (Jensen et al. 2009; Jensen and Dobson 2011; NASEMSO 2017). The secondary objective of PEP is to identify gaps in the body of research informing EMS practice, thus guiding researchers on where to direct their efforts.

As the implementation science literature has developed, the methods used in PEP have evolved since its inception to become more rigorous and systematic, to improve validity and reduce potential bias. This report is a detailed description of the PEP methodology and its evolution over 20 years. Although PEP is primarily designed for EMS decision-makers, it has applicability beyond this context. PEP provides evidence on the design of systems of care for trauma, as well as cardiac and stroke care among others. The PEP program can serve as an example of how evidence can be effectively collected, appraised, and shared within other healthcare sectors.

Program history

The PEP program was initiated in 1998 by the Dalhousie University Department of Emergency Medicine, Division of Emergency Medical Services, in collaboration with Nova Scotia Emergency Health Services (EHS) (PEP 2018) (Table 1). The initiation of PEP occurred in a time when large gaps in the EMS body of knowledge were identified and accepted practices were coming into question (Delbridge 2002). These were highlighted in an often-cited manuscript on the "scanty science of prehospital emergency care" (Callaham 1997). Its inception aligned with the launch of the first North American EMS peer-reviewed journal. Alongside this movement toward more rigorous EMS science, members of our team (DP, EC) realized the importance of cataloguing and appraising the existing body of knowledge on EMS care and that this knowledge base was comprised of multiple forms of evidence (not only randomized controlled trials) (Petrie 1998).

Initially, the primary purpose of PEP was to create an efficient mechanism to synthesize evidence for the paramedic protocols that were required in the newly established Nova Scotia provincial EHS system. It was meant to be a common resource for medical directors in the process of protocol development and a baseline from which EMS researchers could target priority areas (Petrie et al. 2002). From there, PEP quickly expanded to include interventions administered within any Canadian EMS system, and subsequently, to address EMS clinical care in other locations around the world with similar systems to North American EMS. PEP was designed to be open access to seek constructive criticism (Petrie et al. 2002).

PEP design

The PEP process has been adapted from other established appraisal methodologies including the Centre for Evidence Based Medicine (CEBM 2015) and Canadian Task Force Guidelines (CTFPHE 1988). Systematic review methodologies are integrated into the PEP process. PEP searches and reviews are conducted according to a pre-specified topic calendar (Table 2), repeated annually.

PEP categories

The PEP database and website are structured by nature of complaint and clinical presentation (e.g., hypoglycemia) as the main categories, and EMS interventions (e.g., glucagon) listed under each condition as sub-categories (https://emspep.cdha.nshealth.ca/TOC.aspx). Clinical interventions include assessments (e.g., 12-lead ECG and clinical decision rules), treatments (e.g., oxygen) and dispositions (e.g., direct [transport] to percutaneous intervention (PCI) [centre], treat and release). Related research studies are listed under each clinical intervention. Previously, the clinical conditions and interventions listed in PEP were based on the treatment algorithms of the local EMS service, EHS Nova Scotia. Over time, there has been a transition from evidence informed linear protocols to evidence flexible CPGs. The current iteration of PEP focuses on clinical presentation categories and interventions developed by reviewing approximately 20 other EMS systems protocols. More clinical conditions and intervention categories were added as PEP expanded to address the full breadth of EMS

clinical care delivered across Canada. Currently, PEP includes 34 clinical conditions and 684 interventions (as of January 26, 2018). Studies are organized under the relevant intervention categories, appearing under more than one intervention category if the study examined more than one intervention. If a study includes an intervention not currently evaluated in PEP, senior appraisers will discuss if the intervention should be added. This is determined by consensus and considers current and future interventions used in a paramedic-based EMS model. Studies that suggest a unique recommendation for the critical care transport (CCT) environment are placed in separate intervention categories. An example is rapid sequence induction – CCT (https://emspep.cdha.nshealth.ca/LOE.aspx?VProtStr=Medication for Airway Management&VProtID=229). Other recently added clinical condition categories include EMS-delivered palliative care (https://emspep.cdha.nshealth.ca/LOE.aspx?VProtStr=Agitation&VProtID=251).

