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Characteristics of QIs (Quality Indicators) in Prehospital Care: A Review

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ABSTRACT
This literature review aimed to trace, examine, and describe the literature on indicators used to evaluate the quality of prehospital care.
Traditionally, the performance of ambulance services and the quality of prehospital care have been measured using simple indicators, such as response time intervals, often based on low-level evidence. However, the discipline of paramedicine has evolved significantly over the last few decades. Consequently, the validity of utilizing such measures as holistic quality of prehospital care indicators (QIs) has been challenged. There is a growing interest in identifying new and more significant ways to evaluate the quality of prehospital care.
This literature review examined the concepts of prehospital care quality and QIs developed for ambulance services. The review considered primary and secondary research across all paradigms and utilizing any methods, as well as text and opinion. The Joanna Briggs Institute methodology for conducting scoping reviews was employed. Separate searches were conducted for review questions, specifically addressing the characteristics of QIs in the context of prehospital care. The following databases were searched: PubMed, CINAHL, Embase, Scopus, Cochrane Library, and Web of Science. The searches were limited to publications from January 1, 2000, to the search date (April 16, 2017). Non-English articles were excluded. To supplement the above, searches for grey literature were performed, experts in the field of study were consulted, and applicable websites were explored.
Review Question Findings: Thirty articles were included. The predominant source of articles was research literature (n = 23; 76.7%), originating mostly from the USA (n = 13; 43.3%). The most frequently applied QI development method was a form of consensus process (n = 15; 50%). A total of 526 QIs were identified. Of these, 283 (53.8%) were categorized as Clinical QIs and 243 (46.2%) as System/Organizational QIs. Within these categories, QIs related to Out-of-hospital cardiac arrest (n = 57; 10.8%) and Time intervals (n = 75; 14.3%) contributed the most, respectively. The most commonly addressed prehospital care quality attributes were Appropriateness (n = 250, 47.5%), Clinical effectiveness (n = 174, 33.1%), and Accessibility (n = 124, 23.6%). Most QIs were process indicators (n = 386, 73.4%).
Historically, the quality and performance of prehospital emergency care (PEC) have been assessed largely based on surrogate, non-clinical endpoints such as response time intervals or other crude measures of care (e.g., stakeholder satisfaction). However, advances in Emergency Medical Services (EMS) systems and services worldwide have seen their scope and reach continue to expand. This has necessitated the implementation of novel performance measures or evaluations to complement this growth. Significant progress has been made in this area, largely in the form of the development of evidence-informed quality indicators (QIs) of PEC.
While there is a paucity of research specifically defining prehospital care quality, the attributes of generic healthcare quality definitions appear to be accepted and applicable to the prehospital context. There is a growing interest in developing prehospital care QIs. However, there is a need for validation of existing QIs and de novo development addressing broader aspects of prehospital care.
Keywords: Ambulance; emergency medical services; healthcare quality assessment; prehospital care; quality indicators

Introduction:

The definition of prehospital care encompasses all care provided by any service to a patient before their arrival at a hospital. For the purpose of this literature review, prehospital care specifically refers to the care that ambulance services provide to patients with urgent or emergency care needs. This care begins when someone calls the ambulance service and concludes upon the patient's transport to a hospital. In some instances, all necessary patient care can be delivered before transport, eliminating the need for hospitalization. Historically, ambulance services were established to ensure the swift transport of the sick and injured to medical facilities. Timely and safe conveyance of patients with urgent and emergency care needs to an appropriate healthcare facility remains a central function of modern ambulance services. However, the scope and coverage of prehospital care provided by ambulance services have evolved significantly over the last few decades.¹⁻⁵ The primary drivers of these developments have been the professionalization of the paramedic industry, improvements in the integration of ambulance services within the broader healthcare system, and increasing demand due to various factors, including an aging and growing population and the expanding burden of chronic disease. Despite this growth, the relatively recent formation of the paramedicine profession and the consequent limited research capacity, coupled with the complexities of conducting data collection in the prehospital emergency care setting, have resulted in a scarcity of discipline-specific, scientific evidence.⁶⁻¹² Consequently, the performance and quality of ambulance services have traditionally been measured using simplistic indicators based on little to no evidence, such as response time intervals.^{7, 9, 13} These basic measures have dominated ambulance service performance reports because they are easily obtained and readily understood by both the public and policymakers.^{7, 13-15} Although shorter prehospital time intervals may be associated with better outcomes in certain time-critical patient cohorts,^{16, 17} the validity of response time as a holistic prehospital care quality indicator (QI) has been challenged.^{18, 19} As a result, there is a need for, and a growing interest in, identifying new and more significant ways to measure prehospital care quality.

A clear definition of quality is crucial for the development of meaningful QIs. Donabedian²⁰ argued that quality cannot be assessed until its definition is established. In the context of healthcare, formulating a definition has been a persistent challenge for healthcare managers and researchers.²¹⁻²⁶ This has led to two primary approaches in defining healthcare quality: generic and disaggregated definitions.²⁴ Generic definitions are broad and all-encompassing, whereas disaggregated definitions acknowledge the multidimensionality of the concept and focus on individual components.²⁴ These components, or attributes of quality, allow these definitions to be operationalized in the form of quality frameworks, which are essential for developing a balanced suite of QIs.^{27, 28} The boundaries of each attribute may vary depending on its definition, potentially causing overlap. This has led researchers to bundle or aggregate attributes with significant commonalities into broader dimensions. Campbell et al.³⁴ suggested two principal dimensions of quality of care for individual patients: access and effectiveness. When discussing healthcare for populations, additional dimensions are introduced: equity and efficiency.

