

# Evolution of the Literature Identifying Physicians' Roles in Leadership, Clinical Development, and Practice of the Subspecialty of Emergency Medical Services

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## Presentation

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## Abbreviations:

EMS = emergency medical services  
 MeSH = Medical Subject Heading

## Abstract

**Purpose:** The 2007 Institute of Medicine report entitled *Emergency Medical Services at the Crossroads* identified a need for the establishment of physician subspecialty certification in emergency medical services (EMS). The purpose of this study was to identify and explore the evolution of publications that define the role of the physician in EMS systems in the United States.

**Methods:** Three comprehensive searches were undertaken to identify articles that define the physician's role in the leadership, clinical development, and practice of EMS. Independent reviewers then evaluated these articles to further determine whether the articles identified the physician's role in EMS. Then, identified articles were classified by the type of publication in order to evaluate the transition from a non-peer reviewed to peer-reviewed literature base and an analysis was performed on the differences in the growth between these two groups. In addition, for the peer-reviewed articles, an analysis was performed to identify the proportion of articles that were quantitative versus qualitative in nature.

**Results:** The comprehensive review identified 1,504 articles. Ninety articles were excluded due to lack of relevance to the US. The remaining 1,414 articles were reviewed, and 194 papers that address the physician's role within EMS systems were identified; 72 additional articles were identified by hand search of references for a total of 266 articles. The percentage of peer-reviewed articles has increased steadily over the past three decades. In addition, the percentage of quantitative articles increased from the first decade to the second and third decades.

**Conclusions:** This comprehensive review demonstrates that over the past 30 years an evidence base addressing the role of the physician in EMS has developed. This evidence base has steadily evolved to include a greater proportion of peer-reviewed, quantitative literature.

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## Introduction

In 2007, the Institute of Medicine report *Emergency Medical Services at the Crossroads* included a formal recommendation to establish physician subspecialty certification in Emergency Medical Services (EMS).<sup>1</sup> This supported a similar call for subspecialization issued in the *EMS Agenda for the Future*<sup>2</sup> by the National Highway Traffic Safety Administration (NHTSA). To advance this process, in 2008, the National Association of EMS Physicians (NAEMSP) and the American College of Emergency Physicians (ACEP) supported a project to identify and quantify the scientific studies and publications that define the unique role of the physician in EMS.

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Definition of EMS	(Disaster Preparedness OR Disaster Response OR Public Emergency OR Pre-hospital Medicine OR Pre-hospital Emergency OR Disaster Medicine OR Transport Medicine OR Transport Medicine OR Aerospace Medicine [MeSH] OR Mountaineering OR Mass Casualty OR EMS OR Field Medicine OR Wilderness Medicine OR Terrorism OR Terrorist OR Natural Disaster OR Outdoors Medicine OR Outdoor Medicine OR Civil Defense [MeSH] OR Emergency Medical Technicians [MeSH] OR Emergency Medical Services [MeSH] OR Disaster Medicine [MeSH] OR Naval Medicine [MeSH] OR Tactical OR Chemical Warfare [MeSH])
EMS Physician Leader	Definition of EMS AND (Director OR Institutional Management Teams [MeSH] OR Physician's Role [MeSH] OR Physician Executives [MeSH])
EMS Clinical Science	Definition of EMS OR (Director OR Institutional Management Teams [MeSH] OR Physician's Role [MeSH] OR Physician Executives [MeSH]) AND (Knowledge [MeSH] OR Science [MeSH] OR Biomedical Research [MeSH] OR Medicine [MeSH] or Specialties, Medical [MeSH])
EMS Medical Practice	Definition of EMS OR (Director OR Institutional Management Teams [MeSH] OR Physician's Role [MeSH] OR Physician Executives [MeSH]) AND (Guideline [Publication Type] OR Practice Guidelines as Topic [MeSH] OR Clinical Medicine [MeSH] OR Specialism [MeSH])

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**Table 1**—Search strategies (EMS = emergency medical services)

The project was a component of an application submitted to the American Board of Medical Specialties (ABMS) to create a formal subspecialty certification in EMS. This application requires the demonstration of the scientific basis for the subspecialty.<sup>3</sup> In addition to the ABMS requirement, identifying the nature of the science supporting the subspecialty of EMS lends credibility to the position that EMS medicine is a unique clinical entity requiring specialized expertise.