Search strategy

Systematic searches are conducted monthly in a single citation database, PubMed. PubMed was chosen because of its extensive collection of 28 million citations and because it captures several of the main EMS and emergency medicine journals (US National Library of Medicine 2018), accessed on January 26, 2018. The database is searched for studies published in English that meet the inclusion criteria in order to ensure an expeditious and feasible process for regular PEP updates while maximizing the capture of relevant research. While PubMed houses a large proportion of the relevant published research, we also acknowledge that this could introduce bias in terms of only identifying research that is available within this database. Search strings are developed using Medical Subject Headings (MeSH) and title/abstract key words. Search strategies are developed following a Population, Intervention, Comparison, Outcome (PICO) format. The population search includes a string of EMS search terms in most cases (see Appendix 1, available at https://www.longwoods.com/content/25548). Filters, Comparison and Outcome terms, and the EMS search string, may be omitted if the initial search strategy returns few articles. Specific searches are created for each clinical topic. Search strategies are developed by (1) identifying the most appropriate MeSH term for key words, (2) reviewing related terms and locating them within the term trees, (3) hand-searching the reference lists of current studies already in PEP for index terms, and (4) including Title (TI) and Abstract (AB) terms when the MeSH terms do not adequately represent the condition and intervention. A second senior appraiser reviews search strategies for the use of Boolean and proximity operator, subject headings, natural free text language, limits, and the use of filters, prior to execution. For searches that have been conducted previously with the same search strategy, the date range is limited to two years, unless the strategy was identified as requiring improvement. In some cases, study method filters may be used to refine searches. Searches are tested for their ability to identify seminal articles. Finally, results are imported into reference management software (Refworks, Ann Arbor, MI) and duplicates removed. Search strategies have been developed with the assistance of a medical librarian.

TABLE 1. History of major changes and evolution of the PEP program

Year	Change	Description/rationale
1998–2000	Genesis of PEP program	PEP was developed following an EMS Agenda for the Future – Making it a Reality conference on May 21, 1998, in Alexandria, Virginia. A major barrier identified at this meeting was the lack of an EMS evidence repository. PEP's goal was to collect and appraise the existing EMS literature (DP) and was built around the renewal of Nova Scotia EMS protocols (EC). The initial section editor panels were mostly emergency physicians who were members of the Royal College Physicians and Surgeons of Canada and from seven provinces across Canada.
2000	Database displayed online	Use technology to expand reach of the project and streamline appraisal communication.
2001	First PEP coordinator	First PEP coordinator assigned to program (CD) to ensure sustainability.
2003–2009	Expanding appraisers from only emergency physicians to include paramedics, nurses, researchers, students and others	To include and engage all members of the EMS community.
2011	Replacing COR table with 3 × 3 table	Assigning a COR to an intervention required much subjective judgment. Now, appraisers and senior editors can assess the distribution of level and direction of related studies to determine best spot on 3 × 3 table for an intervention.
2012	Expanding appraiser group from only Canadians to those from locations around the world	To expand the exchange of ideas and collaboration with other innovative systems so that we can communally benefit from the knowledge.
2012	Appraisers all assigned articles to appraise from the scheduled topic, rather than having an assigned 'section'	Initially, section editors were assigned to specific topic areas (e.g., cardiac arrest). To encourage ongoing engagement of all members of the appraisal team, the choice was made to distribute articles evenly amongst the team.
2013	PEP recommendations integrated into the provincial CPGs	To marry the clinical practice officially with the evidence.
2014	Designating specific clinical interventions if CCT	The evidence for an intervention may be different if administered by standard EMS paramedics compared to CCT teams. At this point, there was enough literature that we could separate these interventions by level of care.
2014	Addition of second party appraiser step and senior appraiser team.	To increase our internal validity by increasing our rigour.
2014	Addition of palliative care/end-of-life category	There was a noted gap in ability to care for palliative patients from a clinical standpoint. In order to address this practice gap, we needed to understand the existing evidence in palliative care.
2016	List primary outcome of each study	We had feedback from our end-user group that it would be helpful to know what the study primary outcome was when making decisions about practice.

CCT = critical care transport; COR = class of recommendation; CPGs = clinical practice guidelines; EMS = emergency medical services; PEP = Prehospital Evidence-Based Practice.

Inclusion and exclusion criteria

Studies are selected for inclusion by the PEP coordinator (JG), by title and abstract review for relevance. Full text articles of included studies are obtained, and it is confirmed that they meet PEP inclusion criteria (Table 3). Studies are prioritized for send-out using pre-determined criteria (Table 3). Any included studies not assigned to appraisers are retained and sent out during a catch-up month or the following calendar year. A study will be excluded if the study setting is too dissimilar from the EMS environment to inform EMS practice. These decisions are made by senior appraiser team consensus.

