



Many of Quality Indicators for Prehospital Emergency Care's Evaluation; A Vast Topics for the Future of Emergency Medical Services (EMS): An Analytical Review

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Abstract :

The purpose of this analytical review was to trace, examine and describe the analysis of scope on indicators used to evaluate quality of prehospital care. The performance of ambulance services and quality of prehospital care has traditionally been measured using simple indicators, such as response time intervals, based on low-level evidence. 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 growing interest in analysis new and more significant ways to evaluate quality of prehospital care.

This analytical review examined the concepts of prehospital care quality and QIs developed for ambulance services. This analytical review considered primary and secondary research in any paradigm and utilizing any methods, as well as text and opinion.

Keywords :

Ambulance; emergency medical services; healthcare quality assessment; prehospital care; quality indicators



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ABSTRACT

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This analytical review examined the concepts of prehospital care quality and QIs developed for ambulance services. This analytical review considered primary and secondary research in any paradigm and utilizing any methods, as well as text and opinion.

Joanna Briggs Institute methodology for conducting scoping and analytical reviews was employed. Separate searches were conducted for two review questions; review question 1 addressed the definition of prehospital care quality and review question 2 addressed 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 April, 2017. Non-English articles were excluded. To supplement the above, searches for gray literature were performed, experts in the field of study were consulted and applicable websites were perused.

Review question 1: Nine articles were included. These originated mostly from England (n¼ 3, 33.3%) and the USA (n¼ 3, 33.3%). Only one study specifically aimed at defining prehospital care quality. Five articles (55.5%) described attributes specific to prehospital care quality and four(44.4%) articles considered generic healthcare quality attributes to be applicable to the prehospital context. A total of 17 attributes were identified. The most common attributes were Clinical effectiveness (n¼ 17, 100%), Efficiency (n¼ 7, 77.8%), Equitability (n¼ 7, 77.8%) and Safety (n¼ 6, 66.7%). Timeliness and Accessibility were referred to by four and three (44.4% and 33.3%) articles, respectively.

Review question2: Thirty articles were included. The predominant source of articles was research literature (n¼ 23; 76.7%) originating mostly from the USA (n¼ 13; 43.3%). The most frequently applied QI development method was a form of consensus process (n¼ 15; 50%). A total of 526 QIs were identified. Of these, 283 (53.8%) were categorized as Clinical and 243 (46.2%) as System/Organizational QIs. Within these categories respectively, QIs related to Out-of- hospital cardiac arrest (n¼ 57; 10.8%) and Time intervals (n¼ 75; 14.3%) contributed the most. The most commonly addressed prehospital care quality attributes were Appropriateness (n¼ 250, 47.5%), Clinical effectiveness (n¼ 174, 33.1%) and Accessibility (n¼ 124, 23.6%). Most QIs were process indicators (n¼ 386, 73.4%).

Historically, the quality and performance of prehospital emergency care (PEC) has been assessed largely based on surrogate, non-clinical end points such as response time intervals or other crude measures of care (eg, stakeholder satisfaction). However, advances in Emergency Medical Services (EMS) systems and services world-wide have seen their analytical scope and reach continue to expand. This has dictated that novel measures or evaluation of performance be implemented to compliment this growth. Significant

progress has been made in this area, largely in the form of the development of evidence-based quality indicators (QIs) of PEC.