While there are many elements to the scientific basis of a medical specialty, it was the goal of this project to specifically examine the direct participation of physicians in the practice of EMS medicine. It was felt that this was important so as to determine the extent to which physicians have been directly involved with the growth and development of EMS. This article describes this project and reports its findings.

## Methods

A comprehensive review based on literature identified through three expert searches executed by a professional clinical librarian was performed. The purpose of this review was to identify the literature that defines the physician's role in an EMS system.

### Search Strategy

Standard keywords and keyword phrases used by EMS practitioners and researchers that represent primary EMS concepts were identified by surveying the study authors, a group composed of six emergency physicians, a paramedic, and a clinical librarian. All six of the physicians are actively involved in EMS medical direction and/or EMS research. In every case where an appropriate Medical Subject Heading (MeSH) term exists, the librarian then identified the formal MeSH controlled

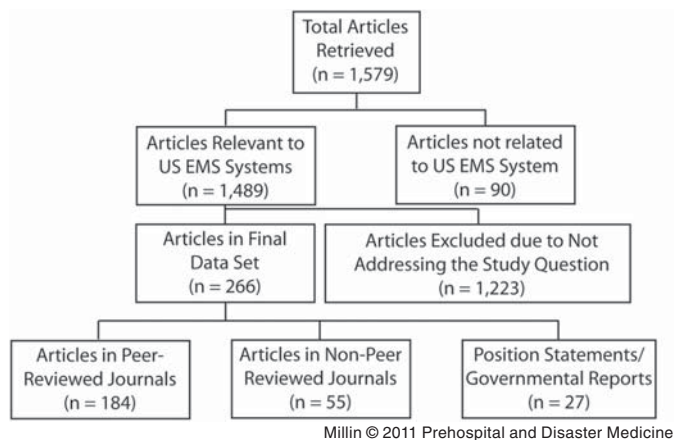
vocabulary terms used to index the literature representing each of these EMS concepts. Ultimately, a total of 27 search terms, including keywords and MeSH-controlled vocabulary terms were used to represent the conglomerate term "EMS" (Table 1). Within PubMed, these EMS keywords and MeSH terms were combined in three different search strategies to identify articles reporting the scientific evidence underpinning three aspects of the physician's role in EMS, specifically: (1) the physician as an EMS leader (Leader); (2) the physician's role in the clinical development of EMS (Clinical); and (3) the physician's role in the practice of EMS medicine (Practice) (Table 1). Although there was considerable overlap in the three search strategies, this approach was taken to ensure the broadest possible search covering all three of these aspects of the physician's role in EMS.

The searches for Leader, Clinical, and Practice were performed on 14 June 2008, 27 August 2008, and 26 June 2008, respectively. All years in the PubMed database, up to the dates of the searches were included in the study.

### Review Strategy

Two independent reviewers evaluated each citation in the three retrieved sets to identify and exclude any papers that actually did not address the role of the physician in the leadership, clinical development, and practice of EMS. Papers that were not relevant to the structure of EMS systems in the United States also were excluded, since EMS system design and the role of the physician within an EMS system may be different in the US compared with other countries. Any discrepancies between the two reviewers were resolved by the primary investigator.

After this initial screening, the references from the bibliographies of the articles retained were searched by hand by one



**Figure 1**—Flow of articles from initial search to final data sets (EMS = emergency medical services)

investigator to identify additional papers that met the inclusion criteria. Potential articles were reviewed by a second investigator with discrepancies resolved by a third investigator.