TABLE 2. PEP appraisal topic calendar

Topic (adult and pediatric)	Appraisal month
Advanced airway management, airway emergency	1
Cardiac arrest	2
Cardiac arrhythmia, chest pain	3
Altered mental state – decreased level of consciousness, stroke/CVA/TIA	4
Respiratory distress	5
Shock	6
Catch-up month	7
Trauma, acute pain, burns	8
Headache, malaise/sick, psychiatric	9
Allergic reaction, environmental emergency, EENT, end-of-life care, GI/Gu/Gyne, toxicological emergency, perinatal care	10
Catch-up months	11/12

CVA = cerebral vascular accident; EENT = eyes, ears, nose and throat; GI/GU/Gyne = gastrointestinal, genitourinary and gynecologica; PEP = Prehospital Evidence-Based Practice; TIA = transient ischemic attack.

TABLE 3. PEP inclusion and exclusion criteria, and criteria to prioritize included articles for primary appraisal assignment

Inclusion criteria	Exclusion criteria	Criteria to prioritize included articles for appraisal assignment
Studies of live patients	Animal studies*	Study conducted in EMS setting or by EMS clinicians
Registry/retrospective studies	Opinion articles/editorials	New publication
Simulation studies	Descriptive epidemiological reports	High-quality study
Systematic reviews	Surveys	Pediatric or critical care transport
	Narrative and scoping reviews	'Landmark' study or referred by appraiser or PEP user
		Canadian study

*Animal studies may be considered for inclusion if there is little other evidence available; decision is made by consensus of the senior appraiser team. EMS = emergency medical services; PEP = Prehospital Evidence-Based Practice.

Evidence appraisal

PEP appraisers include physicians, paramedics, nurses, and researchers trained in critical appraisal. Appraisers are from several countries and include CCT. Appraisers are oriented to the PEP process and updated regularly. Appraisals are completed using online forms, which are logged in the PEP database upon submission. The purpose of the primary appraisal is to review each study and assign a level and direction of evidence for the intervention(s) studied. Included studies are scored on a three-point level of evidence (LOE) scale, based on study design and quality (Table 4) and a three-point colour-coded direction of evidence (DOE) scale, which indicates if the study is supportive, neutral, or opposing for the use of the intervention in EMS clinical practice (Table 5). PEP senior appraisers perform secondary review on every submitted appraisal.

TABLE 4. Level of evidence

Level	Criteria
Level 1	Evidence obtained from adequately powered, properly randomized controlled trials on live human participants or systematic reviews or meta-analysis that contain only randomized controlled trials. No pilot studies to be included here.
Level 2	Evidence obtained from adequately powered, non-randomized studies with a comparison group of live human participants or systematic reviews of non-randomized studies with a comparison group. Prospective or retrospective registry-type studies in which comparisons are made; cohort and case control studies are included here.
Level 3	Evidence from studies with no randomization and no comparison group, simulation/manikin studies and animal studies. Pilot studies and underpowered studies are included here.

TABLE 5. Direction of evidence

Colour	Direction of evidence
Green	Direction of results of this study are supportive for the use of this intervention
Yellow	Direction of the results of this study are neutral for the use of this intervention
Red	Direction of the results of this study oppose the use of this intervention
White	Direction of results of this study are not yet evaluated

Primary outcomes of included studies

Appraisers abstract the primary or main outcome reported in each study. If the primary outcome is not explicitly stated, the first reported result is used. This is presented on the PEP website (PEP 2018). The DOE is determined by reviewing the results for the identified primary outcome of included studies.

Level of evidence

The PEP three-point LOE scale (Table 4) is a similar hierarchy of evidence used in other grading schemes, namely Centre for Evidence-Based Medicine (CEBM 2015). The LOE was developed to be useful and pragmatic for all clinicians (and experience levels) who accessed the database. The initial grading scheme took into account the type of evidence being evaluated and research experience of the appraisers. Both are important factors that inform decisions on the selection of a grading system (Baker et al. 2011). The LOE does not change if non-EMS practitioners perform the intervention, nor does it change if conducted in other environments beyond EMS. The LOE scale is specific to the study design and quality so is the same throughout the PEP database, regardless of the intervention category under which the study is categorized. The three-point LOE scale can be easily interpreted when there is high-quality evidence (e.g., adequately powered randomized controlled trials); however, it poses challenges when the evidence is of lower quality. For example, underpowered randomized controlled trials are scored Level III, the same category as simulation research or studies with no comparison group. The three-point LOE allows for consistency between appraisers and addresses research included in PEP in a way that makes sense from a clinical point of view.