Whilst there is paucity in research aiming to specifically define prehospital care quality, the attributes of generic healthcare quality definitions appear to be accepted and applicable to the prehospital context. There is growing interest in analysis and 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 includes all care that is provided by any service to a patient before they reach a hospital. For the purpose of this literature review, prehospital care is the care that ambulance services provide for patients with urgent or emergency care needs. It starts when someone calls the ambulance service and ends when the patient has been transported to hospital. In some cases, all the care a patient needs can be provided before being transported to hospital and there is no need to transport them. Historically, ambulance services were established to provide swift transport of the sick and injured to hospital. Timely and safe conveyance of patients with urgent and emergency care needs to an appropriate healthcare facility remains the central function of modern ambulance services. However, the scope of prehospital care and coverage that ambulance services provide has 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 how ambulance services integrate into the wider healthcare systems and increasing demand due to a range of factors, including an aging and growing population and the expanding burden of chronic disease. Despite this growth, the relatively new formation of the paramedicine profession and consequent lack of research capacity coupled with the complexities of conducting data collection in the prehospital emergency care setting have led to paucity of discipline-specific, scientific evidence.⁶⁻¹² Consequently, the performance and quality of ambulance services has traditionally been measured using naive indicators based on poor low-level evidence, e.g. response time intervals.^{7,9,13} These simple types of measures have dominated ambulance services' performance reports because they are easily obtained and readily understood by the public and policymakers alike.^{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 growing interest in finding 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 it is decided how it is to be defined. In the context of healthcare, the formulation of a definition has been a perpetual problem among healthcare managers and researchers.²¹⁻²⁶ This has led to two approaches in defining quality in healthcare – generic and disaggregated definitions.²⁴ Generic definitions are broad and all-encompassing, whereas disaggregated definitions recognize 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 the development of a balanced suite of QIs.^{27,28} The boundaries of each attribute may vary depending on how the attribute itself is defined. This can cause overlap which has led researchers to bundle or aggregate attributes with significant commonalities into dimensions. Campbell et al.³⁴ suggested there are 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 which provide a quantitative basis for clinicians, organizations and planners aiming to improve the processes by which patient care are provided and their outcomes.²⁸ Quality indicators can be classified in a range of different ways. Donabedian's approach of assessing the structures, processes and outcomes of medical care is widely accepted as the pre-eminent model for the measurement of quality 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.

The current analytical 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 revealed no results. It forms part of a wider research project, the Indian Prehospital care quality Indicator project (IPIRE), which aims to analyze, develop and test prehospital care QIs for the Indian setting.

Methods:

This analytical review employed Joanna Briggs Institute (JBI) methodology for conducting analytical and 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 find both published and unpublished studies. The two review questions, an initial limited search of PubMed and CINAHL was undertaken followed by analysis of the text words contained in the titles and abstracts, and of the index terms used to describe the articles. A second search for each review question using all identified keywords and index terms was then undertaken 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 in this analytical review due to this being the only language all reviewers understand, as well as time and budget constraints. The searches were limited to publications from January 1, 2000 to April 16, 2017 since more wide-spread application of quality improvement techniques, throughout all sectors of healthcare, has occurred in the 21st century.³¹ To supplement the above, searches for gray literature on ProQuest Dissertations and Theses, Open Thesis, Networked Digital Library of Thesis and Dissertations were performed. 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 Clearing-house (NQMC)³²

Association of Ambulance Chief Executives (AAACE)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 was conducted by two reviewers in accordance with the inclusion/exclusion criteria above. Due to the large volume of initial search results, the second reviewer was asked to screen a random sample (20%) of all titles and abstracts. Full-text reviews were done for all potential articles by both reviewers. Disagreements between the two reviewers were resolved through discussion and a third reviewer, when required.

Data Extraction:

Two charting tables were developed as part of the protocol; one for each of the two review questions. In the charting table for review question 1, the attribute categories were changed to “explicitly stated” and “extrapolated from generic healthcare definitions”. In the charting table for review question 2, a generic QI framework consisting of Clinical and System/Organizational categories and relevant sub-categories, as well as the analyzed attributes or prehospital care quality, was compiled. These refinements resulted from the iterative analytical 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 review question, concept-related data extracted review question 1 were definitions and/or attributes of prehospital care quality. Furthermore, the intended EMS system was recorded, and the attributes were categorized into those that were explicitly stated in the articles and those that were extrapolated from generic definitions of healthcare quality and reasoned to be applicable to prehospital care setting by the articles’ authors. For review question 2, concept-related data extracted were 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 analytical 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 distribution of prehospital care quality attributes and framework categories using Microsoft¹ Excel for Mac 2016.

Review Question 1**Selection:**

The database searches yielded 1301 citations in total (Figure 1). An additional 26 records were found through other sources. After duplicates were removed, 1185 citations remained. The titles and abstracts for these were screened, 1170 papers had irrelevant titles and/or abstracts and hence were excluded. The remaining 15 citations were considered for further detailed assessment of the full article and six were excluded as they did not meet the inclusion criteria, i.e. not prehospital care provided by ambulance services. The search yielded a total of nine articles for inclusion in the review.