Quality indicators are measurable aspects that provide a quantitative basis for clinicians, organizations, and planners aiming to improve patient care processes and outcomes.²⁸ QIs can be classified in various ways. Donabedian’s approach of assessing the structures, processes, and outcomes of medical care is widely accepted as the pre-eminent model for quality measurement in healthcare. Donabedian defined “structure” as the attributes of the setting in which care is provided (e.g., material resources, human resources, and organizational characteristics), “process”

as the activities that contribute to healthcare carried out by healthcare practitioners (e.g., diagnosis, treatment, and patient education), and "outcomes" as the effects of healthcare on individuals or populations.

This scoping review sought to locate, examine, and describe the literature on indicators used to measure prehospital care quality. Prior to the development of the protocol,²⁹ a preliminary search of the JBI Database of Systematic Reviews and Implementation Reports and the Cochrane Database of Systematic Reviews for previous scoping or systematic reviews on the topic was performed and yielded no results. It forms part of a wider research project, the Indian Prehospital care quality Indicator project (IPIRE), which aims to develop and test prehospital care QIs for the Indian setting.

Methods:

This review employed the Joanna Briggs Institute (JBI) methodology for conducting scoping reviews.³⁰ The inclusion criteria and methods for this review were specified in advance and documented in a protocol.

Search Strategy:

The search strategy aimed to identify both published and unpublished studies. For the review question addressing the characteristics of QIs in prehospital care, an initial limited search of PubMed and CINAHL was undertaken, followed by an analysis of the text words in the titles and abstracts, as well as the index terms used to describe the articles. A second search using all identified keywords and index terms was then conducted[1] in the following databases: PubMed, CINAHL, Embase, Scopus, Cochrane Library, and Web of Science. Thirdly, the reference lists of all selected reports and articles were searched for additional studies. Only English language papers were included due to the reviewers' language proficiency and time and budget constraints. The searches were limited to publications from January 1, 2000, to April 16, 2017, as the widespread application of quality improvement techniques across all healthcare sectors has largely occurred in the 21st century.³¹ To supplement the database searches, grey literature was sought on ProQuest Dissertations and Theses, OpenThesis, and the Networked Digital Library of Theses and Dissertations. Furthermore, experts in the field of study were consulted, and the following websites of professional organizations, accrediting bodies, and government agencies were manually searched:

- Agency for Healthcare Research and Quality (AHRQ)
- National Quality Measures Clearinghouse (NQMC)³²
- Association of Ambulance Chief Executives (AACE)³³
- Australian Commission for Safety and Quality in Health Care (ACSQHC)³⁴
- Australian Government Productivity Commission³⁵
- Care Quality Commission (CQC)
- Council of Ambulance Authorities (CAA)
- International Association of Fire Fighters (IAFF)³⁶
- National Highway Traffic Safety Administration (NHTSA) Office of Emergency Medical Services (EMS)³⁷
- National Health Service (NHS) India

Study Screening and Selection:

Screening and selection for inclusion were conducted by two reviewers in accordance with the inclusion/exclusion criteria. Due to the large volume of initial search results, the second reviewer screened a random sample (20%) of all titles and abstracts. Full-text reviews were performed for all potential articles by both reviewers. Disagreements between the two reviewers were resolved through discussion and a third reviewer when required.

Data Extraction:
Charting tables were developed as part of the protocol for the review question and were amended during piloting. In the charting table for the review question, a generic QI framework consisting of Clinical and System/Organizational categories and relevant sub-categories, as well as the identified attributes of prehospital care quality, was compiled. These refinements resulted from the iterative review and charting process typically performed in scoping reviews.³⁸ Relevant data were extracted from the included articles and web-based sources to address the review question. For the review question, concept-related data extracted were the characteristics of the QIs. This included the origin, intended EMS system, method of development, and the Donabedian type. Each indicator was categorized by the scoping review authors into the QI framework (Clinical or System/Organizational category and sub-category), assigned to one or more of the identified prehospital care quality attributes, and classified according to Donabedian's model.
Presentation of Results:
Search results and article selections were summarized in flowcharts adapted from the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) flowchart developed by Moher et al.⁵⁶ Article characteristics, prehospital care quality attributes, and QI characteristics were summarized in tabular form showing counts and proportions. Bar charts were compiled to illustrate the distribution of prehospital care quality attributes and framework categories using Microsoft Excel for Mac 2016.
Review Question Selection:
The database searches identified a total of 10,359 potential records for review (Figure 1). An additional six records were found through other sources. After duplicates were removed, 7594 articles remained. Following title and abstract screening, 7540 records did not meet the inclusion criteria and were excluded. The full-text articles of the remaining 54 citations were read, and 24 were excluded due to not containing any QIs, being set in an irrelevant context, or being specific to an individual ambulance service. The search produced 30 articles for inclusion in the review.
Description of Articles:
All included articles aimed at producing QIs or quality measures, either exclusively or in part, for ambulance services providing prehospital care. Where only part of the indicators was intended for prehospital care, details of only those indicators were extracted. The predominant source of articles was the research literature (n = 23; 76.7% of included articles), and the most common method applied to develop QIs was a form of consensus process (n = 15; 50%) (Table 1). There was an increase in publications over time, with 20 (66.7%) articles being published since the year 2010. The most prevalent country of origin was the USA (n = 13; 43.3%). Three articles originated from Australia (10%). The majority of articles presented QIs that were developed for paramedic systems (n = 25; 83.3%).
Description of Quality Indicators:
A total of 526 QIs were identified in the review (median per article 12.5; interquartile range 6.3), ranging from one to 101 QIs per article. The majority (n = 436; 82.9%) of QIs originated from research literature identified in the database searches (Table 2). The remaining 90 (17.1%) were developed by government agencies (n = 69; 13.1%) and professional organizations or accrediting bodies (n = 21; 4%). Four hundred and nine QIs (77.8%) were developed by means of a consensus process. Literature, scoping, or systematic reviews were used for the development of 281 QIs (53.4%).