Direction of evidence

A major change to PEP involved moving away from providing a class of recommendation (COR) to a DOE. The COR was a five-level scale ranging from A (good evidence to support procedure or treatment) to D (evidence to support that the procedure or intervention should not be used) and I (indeterminate). The more recent DOE scale provides improved clarity for the reader by both its words and colour. At a similar time, the American Heart Association was also moving away from their COR scale.

The DOE indicates if the study findings for the primary outcome are supportive (green), neutral or unclear direction (yellow) or opposing (red). One study may be listed under several clinical interventions and may have different DOEs for each intervention. For example, a study examining intubation versus bag mask ventilation in out-of-hospital cardiac arrest may have opposing DOE for intubation (see Fouche et al. 2014 under 'Direct Laryngoscopy [No airway reflexes]': https://emspep.cdha.nshealth.ca/LOE.aspx?VProtStr=Intubation&VProtID=226) and supporting DOE for basic airway management ('BVM': https://emspep.cdha.nshealth.ca/LOE.aspx?VProtStr=Alternative Rescue Airway Management&VProtID=225). Studies in which the results for the primary outcome find no difference between the interventions studied may have a supportive DOE applied for each if both were effective, i.e., this is not necessarily "neutral" (conversely both could be opposed if both were harmful). The neutral DOE is not used to indicate that both interventions perform equally when both were beneficial or harmful. Studies are assigned an opposing DOE if the results of the study demonstrate the intervention could negatively impact outcomes. When assigning DOE, the primary appraiser considers generalizability to EMS settings and practitioners. If a setting is substantially different from EMS, but the article is still somewhat informative, the appraiser will assign DOE neutral if it is likely that the application of the study intervention could lead to significantly different clinical outcomes in the EMS setting.

Second party appraisal

Senior appraisers perform a second party review of primary appraisals. Disagreement between primary and secondary appraisal (primary outcome, LOE, DOE) is resolved by consensus at the monthly senior appraisers meeting.

Evidence recommendation

Once all studies are appraised and reviewed, the senior appraiser team plots interventions for each clinical condition on 3 × 3 evidence matrix (LOE × DOE) (Table 6). The senior appraiser consensus decision on 3 × 3 evidence matrix placement takes into account the number of studies, LOEs, DOEs, effect sizes, relevance, current practice, and applicability.

PEP KT

In 2017, PEP began obtaining website analytics to identify patterns of use. PEP receives over 1,700 hits per month, with most occurring from desktop computers (84%). PEP end-users

have come from each Canadian province and territory, as well as the US, South America (Brazil), Europe (UK), Africa (South Africa), Asia (Thailand and Taiwan) and Australia.

In 2017, the PEP editors also sought feedback from end-users via an electronic survey, focus groups, and teleconferences with end-users and primary appraisers. Feedback was received from 52 end-users from seven provinces. The comments were mostly supportive of the current program output, including the 3 × 3 evidence matrix and list of appraised evidence. Respondents reflected an interest to have more information presented on individual studies (e.g., intervention-related adverse events, patient- versus process-related outcome, setting).

PEP has been involved in several KT initiatives. PEP is a KT product; intending to get the evidence straight and get the evidence used (Cone 2007). PEP's approach is simple; making it easy to apply, understand and present; however, it may be too simple to include a comprehensive review for the risk of bias and other methodological limitations of each study (Atkins et al. 2004). All clinicians should be able to use PEP regardless of their EBM experience. The PEP program has been presented at several national (CAEP) (Carter et al. 2016) and international conferences (Carter et al. 2015). More recently, PEP was presented as a plenary at the National Association of EMS Physicians annual meeting in January 2018 and PEP continues to have a standing update during the conference. Senior PEP editors and appraisers have constructed an online EBM course and have instructed an in-person EBM program in five provinces. In this program, paramedics are taught the fundamentals of EBM, including how to use PEP to inform their practice. PEP has a social media presence managed by the PEP KT coordinator. One of PEPs main KT successes has been engaging the PEP appraiser team (comprised of over 40 national and international appraisers). The PEP appraisers have a vested interest in the program and have integrated PEP into their own services simply by being involved. PEP has shared information with teams in Australia and the UK, and have been cited in the US National Clinical Guideline documents (NASEMSO 2017). The PEP editors continue to seek and encourage collaboration with other EBM groups in EMS around the world.