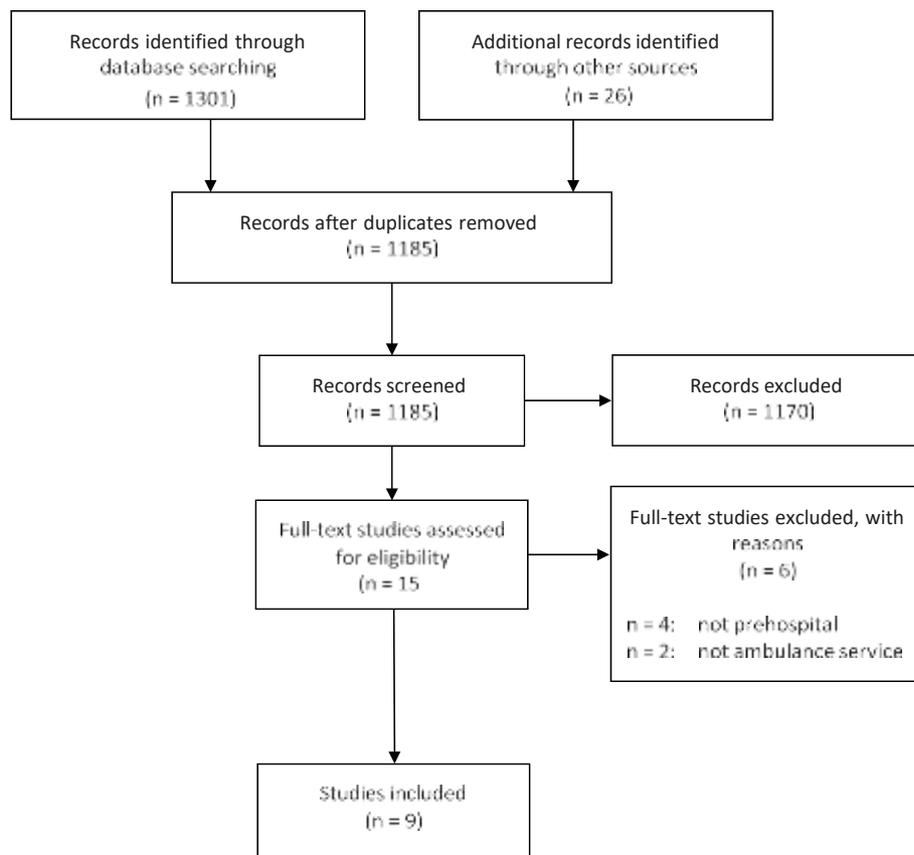


Figure 1: Search results and study selection and inclusion process for review question 1

Description of articles

Two (22.2%) articles stemmed from primary research studies (Table 1). The remaining seven were secondary research articles (n 4; 44.4%) and government/industry reports (n 3; 33.3%). Only one study (Owen⁴²) specifically aimed at defining pre-hospital care quality and its attributes. Haugland et al.⁴⁹ developed QIs for prehospital care and aligned these to attributes of quality taken from a generic healthcare quality definition. The two included literature reviews (O'Meara¹³; El Sayed⁵⁰) explored performance frameworks for ambulance services and referred to several framework dimensions or quality attributes, either specific to prehospital care or healthcare in general. Spaitetal.¹² proposed a conceptual model for prehospital care outcomes research. Outcome categories can provide a useful framework for measurement, analysis and hence attributes of prehospital care quality. Milner⁵¹ provided an opinion piece on improving ways to evaluate the quality of emergency services, including ambulance services. Lastly, a national ambulance services performance report,⁵² an ambulance service quality inspection framework,⁵³ and a report on the future of emergency medical services⁵⁴ were conceptually and contextually appropriate for inclusion. Proportionally, most articles were published after 2014 (n3; 33.3%) and originated from India (n 3; 33.3%). Two articles originated from India (22.2%). The majority (n 8; 88.9%) of articles referred to para-medical systems. Five articles (55.5%) described attributes to specifically define prehospital care quality and four (44.4%) articles considered attributes of healthcare quality in general as applicable to the prehospital context.

Table 1, Characteristics of articles (Review Question 1):

Characteristic	No. (%) out of a total of nine articles
Types of Research / Project	
Primary Research	2 (22.2)
Consensus Method	1 (11.1)
Mixed Qualitative Methods	1 (11.1)
Secondary Research	4 (44.4)
Literature / Systemic Review	2 (22.2)
Editorial, Focus, Perspective, Commentary, other	2 (22.2)
Governmental Sources / Industry Report	3 (33.3)
Year of Publication	
2000 – 2004	2 (22.2)
2005 – 2009	2 (22.2)
2010 – 2014	2 (22.2)
2015 – 2017	3 (33.3)
Country of Origin:	
England	3 (33.3)
USA	3 (33.3)
Australia	2 (22.2)
Norway	1 (11.1)
International	1 (11.1)
EMS System	
Paramedic	8 (88.9)
Physician	1 (11.1)
Attributes of Prehospital Care Quality:	
Explicitly Stated	5 (55.5)

^aPercentages may not total 100 due to rounding.