Table1:Characteristicsofarticlesthatinformthedevelopmentofprehospitalcarequalityindicatorsandtheirunderlyingframeworks(reviewquestion)

Characteristic	**No. (%) out of a total of 30 articles**
Literature Origin:	
Research Literature	23 (76.7)
Governmental	5 (16.7)
Professional Association / Accrediting body	2 (6.7)
Type of Research / Project:	
Consensus Method	15 (50)
Systematic / Scoping / Literature Review	5 (16.7)
Observational Cohort Study	4 (13.3)
Retrospective Case Series / Audit	3 (10)

Table 1. (Continued)

Characteristic	**No. (%) out of a total of 30 articles**
Not Reported	3 (10)
Year of Publication	
2000 – 2004	3 (10)
2005 – 2009	7 (23.3)
2010 – 2014	11 (36.7)
2015 - 2017	9 (30)
Country of Origin:	
USA	13 (43.3)
Canada	4 (13.3)
England	4 (13.3)
Australia	3 (10)
Netherlands	2 (6.7)
Denmark	1 (3.3)
Ireland	1 (3.3)
Israel	1 (3.3)
Norway	1 (3.3)
EMS System	
Paramedic	25 (83.3)
Physician	5 (16.7)

Percentages may not total 100 due to rounding.

Table 2: Characteristic of Quality Indicators

Characteristic	No. (%) out of a total of 526QIs
Literature Origin:	
Research Literature	436 (82.9)
Governmental	69 (13.1)
Professional Association / Accrediting body	21 (4)
Indicator Development Method:	
Consensus Process	409 (77.8)
Systematic / Scoping / Literature Review	281 (53.4)
Guidelines-based	45 (8.6)
Case Audit	20 (3.8)
Unclear / Not Reported	38 (7.2)
EMS System:	
Paramedic	464 (88.2)
Physician	62 (11.8)

Table 2: Continued

Characteristic	No. (%) out of a total of 526QIs
Framework Component:	
Clinical QIs:	283 (53.8)
Airway Management and Oxygenation	27 (5.1)
Asthma	23 (4.4)
Acute Coronary Syndrome	36 (6.8)
Out of Hospital Cardiac Arrest	57 (10.8)
Pain Management	17 (3.2)
Seizures	11 (2.1)
Stroke	27 (5.1)
Trauma	35 (6.7)
Hyperglycemia	11 (2.1)
General	27 (5.1)
Other Disease – Specific	12 (2.3)
System / Organizational QIs:	243 (46.2)
Communication / Dispatch	7 (1.3)
Documentation	12 (2.3)
Education	3 (0.6)
Financial	2 (0.4)
Hospital Notification	11 (2.1)
Paramedic Health and Safety	10 (1.9)
Patient Safety	14 (2.7)
Patient Satisfaction	11 (2.1)
Personal Performance Evaluation	11 (2.1)
Research	1 (0.2)
Resources / Deployment	66 (12.5)
Time Intervals	75 (14.3)

Other	20 (3.8)
Prehospital Care Quality Attributes	
Acceptability	11 (2.1)
Accessibility	124 (23.6)
Appropriateness	250 (47.5)
Availability	48 (9.1)
Caring	33 (6.3)
Capability	35 (6.7)
Clinical Effectiveness	174 (33.1)
Continuity / Sustainability	15 (2.9)
Cost – Effectiveness	12 (2.3)
Efficiency	11 (2.1)
Equitability	36 (6.8)
Interpersonal Effectiveness	13 (2.5)

Table 2: Continued

Characteristic	**No. (%) out of a total of 526QIs**
Patient - Centeredness	34 (6.5)
Responsiveness	32 (6.8)
Safety	36 (6.8)
Timeliness	86 (16.3)
Well-Led	24 (4.6)
Reported Donabedian Type	
Structure	49 (9.3)
Process	268 (51)
Outcome	57 (10.8)
Not Reported	154 (29.3
Assigned Donabedian Type	
Structure	63 (12)
Process	386 (73.4)
Outcome	77 (14.6)

[a]Percentagesmaynottotal 100duetorounding.

Categories are not mutually exclusive.
EMS, Emergency Medical Services; QI, Quality Indicator.