TABLE 6. An example of a 3 × 3 evidence matrix – intubation*

Level	Supportive (green)	Neutral (yellow)	Against (red)	Not yet graded (white)
1 (strong evidence exists)		• Direct laryngoscopy (no airway reflexes) • Direct laryngoscopy (with airway reflexes) • Lighted stylet • Nasotracheal intubation • Optical (non-video) visualization (e.g., Airtraq) • Video visualization (e.g., Glidescope)		• Passive oxygenation during ETI
2 (fair evidence exists)	• Laryngeal manipulation	• Bougie • Intubating LMA • Securing tube	• Cricoid pressure	
3 (weak evidence exists)		• Digital intubation		

ETI = endotracheal intubation; LMA = laryngeal manipulation.

*From September 1, 2015. *Source:* PEP 2018: Intubation (https://emspep.cdha.nshealth.ca/LOE.aspx?VProtStr=Intubation&VProtID=226#Direct).

Discussion

This manuscript describes the methodology and evolution of the PEP program. The PEP program is the only known openly available repository of appraised research evidence specific to EMS care. PEP is a continuously updated KT initiative, providing evidence synthesis for EMS clinical interventions, which can in turn be used by EMS guideline developers and system leaders to inform local EMS CPGs and protocols. Its open format enables PEP to be "peer reviewed" by site users (Petrie et al. 2002). The annual PEP topic review could decrease the lag time between the recognition of scientific advancement to application into clinical care via evidence inclusion into local CPGs or protocols (Province of Nova Scotia 2015; Vernooij et al. 2014).

The PEP methods seek to balance the requirements for a rigorous and transparent process with a practical need for rapid evidence synthesis. The monthly process includes execution of search strategies and subsequent selection, appraisal, blinded peer review and recommendation scoring. This is possible with PEP's pragmatic methodological design. There are many other evidence appraisal methods, each with advantages and disadvantages (Atkins et al. 2004), some of which are continuously re-developed to overcome identified shortcomings. The Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) approach has been widely implemented (Guyatt et al. 2008), including into the International Liaison Committee on Resuscitation (ILCOR) evidence review process (Olasveengen et al. 2017). GRADE evaluates evidence for specific questions by outcome, which differs from PEP, which evaluates all related evidence per specific intervention. The GRADE approach is comprehensive and the recommendations are made with clear terms, such as 'strong recommendation'. Similar to other appraisal schemes, the use of GRADE recommendations to inform CPGs when the science is elusive can be challenging (Guyatt et al. 2012; McGregor 2014). Others are more complex. The Australian National Health and Medical Research Council (NHMRC) uses an evidence matrix that lists five components that should be considered when grading evidence: (1) the evidence (the number of studies, LOE, and quality of studies), (2) consistency of study results, (3) potential clinical impact, (4) generalizability, and (5) applicability (NHMRC 2015; Cone et al. 2012). The guiding philosophy of PEP was that the evidence grading system should be as simple as possible and still enable valid judgment of quality and direction of evidence. This enables PEP recommendations to be easily used by clinicians and policy makers. The recent introduction of abstracting primary outcomes is intended to provide more granular information for PEP-users on how the interventions were measured.

Applicability of PEP to the Health System

As many parts of the healthcare system interact with EMS, the findings in PEP are applicable to those settings. Evidence-based approaches can be used for decisions and interventions such as prehospital cardiac catheterization lab activation, bypass direct to a percutaneous coronary intervention centre, direct transport to pediatric tertiary care, direct transport to a trauma centre, palliative care collaboration, stroke, and sepsis care. PEP identifies gaps in the literature such as we see with EMS palliative care.

The Canadian EMS setting is the reference point, so many of our recommendations may not be generalizable to all EMS (e.g., interventions used by EMS physicians providing on-scene care in other countries may not be included). Evidence that PEP shortens the knowledge to practice gap is mostly anecdotal. A "How to Cite" reminder was recently published on the PEP website and publishing the methods will serve as a foundation document to build upon identifying how widely PEP is used to inform EMS systems. Future work will focus on optimizing how PEP accounts for risk of bias, consistency, directness, and precision of the evidence. There are also opportunities to partner with others interested in EMS EBM. PEP aims to be the foremost evidence resource informing EMS by focusing on its strength of being a repository of critically appraised evidence. Collaborations with clinician groups, EMS guideline developers, researchers and other stakeholders will ensure that this body of appraised evidence can be used to inform patient care.

Conclusion

PEP is an online, freely accessible, repository of appraised EMS evidence. Literature is appraised using a modified grading system for level and direction of evidence with appraisals conducted by active EMS stakeholders. This evidence is summarized into easily interpreted evidence tables, which serve as recommendations. PEP project rapidly translates and disseminates EMS evidence, which can be useful for clinicians and policy makers. PEP is an important tool for moving the culture of evidence-based practice forward in EMS.

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