#### Classification Strategy

All of the articles identified for inclusion were placed into one of three final data sets: (1) citations published in peer-reviewed journals; (2) citations published in non-peer-reviewed journals; and (3) professional society position statements or governmental reports. The determination that a journal was peer-reviewed or non-peer-reviewed was made by referring to Ulrich's Periodicals Directory.<sup>4</sup> In cases for which it was not possible to determine if a journal was peer-reviewed or non-peer-reviewed using Ulrich, the publisher of the journal was contacted directly.

Subsequently, the three data sets were examined to determine changes in the amount of published articles within each set over time. Changes in the proportion of peer-reviewed versus non-peer reviewed articles were evaluated using the Chi-square test for linear-by-linear association, with articles analyzed in 10-year increments (1978–1987, 1988–1997, and 1998–2007). Since the review did not include the full year's worth of articles from 2008, that year was excluded from this analysis.

In regard to the peer-reviewed articles, an analysis was performed to identify the percentage of articles that were quantitative versus qualitative in nature. Articles were defined as quantitative if the authors used either descriptive or comparative statistical analysis in the paper. Articles were analyzed in 10-year increments (1978–1987, 1988–1997, and 1988–2007). As with the analysis on peer-reviewed versus non-peer-reviewed papers, articles from 2008 were not included in this analysis. Analysis to determine changes over time was done using Chi-square for linear-by-linear association.

#### Institutional Review

This study was determined by the Johns Hopkins University Institutional Review Board as not qualifying as human subjects research.

#### Results

The process of identifying and selecting articles for inclusion, from the initial search to the final three data sets, is diagrammed in Figure 1. A total of 1,504 articles were identified

via the three independent searches: 1,006 articles in the Leader set; 444 articles in the Clinical set; and 54 articles in the Practice set. Ninety of these articles were excluded because the articles clearly pertained to international EMS systems and were not relevant to EMS systems within the US (e.g., "The emergency medical system in Japan" and "Profile of the prehospital system in Madagascar"). Of the remaining 1,414 citations, (950 Leader, 411 Clinical, 53 Practice), 1,220 subsequently were identified for exclusion, with 194 unique papers addressing the physician's role within an EMS system retained for the review. Using the technique to calculate concordance in review as described by Sackett *et al*,<sup>5</sup> Kappa values for the inter-rater reliability for the three review subsets (Leader, Clinical, and Practice) were 0.240, 0.475, and 0.764, respectively. Hand searching the references of these 194 papers identified an additional 72 relevant articles, for a final data set of 266 unique papers.

In terms of the type of publication, 184 papers were published in peer-reviewed journals<sup>6–189</sup> (Appendix); 55 papers were published in non-peer-reviewed journals<sup>190–244</sup> (Table 2); and 27 were position statements or governmental reports<sup>2,245–270</sup> (Table 3).

When evaluating the growth of published articles over time, the number of articles published in non-peer-reviewed journals and the number of position statements or governmental reports has remained relatively stable. The number of peer-reviewed publications, however, surged in the mid-1980s, and since, has remained relatively constant and greater than the number of articles published in non-peer reviewed journals (Figure 2). Furthermore, the proportion of articles published in peer-reviewed journals has been steadily increasing, from 72% for 1978–1987 to 77% for 1988–1997 and 80% for 1998–2007 (Table 4), although this does not achieve statistical significance ( $p = 0.271$ ). In addition, the proportion of articles in the peer-reviewed set that are quantitative, increased from 31% for 1978–1987 to 51% for 1988–1997 and 36% for 1998–2007 (Table 5), although this increase also does not achieve statistical significance ( $p = 0.972$ ).