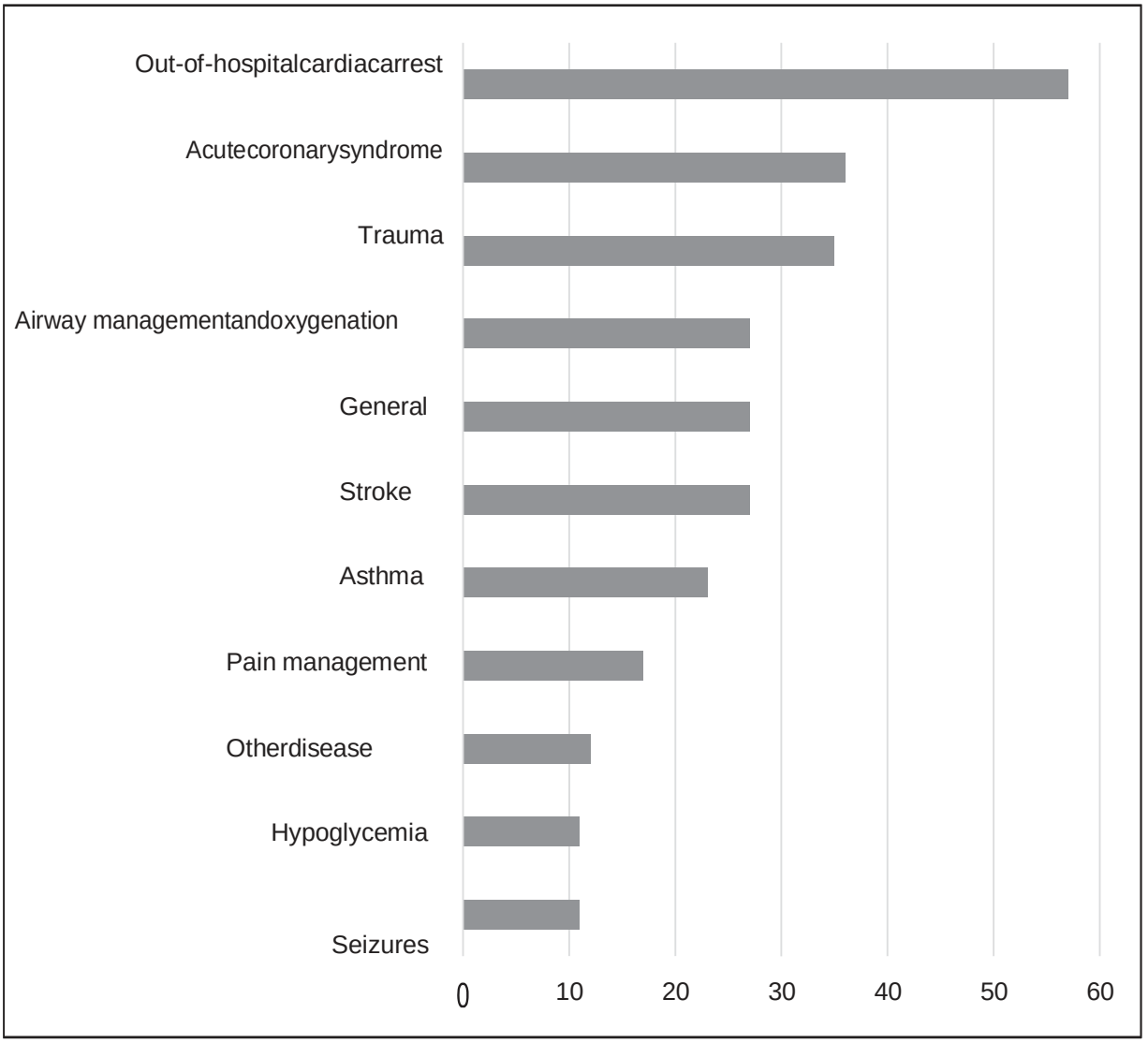

Figure 2: Distribution of quality indicators within the Clinical framework component (Total quality indicators n = 526, Clinical quality indicators n = 283)