^bCategories are not mutually exclusive.

EMS, emergency medical services.

Descriptions of prehospital care quality attributes:

A total of 17 attributes of prehospital care quality were analyzed via the article review ranging from two to nine attributes per article (Table 2). All articles referred to Clinical effectiveness. Other common attributes were Efficiency (n 7; 77.8%), Equitability (n 7; 77.8%) and Safety (n 6; 66.7%). Timeliness and Accessibility were referred to by four and three (44.4% and 33.3%) articles, respectively. Table 2 details which attributes were specifically described as those of prehospital care quality and which were extrapolated from generic healthcare quality definitions but considered applicable to the prehospital context by the articles' authors. The generic healthcare quality definitions the articles' authors referred to originated from the Institute of Medicine (IOM)⁵⁵ and Maxwell ⁵⁶.

Table 2: Attributes and Analysis of Prehospital Care Quality (Review Question 1)

Attribute	Owen 2010	O'Meara 2005	Spaite, et al., 2001	AGPC/CAA, 2016	CQC 2016	IOM 2006	El-Sayed 2012	Milner, et al., 2001	Haugland, et al., 2017	No. (%) Out of a total of nine articles
Clinical Effectiveness	√	√	√	√	√	√√	√√	√√	√√	9 (100)
Efficiency	√	√		√		√√	√√	√√	√√	7 (77.8)
Equitability	√	√		√		√√	√√	√√	√√	7 (77.8)
Safety		√		√	√	√√	√√		√√	6 (66.7)
Appropriateness	√	√		√				√√		4 (44.4)
Timeliness	√					√√	√√		√√	4 (44.4)
Accessibility	√	√		√						3 (33.3)
Patient Centeredness						√√	√√		√√	3 (33.3)
Responsiveness				√	√			√√		3 (33.3)
Acceptability		√						√√		2 (22.2)
Continuity/Sustainability		√		√						2 (22.2)
Availability	√									1 (11.1)
Capability		√								1 (11.1)
Caring					√					1 (11.1)
Cost Effectiveness			√							1 (11.1)
Interpersonal Effectiveness	√									1 (11.1)
Well-Led					√					1 (11.1)

√: specifically described as prehospital care quality attributes.

√√: extrapolated from generic health care quality attributes by the articles' authors

Review Question 2

Selection:

The database searches identified a total of 10,359 potential records for review (Figure 2). 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 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 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 3). There was an increase in publications over time with 20

(66.7%) articles being published since the year 2010. The 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 ¼ 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 4). 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%).