#### Discussion

The purpose of this study was to categorize the literature that identifies the role of the physician in the subspecialty of EMS medicine. Emergency medical services systems have grown dramatically since the 1960s, and the field of EMS medicine has an expanding evidence base that guides direct patient care activities in the prehospital setting, as well as maximization of resource utilization through EMS system designs and operational methods. Although the evidence base for EMS medicine still is in its infancy, this scientific knowledge has been steadily increasing since the 1970s, with marked increases in clinical trials beginning in the 1990s.<sup>1</sup>

The modern specialty of EMS began after the publication in 1966 of *Accidental Death and Disability: The Neglected Disease of Modern Society*.<sup>271</sup> This document identified the need for a new discipline in medicine that would address the care of sick and injured patients outside of the traditional hospital setting, and the efficient transportation of these patients to appropriate acute care centers. More recently, both the *National EMS Agenda for the Future*<sup>2</sup> and the Institute of Medicine Report on EMS<sup>1</sup> have called for formal recognition of EMS as a physician subspecialty. While there is no clear definition on what defines a medical specialty, and no accepted number of published articles required

Author	Title	Year
	Control of medical emergency services	1984
	EMS workshop	1979
Amey	Medical control of paramedic services	1978
Barishansky	Docs on demand	2006
Becknell	The benevolent dictator	1997
Blackwell	Prehospital care	1993
Busko	Professional medical direction	2006
Carmona	Inside the perimeter: Essentials of tactical emergency medical support	1990
Dinerman	Forging new paths in medical control	1990
Eastham	Assuring quality from the ground up	1991
Erich	What's up doc	2006
Ferko	Why EMS needs physicians	1987
Frank	Medical director vs. fire chief	1984
Funk	10 minutes with Deb Funk	2004
Gates	Prehospital emergency medical care in Ohio	1978
Golin	How MDs would improve emergency medical care	1980
Gordon	Profiles in leadership	2005
Graham	Documenting patient refusals	2001
Grotewiel	What makes an effective administrator	1990
Gunderson	The medical communications officer	2002
Gunter	Physician involvement	1979
Hall	Prehospital care and the physician intervener	1985
Henry	EMTs and medical control	1985
Jaslow	Prehospital pharmacology: Nitrous oxide	2007
Krohmer	Medical director—The patient's best advocate	1997
Krentz	Medical accountability	1990
Kuehl	Passing the torch	1991
Latessa	The physician medical director	1981
Lilja	Role of EMS medical directors	1986
Lonchena	The three Rs: Reciprocity, recertification, registry	2002
Ludwig	How do you get along with your medical director	2006
Martinez	Medical coverage of cycling events	2006
Matera	Move over EM docs	2006
Matera	Medical Director: Doc on the Street	1997
McSwain	Controversies in prehospital care	1990
Meador	EMS bill of rights	2003
Miller	On-board docs	1988
Newman	EMS medical control	1982

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Table 2—Articles published in non-peer-reviewed journals (*continues*)

Author	Title	Year
Nicholson	Medical director—Liability risks, fact or fiction	1997
Page	Whose license is it anyway	1999
Polsky	Quality assurance in emergency medical service systems	1990
Riggins	Tackling disaster	2005
Riner	Developing medical control in a rural EMS system	1981
Sacra	Oklahoma City and Tulsa metropolitan medical response system	2002
Salomone	Ethics in EMS	1989
Shanaberger	Determining domain. The issue of medical control	1991
Shanaberger	No heroics. Whose wish is your command	1989
Shanaberger	Medical-control physicians and DNR protocols	1989
Stensrud	Floodwaters bring docs to the front	1997
Stewart	Medical direction in emergency medical services: role of the physician	1987
Suter	Community relations and organizations	2004
Taylor	Is your system cutting edge	1994
Timmermann	Paramedic vs. emergency physician	2008
Tripoli	Disaster communications	2002
White	AED	1992

**Table 2** (*continued*)—Articles published in non-peer-reviewed journals

to establish that a medical specialty has a unique scientific basis, the findings in this review demonstrate that, over the past 30 years, there has been a building and evolving scientific basis addressing the unique role of physicians in EMS medicine.