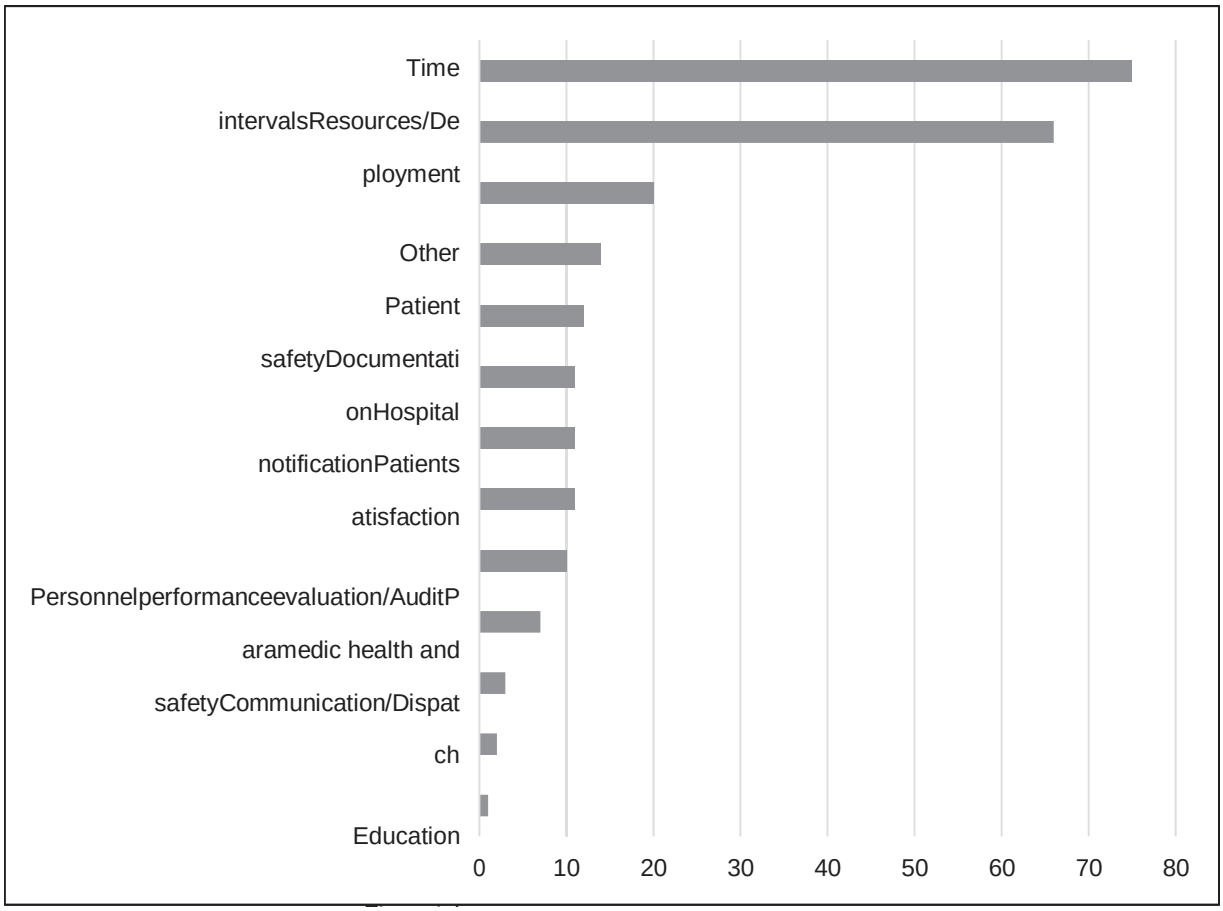

Figure 3: Distribution of quality indicators within the System/Organizational framework component (Total quality indicators n = 526, System/Organizational quality indicators n = 243)

Most QIs were developed in countries or for ambulance services with paramedic systems (n = 464; 88.2%). Among the 526 QIs, there was an almost even distribution between Clinical QIs (n = 283; 53.8%) and System/Organizational QIs (n = 243; 46.2%). Further distribution amongst the Clinical and System/Organizational sub-categories is detailed in Table 2 and illustrated in Figures 2 and 3. The Clinical conditions for which most QIs were developed were Out-of-hospital cardiac arrest (n = 57; 10.8%), acute coronary syndrome (n = 36; 6.8%), and Trauma (n = 35, 6.7%).

Within the System/Organizational category, the most frequent sub-categories were Time intervals (n = 75; 14.3%), Resources/Deployment (n = 66; 12.5%), and other (n = 20; 3.8%), which comprised many low-acuity transport and referral aspects. The most commonly addressed prehospital care quality attribute was Appropriateness (n = 250; 47.5%). This was followed by Clinical effectiveness (n = 174; 33.1%) and Accessibility (n = 124; 23.6%). Figure 4 shows the distribution of prehospital care quality attributes amongst the QIs. The Donabedian type was reported for 372 QIs (71.1%). Two QIs were classified as both Structure and Process indicators. The remaining 154 QIs (29.3%) were assigned a Donabedian type by the scoping review authors. Ultimately, QIs assessing a Process were the predominant type (n = 386; 73.4%). When bundled

into an Access dimension (Availability, Accessibility, and Timeliness) and an Effectiveness dimension (Appropriateness, Clinical effectiveness, Interpersonal effectiveness), the number of QIs from the research literature (n = 436) which addressed at least one of the attributes within the Access dimension was 109 (25%), and the number of QIs which addressed at least one of the attributes within the Effectiveness dimension was 260 (59.6%). For QIs stemming from government agencies (n = 69), these numbers were 26 (37.7%) and 41 (59.4%), respectively. For QIs developed by professional organizations or accrediting bodies (n = 21), they were five (23.8%) and seven (30%). This is illustrated in Figure 5.