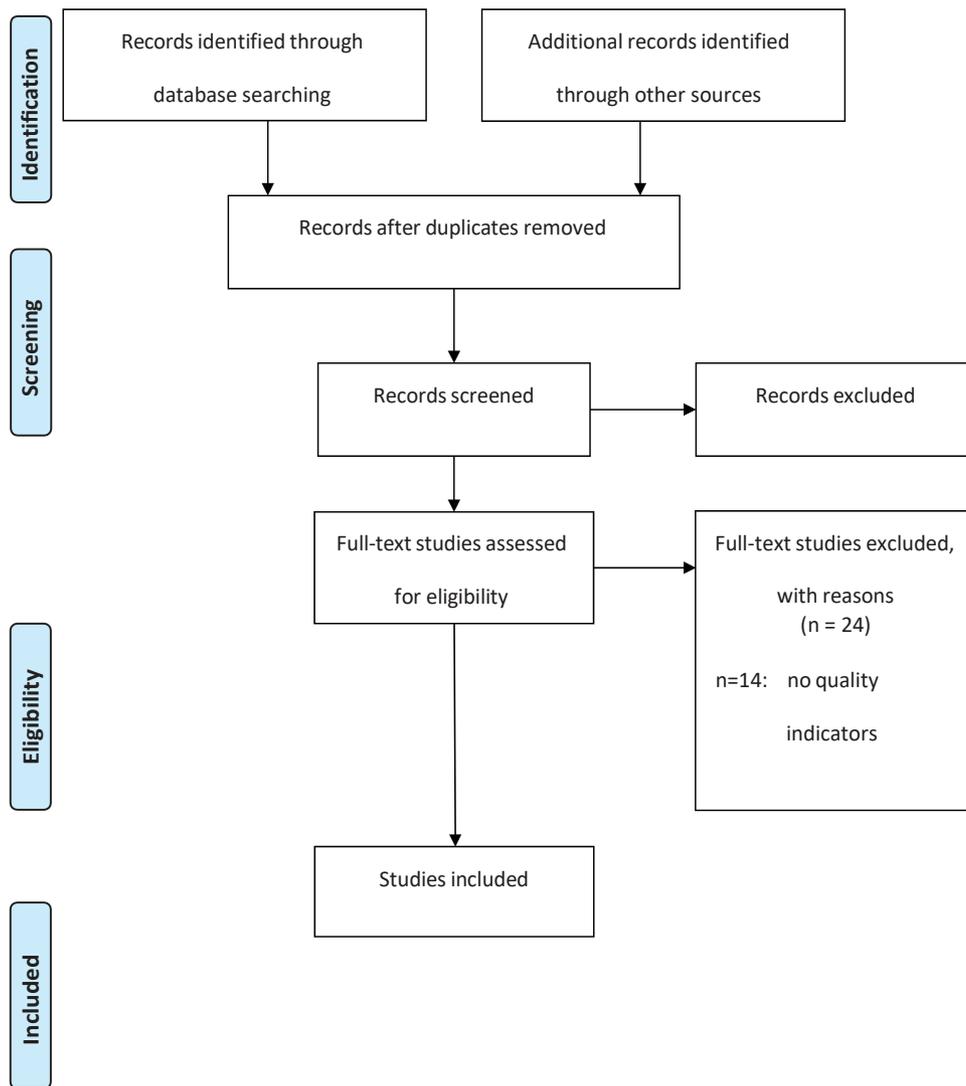


Figure 2: Search results and study selection and inclusion process for review question

Table 3: Characteristics of articles that inform the development of prehospital care quality indicators and their underlying frameworks (review question)

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 3. (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 4: Characteristic of Quality Indicators

Characteristic	No. (%) out of a total of 526 QIs
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 4: Continued

Characteristic	No. (%) out of a total of 526 QIs
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 4: Continued

Characteristic	No. (%) out of a total of 526 QIs
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)

^aPercentages may not total 100 due to rounding.

^bCategories are not mutually exclusive.

EMS, emergency Medical Services; QI, quality indicator.