Although this study was not designed to draw exact scientific conclusions from the compiled manuscripts, it is evident that there are some common themes identified in these manuscripts. The aggregate review of these manuscripts demonstrates that physicians have had a positive effect on the quality of patient care delivered in the out-of-hospital environment and the development of the science of EMS. Physicians have been instrumental in pushing the boundaries of EMS as medical specialty, and therefore, the continuous improvement of patient care. The current data set, with increasing proportions of manuscripts that are quantitative/peer-reviewed articles, lends credence to the gross analysis that these manuscripts show that the drive for quality in EMS by physicians has largely been through the establishment of measurable standards and an increasing scientific basis. Therefore, the 266 papers identified through this review demonstrate that there is a unique and specific body of evidence addressing the role of physicians involved in EMS, and that this body of evidence has shown that physicians have had a positive effect on the growth of EMS.

#### *Limitations*

In an effort to focus specifically on articles that addressed the role of the physician in EMS, a search strategy was designed that would only capture articles that were catalogued with one of the following search terms: Director, Institutional Management Teams [MeSH], Physician's Role [MeSH], or Physician

Executives [MeSH]. While this strategy may seem a bit narrow, it was intended that in an unbiased manner, articles be identified that specifically addressed the physician's role in EMS. Therefore, this data set did not capture certain relevant articles on the overall development of EMS as a clinical specialty of medicine. Importantly, the intent of this review was not to identify sentinel or important papers related to EMS, but rather, to identify articles specifically addressing the unique role of physicians in EMS medicine. Future research may be designed to identify those articles that are important to the overall growth of EMS.

This review is limited further by lack of agreement by study authors in what articles to include in the final data sets. While study authors largely agreed on which articles to include from the Practice set (*Kappa* statistic = 0.764), there was less agreement on articles to include from the Clinical set (*Kappa* statistic = 0.475), and even less agreement from the Leader set (*Kappa* statistic = 0.240). It is possible that the lack of agreement reflects some statistical error as the Leader set was the largest of the three sets, and the Practice set was the smallest of the three sets. However, it also is possible that this variance in agreement reflects the differences in the opinions of the study authors' interpretations of the physician's role in EMS based on the three sets. Study authors appear to agree on the physician's role with regards to the Practice of EMS medicine, and to some extent, on the physician's role in the clinical development of EMS medicine, yet they appear to disagree on the role of the physician as a Leader in EMS medicine. This variance in agreement may reflect that the unique clinical aspects of the practice of EMS medicine are well understood by the authors, but the physician's role as a leader is less well defined.

Title	Year
Control of advanced life support at the scene of medical emergencies	1984
Direction of prehospital care at the scene of medical emergencies	1994
Emergency ambulance destination	1999
Emergency medical services agenda for the future	1996
Emergency physician's patient care responsibilities outside the emergency department	2006
Emergency preparedness for children with special health care needs	1999
Ethical challenges in EMS	1993
Equipment for ambulances	2001
Guidelines for "do not resuscitate" orders in the prehospital setting	1988
Guidelines for emergency medical services systems	1988
Guide for preparing medical directors	2002
Mass participation event management for team physicians	2004
Medical control of prehospital EMS	1982
Medical direction of air medical services	2003
Medical direction of air medical services	2002
Medical direction of EMS	1998
Medical direction of prehospital emergency medical services	1993
Medical direction for staffing ambulances	1999
Medical direction for staffing ambulances	2006
Medical director for air medical transport	1995
Physician medical direction of EMS dispatch	1999
Physician medical direction in EMS education	1998
Role of the pediatrician in rural EMSC	2005
Role of the state EMS medical director	2005
Role of the state EMS medical director	2005
The role of emergency physicians in emergency medical services for children	2002
The role of the pediatrician in rural EMSC	1998