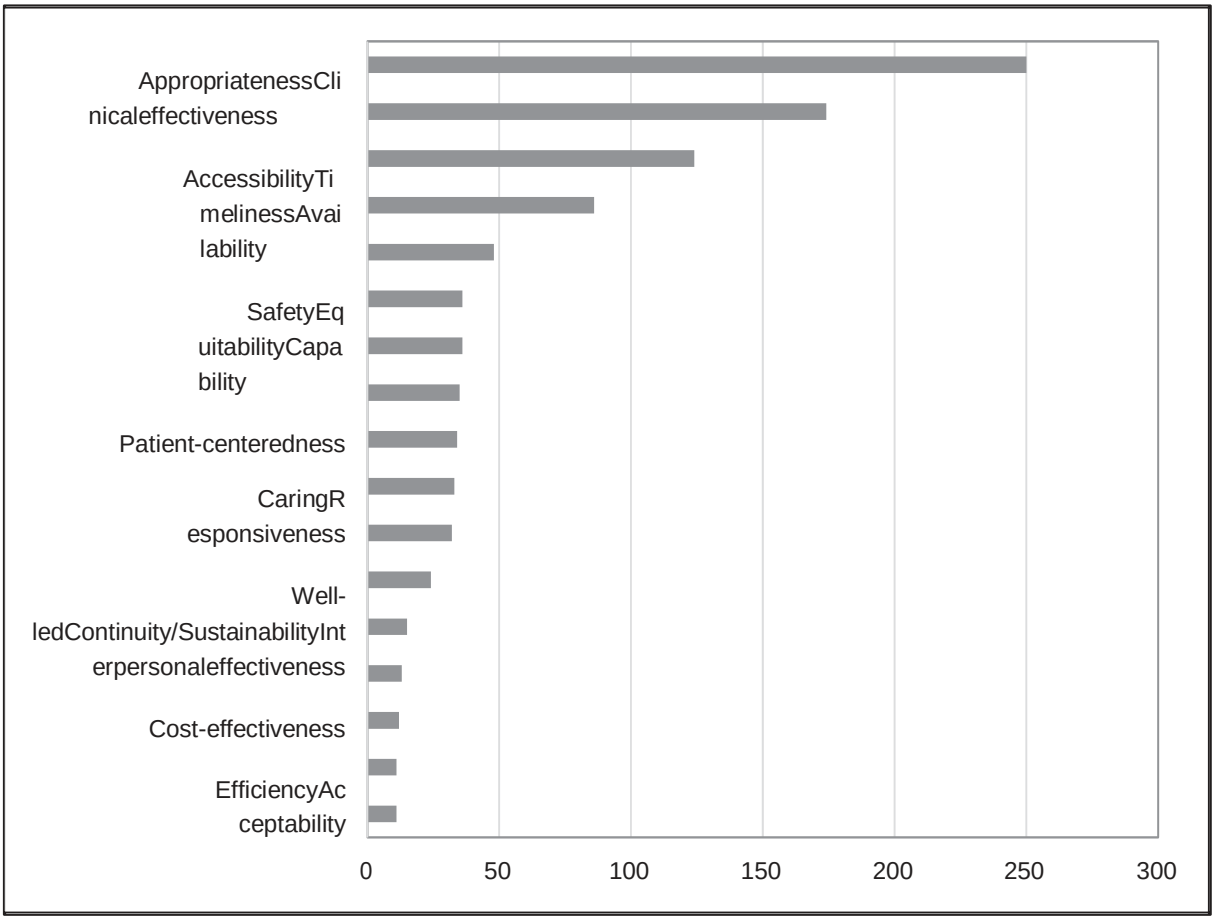

Figure 4: Distribution of quality indicators amongst prehospital care quality attributes (Total quality indicators n = 526, categories are not mutually exclusive)

QI: Quality Indicator
Figure 5: Percentage of quality indicators under Access, Effectiveness, and Other dimensions (research literature n = 436, government agencies n = 69, and professional organizations/accrediting bodies n = 21)
As detailed in the protocol for the review,²⁹ the authors had intended to present a table combining duplicate QIs and showing frequency counts. However, due to significant heterogeneity amongst the QIs, this synthesis was deemed infeasible.
Discussion:

This review identified and examined the literature on indicators used to measure prehospital care quality. Given that the development of meaningful QIs requires a clear understanding of how quality is being defined, the first part of the review addressed attributes of prehospital care quality. It has been argued that the characteristics of prehospital care quality should be no different from those of healthcare quality in other parts of the system.⁴⁰ When compared to attributes of quality in performance frameworks of wider healthcare systems internationally,⁴¹ none of the attributes identified in this review which were specifically described as prehospital care quality attributes can be considered exclusive to this context. Thus, it could be said that as a component of healthcare, prehospital care has common attributes with generic definitions of healthcare quality. The prehospital setting, however, is different and unique in many ways. Ambulance services deal predominantly with urgent and emergency calls, either real or perceived, and are often required to provide coverage for communities spread over large geographical areas. Prehospital care practitioners frequently work in austere environments and with relatively limited resources. Besides being responsible for initial access to the healthcare system, in most cases, ambulance services need to provide transport and facilitate further access to appropriate healthcare services. Although the search results indicate a significant scarcity of research that defines quality in this specific context, the findings suggest that timely access to appropriate, safe, and effective care, which is responsive to patients' needs and efficient and equitable to populations, are the key quality attributes in the prehospital context. These key attributes, or dimensions encompassing them, may be mapped to a routine prehospital care pathway.⁴² Furthermore, they should be addressed in prehospital care quality indicator frameworks to facilitate holistic performance measurements and quality improvement. Campbell et al.²⁴ and Owen⁴² developed such frameworks for general healthcare and prehospital care, respectively. The frameworks were created by combining the dimensions of quality (access and effectiveness) with Donabedian's structure, process, and outcomes model. Integrating the key attributes of prehospital care quality identified in this scoping review into such frameworks may provide useful models for QI developers and ultimately ambulance services endeavoring to systematically evaluate the quality of their care.

The increase in publications on prehospital care QIs in recent years confirms that, at least in the research community, there is a growing interest in the measurement of quality in this context. Considering the relative paucity of QIs available from governments and professional organizations or accrediting bodies, the evidently increasing capacity to develop QIs using systematic, evidence-based methods could be seen as an opportunity for ambulance services or professional associations to collaborate with academic institutions.

The majority of QIs identified in this review were developed in English-speaking countries and for paramedic systems. However, these findings are likely to have been influenced by the language restrictions in the database searches. Paramedic systems, as opposed to physician systems, are the more common EMS model found in English-speaking countries.^{43, 44} Ideally, the content of a QI should be based on clinical evidence. However, in healthcare disciplines with a limited clinical evidence base, such as paramedicine, QIs may need to be developed using available clinical evidence alongside expert judgment.⁴⁵ It is therefore unsurprising that consensus processes were the most frequent method being applied in the development of QIs.

Whilst several consensus methods exist, the RAND/UCLA Appropriateness Method (RAM), developed by the Research and Development (RAND) Corporation in collaboration with the

University of California, Los Angeles (UCLA),⁴⁶ is the only method combining available evidence with expert opinion. Originally designed to investigate expert consensus on the appropriateness of medical interventions, RAM is a validated method to develop quality indicators,^{45, 47, 48} including those specific to prehospital care.

There was reasonable balance overall between QIs categorized as Clinical and those categorized as System/Organizational. However, within the Clinical category, there was a strong focus on Out-of-hospital cardiac arrest, and within the System/Organizational component, the most frequent sub-category was Time intervals. Although these QIs address vital aspects of care for small cohorts of time-critical patients, the results suggest that even in the new millennium, these indicators continue to dominate what is meant to be holistic and balanced prehospital care quality measurement.