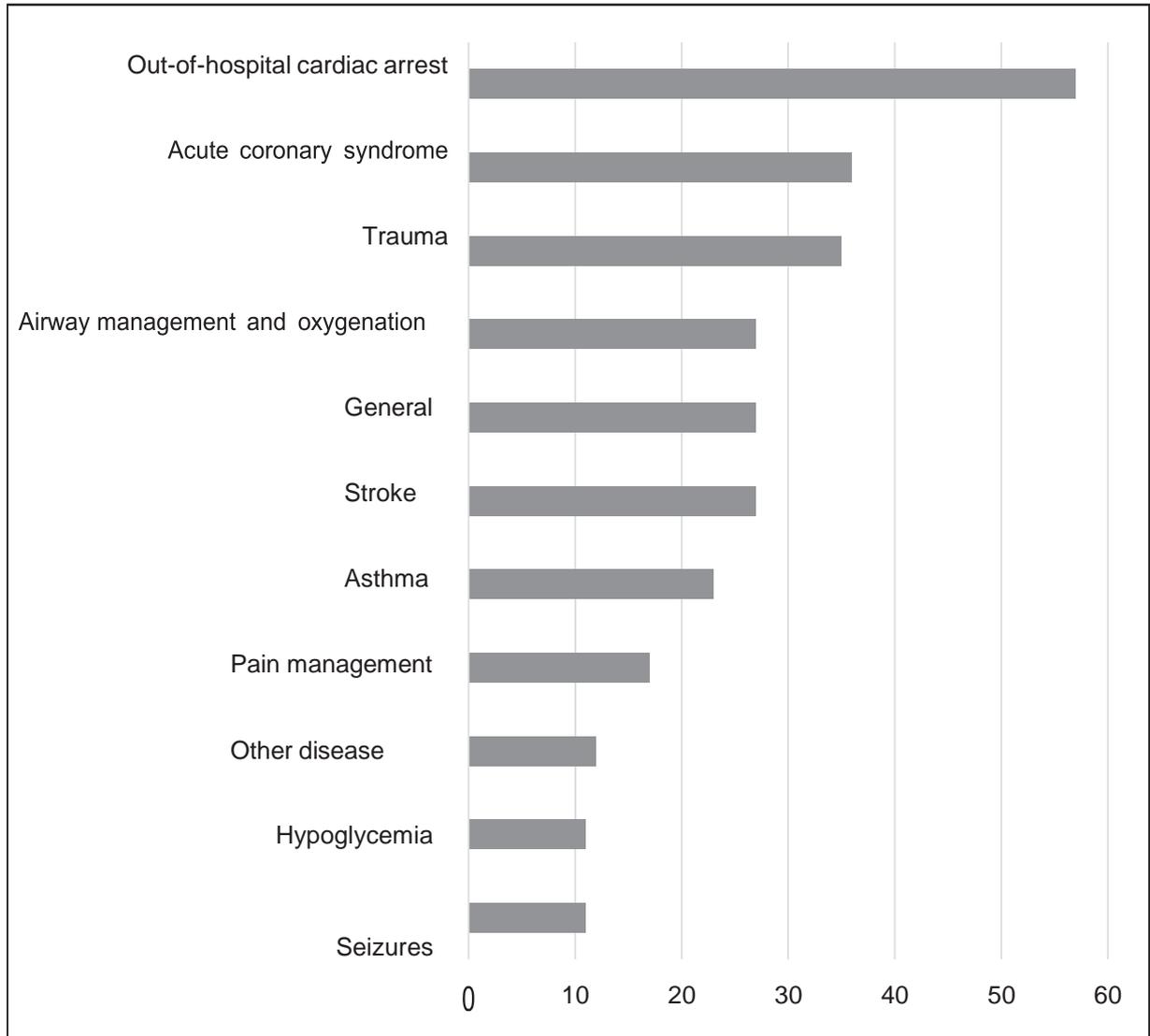


Figure 3: Distribution of quality indicators within the *Clinical* framework component (total quality indicators n¼526, *Clinical* quality indicators n¼283)

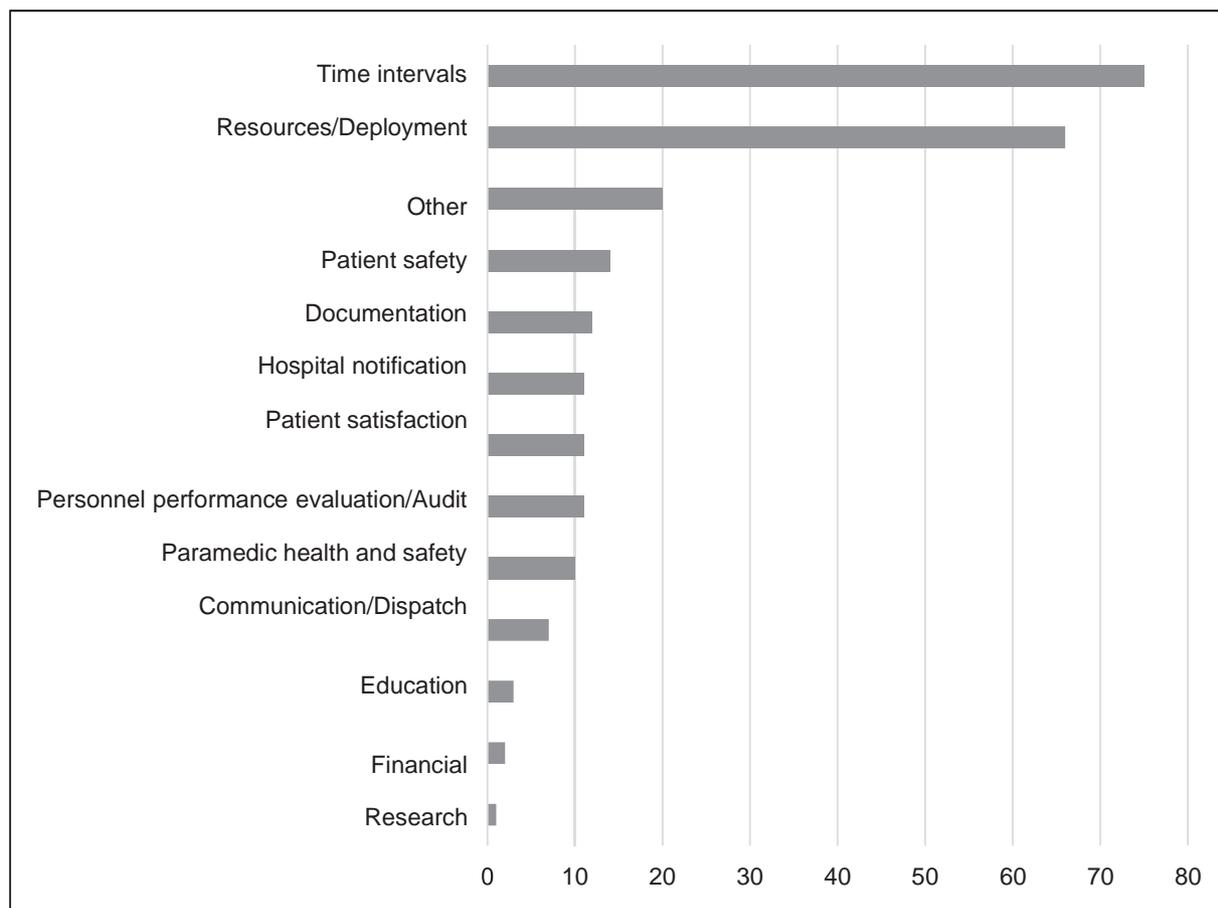


Figure 4: Distribution of quality indicators within the *System/Organizational* framework component (total quality indicators n=526, *System/Organizational* quality indicators n=243)

Most QIs were developed in countries or for ambulance services with paramedic systems (n 464; 88.2%). Amongst 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 areas is detailed in Table 4 and illustrated in Figures 3 and 4. 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 analysis, the most frequent sub-categories or analysis 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 5 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 6.