The attributes of prehospital care quality which were addressed most frequently by the QIs appeared to correspond somewhat with the key attributes identified in the first part of the review. The exception to this was Efficiency, which was included in seven (77.8%) articles describing prehospital care quality but addressed by only 11 (2.1%) of all QIs. When bundled into Access (Accessibility, Availability, Timeliness) and Effectiveness (Appropriateness, Clinical effectiveness, Interpersonal effectiveness) dimensions, a comparison between the different QI origins suggests that professional organizations and accrediting bodies appeared to have relatively less focus on QIs addressing aspects of Effectiveness (Figure 5), strengthening the argument for more collaboration between academic and non-academic institutions.

Process was the most common Donabedian type amongst the QIs, both before and after the review authors assigned a type. Considering the short patient contact time in prehospital care and the complexities of relating hospital-based outcome measures to preceding prehospital care, a prevalence of process QIs in this context can be expected. For these to be true QIs though, they need to relate to improved outcomes. A valid process indicator is one which previously has been demonstrated to produce a better outcome.²⁸ Similar principles apply to structural indicators for quality assessment in that the structural component needs to show an increased likelihood of resulting in a desirable outcome or related process.²⁸ An assessment of the underlying evidence and validation of the QIs was beyond the scope of this review. Considering the historical perspectives of quality measurement in prehospital care, there is a need for research appraising the validity of prehospital care QIs.

These reviews are subject to the limitations of any review. The search may not have been exhaustive due to date range settings and language restrictions. This may be especially true for data originating from physician EMS systems (Franco-German system), which are more likely to be published in languages other than English. Being a review, no rating of the quality of evidence was performed.

Conclusion:

There is a paucity of research reviewing how prehospital care quality is defined or which generic attributes of healthcare quality are perceived to be most important in prehospital care. Literature reviewed in this study suggests that high-quality prehospital care involves timely access to appropriate, safe, and effective care, which is responsive to patients' needs and efficient and equitable to populations. There is growing interest in how prehospital care quality can be measured. Considering the limited evidence base of paramedicine, the prevalence of consensus methods being used in the development of QIs, and the advances of the profession, there is a need for validation of existing QIs and scientifically rigorous de novo QI development.

Bibliography

O'Meara PF, Tourle V, Stirling C, Walker J, Pedler D. Extending the paramedic role in rural Australia: A story of flexibility and innovation. *Rural and Remote Health* 2012;12(2):1978.

Cooper SJ, Grant J. New and emerging roles in out-of-hospital emergency care: A review of the international literature. *International Emergency Nursing* 2009;17(2):90–8.

O'Meara P, Grbich C. *Paramedics in Australia*. Frenchs Forest, NSW: Pearson Education Australia; 2009.

Woollard M. The role of the paramedic practitioner in the UK. *Journal of Emergency Primary Health Care* 2006;4(1):1–9.

Trevithick S, Flabouris A, Tall G, Webber CF. International EMS systems: New South Wales, Australia. *Resuscitation* 2003;59(2):165–70.

Callaham M. Quantifying the scanty science of prehospital emergency care. *Annals of Emergency Medicine* 1997;30(6):785–90.

Dunford J, Domeier RM, Blackwell T, Mears G, Overton J, Rivera-Rivera EJ, et al. Performance Measurements in Emergency Medical Services. *Prehospital Emergency Care* 2002;6(1):92–8.

Tippett V, Clark M, Woods S, FitzGerald G. Towards a national research agenda for the ambulance and prehospital sector in Australia. *Journal of Emergency Primary Health Care* 2003;1(1):Tippett.

MacFarlane C. The advances and evidence base for prehospital care. *Emergency Medicine Journal* 2003;20(2):114–5.

Myers JB, Slovis CM, Eckstein M, Goodloe JM, Isaacs SM, Loflin JR, et al. Evidence-based performance measures for emergency medical services systems: A model for expanded EMS benchmarking. *Prehospital Emergency Care* 2008;12(2):141–51.

Turner J. *Building the evidence base in pre-hospital urgent and emergency care: a review of research evidence and priorities for further research*. Sheffield: University of Sheffield Medical Care Research Unit; 2010.

Spaite D, Maio RF, Garrison H, Desmond J, Gregor M, Stiell I, et al. Emergency Medical Services Outcomes Project (EMSOP) II: Developing the Foundation and Conceptual Models for Out-of-Hospital Outcomes Research. *Annals of Emergency Medicine* 2001;37(6):657–63.

O'Meara P. A generic performance framework for ambulance services: an Australian health services perspective. *Australasian Journal of Paramedicine* 2005;3(3):1–13.

Moore L. Measuring quality and effectiveness of prehospital ems. *Prehospital Emergency Care* 1999;3(4):325–31.

Maio R, Garrison H, Spaite D, Desmond J, Gregor M, Cayten C, et al. Emergency Medical Services Outcomes Project I (EMSOP I): Prioritizing Conditions for Outcomes. *Annals of Emergency Medicine* 1999;33(4):423–32.

Studnek JR, Garvey L, Blackwell T, Vandeventer S, Ward SR. Association between prehospital time intervals and ST-elevation myocardial infarction system performance. *Circulation* 2010;122(15):1464–9.

Takahashi M, Kohsaka S, Miyata H, Yoshikawa T, Takagi A, Harada K, et al. Association between prehospital time interval and short-term outcome in acute heart failure patients. *Journal of Cardiac Failure* 2011;17(9):742–7.

Blanchard IE, Doig CJ, Hagel BE, Anton AR, Zygun DA, Kortbeek JB, et al. Emergency medical services response time and mortality in an urban setting. *Prehospital Emergency Care* 2012;16(1):142–51.