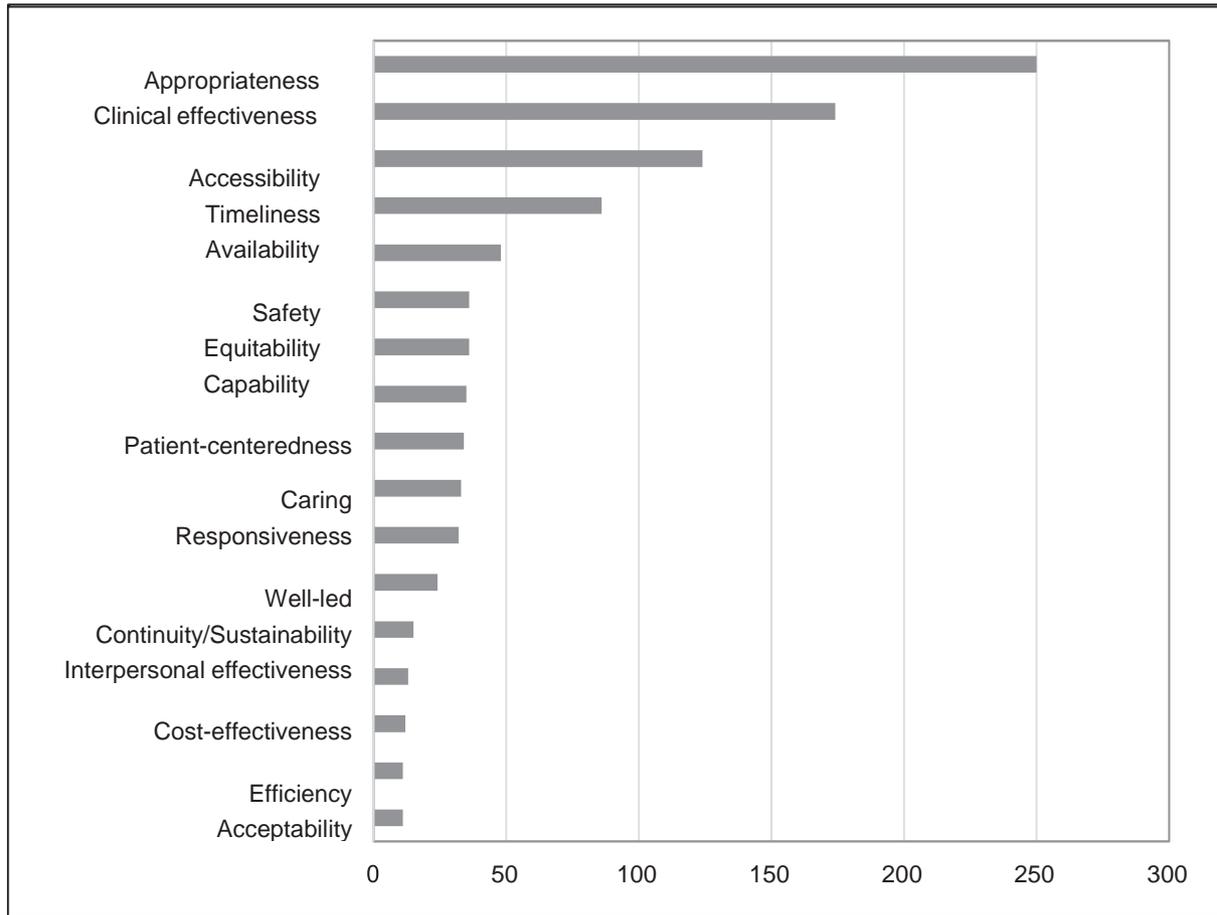


Figure 5: Distribution of quality indicators amongst prehospital care quality attributes (total quality indicators n=4526, categories are not mutually exclusive)

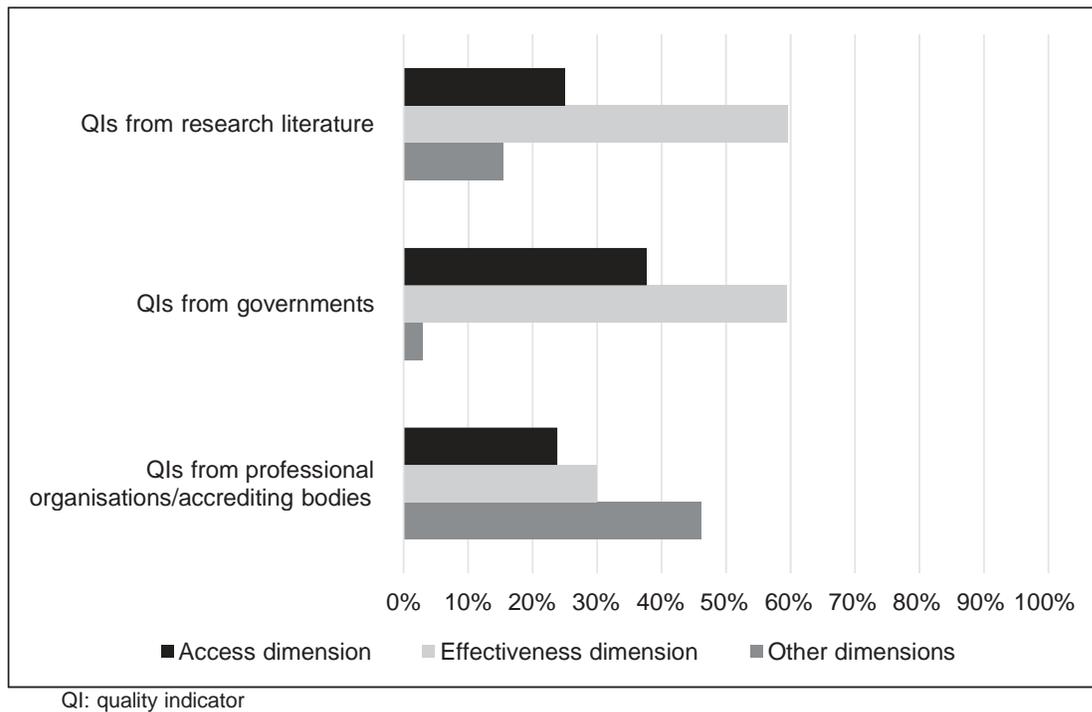


Figure 6: Percentage of quality indicators under Access, Effectiveness and Other dimensions (research literature n=436, government agencies n=69 and professional organizations/accrediting bodies n=21)

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 analytical review identified and examined the literature on indicators to measure prehospital care quality. Given that the development of meaningful QIs requires 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 characteristics of prehospital care quality should be no different to 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 often are 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 health-care

services. Although the search results indicate significant scarcity of research that defines quality in this specific context, the findings and analysis 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 analytical scoping review to 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 vast and growing future interest in 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 health-care disciplines with a limited clinical evidence base, such as paramedicine, QIs may need to be developed using available clinical evidence alongside expert judgement.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 analytical 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, Timelines) 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 6), 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 analytical 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 increased like-lihood of resulting in a desirable outcome or related process.²⁸ An assessment of the underlying evidence and validation of the QIs was beyond the analytical 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 analytical 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 analytical review how prehospital care quality is defined or which generic attributes of healthcare quality are perceived to be most important in prehospital care. Analytical 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 vast and growing future 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 future QI development.

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