Pons PT, Haukoos JS, Bludworth W, Cribley T, Pons KA, Markovchick VJ. Paramedic response time: Does it affect patient survival? *Academic Emergency Medicine* 2005;12(7):594–600.

Donabedian A. The quality of care: How can it be assessed? *JAMA* 1988;260(12):1743–8.

Deming WE. *Out of the Crisis*. Cambridge, MA: Massachusetts Institute of Technology; 1986.

Donabedian A. Evaluating the quality of medical care. *Milbank Memorial Fund Quarterly* 1966;44(3):166–206.

Blumenthal D. Quality of health care—part 1: Quality of care—What is it? *New England Journal of Medicine* 1996;335(12):891–4.

Campbell S, Roland M, Buetow S. Defining quality of care. *Social Science & Medicine* 2000;51(11):1611–25.

Cooperberg MR, Birkmeyer JD, Litwin MS. Defining high quality healthcare. *Urology Oncology: Seminars and Original Investigations* 2009;27(4):411–6.

Australian Institute for Health and Welfare. *Definitions of safety and quality of healthcare* [Internet]. 2016 [cited 2016 Feb 23]. Available from: http://www.aihw.gov.au/sqhc-definitions/.

Rubin HR, Pronovost P, Diette GB. From a process of care to a measure: The development and testing of a quality indicator. *International Journal for Quality in Health Care* 2001;13(6):489–96.

Mainz J. Defining and classifying clinical indicators for quality improvement. *International Journal*[1] *for Quality in Health Care* 2003;15(156):523–30.

Pap R, Lockwood C, Stephenson M, Simpson P. Indicators to measure pre-hospital care quality: a scoping review protocol. *JBI Database of Systematic Reviews and Implementation Reports* 2017;15(6):1537–42.

Aromataris E, Munn Z, editors. *The Joanna Briggs Institute Reviewer's Manual* [Internet]. The Joanna Briggs Institute; 2017. Available from: https://reviewersmanual.joannabriggs.org/.

Sollecito WA, Johnson JK. *McLaughlin and Kaluzny's Continuous Quality Improvement in Health Care*. 4th ed. Burlington, MA: Jones & Bartlett Learning; 2013.

Agency for Healthcare Research and Quality - National Quality Measures Clearinghouse. NQMC website [Internet]. [cited 2017 Apr 16]. Available from: https://www.quality-measures.ahrq.gov/.

Association of Ambulance Chief Executives. AACE website [Internet]. [cited 2017 Apr 16]. Available from: https://aace.org.uk/.

Australian Commission for Safety and Quality in Health Care. ACSQHC website.

Australian Government Productivity Commission. PC website [Internet]. [cited 2017 Apr 17]. Available from: https://www.pc.gov.au/.

International Association of Fire Fighters. IAFF website [Internet]. [cited 2017 Apr 16]. Available from: http://client.prod.iaff.org/.

National Highway Traffic Safety Administration's Office of Emergency Medical Services. NHTSA's Office of EMS website [Internet]. [cited 2017 Apr 16]. Available from: https://www.ems.gov/.

Peters M, Godfrey C, McInerney P, Baldini Soares C, Khalil H, Parker D. Chapter 11: Scoping Reviews. In: Aromataris, E., Munn, Z., editors. *Joanna Briggs Institute Reviewer's Manual* [Internet]. 2017. Available from: https://reviewersmanual.joannabriggs.org/.

Moher D, Liberati A, Tetzlaff J, Altman DG, Altman D, Antes G, et al. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *BMJ* [Internet] 2009;6(7):339;b2535. Available from: https://doi.org/10.1136/bmj.b2535.

Pirrallo R, Forster R, Swor R. Reconciling the Pursuit of Excellence: Essentials of a Quality EMS Organisation. In: *Improving Quality in EMS*. Dubuque: Kendall/Hunt; 2005.

Braithwaite J, Hibbert P, Blakely B, Plumb J, Hannaford N, Long JC, et al. Health system frameworks and performance indicators in eight countries: A comparative international analysis. *SAGE Open Medicine* 2017;5:1–10.

Owen RC. The development and testing of indicators of prehospital care quality [dissertation]. Manchester: University of Manchester; 2010;340p.

Roudsari BS, Nathens AB, Arreola-Risa C, Cameron P, Civil I, Grigoriou G, et al. Emergency Medical Service (EMS) systems in developed and developing countries. *Injury* 2007;38(9):1001–13.

Dick WF. Anglo-American vs. Franco-German emergency medical services system. *Prehospital and Disaster Medicine* 2003;18(1):29–35; discussion.

Campbell SM, Braspenning J, Hutchinson A, Marshall M. Research methods used in developing and applying quality indicators in primary care. *BMJ* 2003;326(7393):816–9.

Fitch K, Bernstein SJJ, Aguilar MDD, Burnand B, La Calle JRR, Lazaro P, et al. *The RAND/UCLA Appropriateness Method User's Manual* [Internet]. Transformation. 2001. 109p. Available from: http://www.rand.org.

Campbell S, Kontopantelis E, Hannon K, Burke M, Barber A, Lester H. Framework and indicator testing protocol for developing and piloting quality indicators for the UK quality and outcomes framework. *BMC Family Practice* [Internet] BioMed Central Ltd 2011;12(1):85. Available from: http://www.bio-medcentral.com/1471-2296/12/85.

Kötter T, Blozik E, Scherer M. Methods for the guideline-based development of quality indicators – a systematic review. *Implementation Science* 2012;7(1):21.