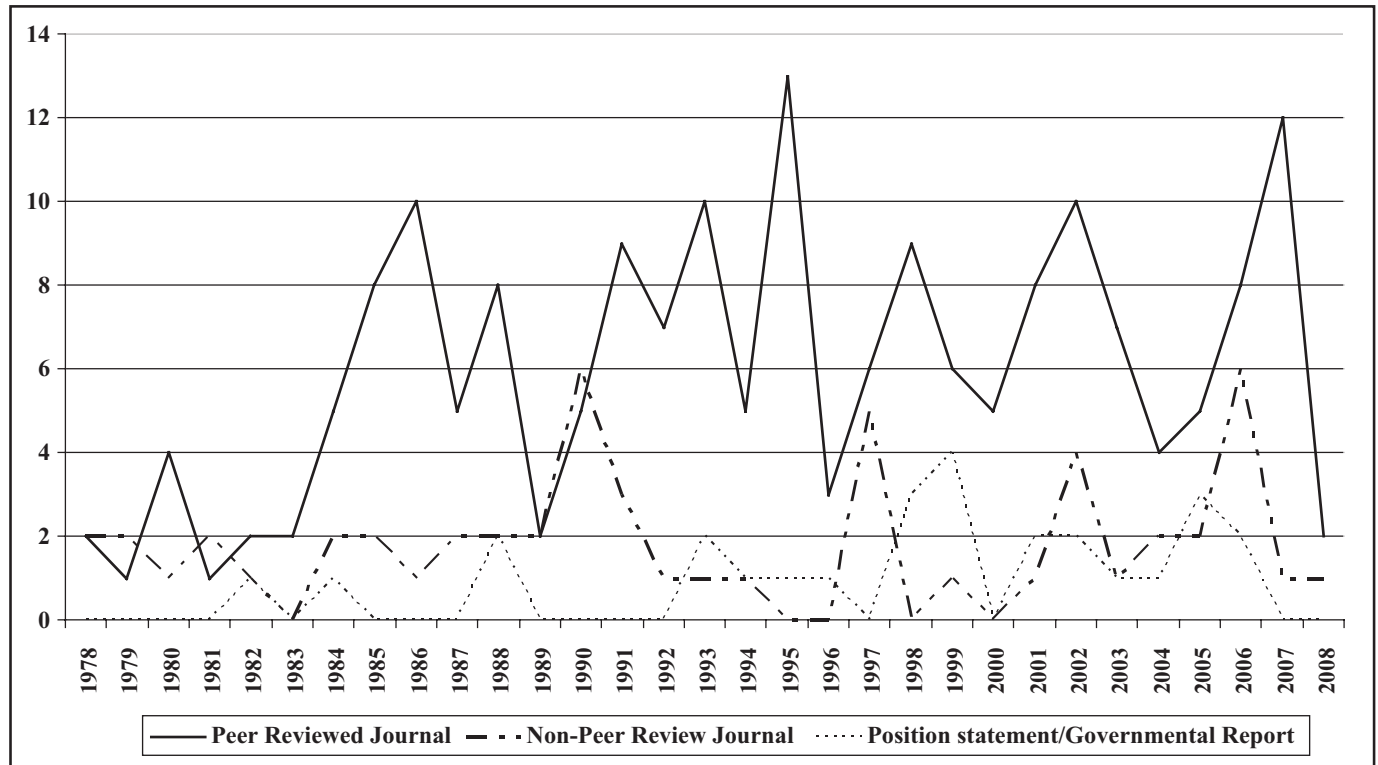
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**Table 3**—Position statements/governmental reports

There likely are two reasons for the variance in study authors' agreement on what articles to include in the leader set. Both of these reasons speak to the variance in which EMS physicians are leaders in EMS. Emergency medical services physicians serve in many different capacities that range from pure clinical work providing patient care in the out-of-hospital environment, medical oversight of ancillary healthcare providers in fire/municipal/commercial EMS agencies, EMS system data analysis and research, and local/state/national EMS system development. Some EMS physicians serve in a capacity involving some or all of these roles. With the great variance in the ways that EMS physicians work, it is no wonder that there is variance in the interpretation of what articles to include in the leader set. In addition, there is variance even within the clinical aspects the physician's role in EMS. Depending on the local environment, the physician will have varying degrees of leadership responsibilities and authority.

This variance also will lead to a variance in the interpretation of what articles to include in the leader set. Therefore, the variance in what articles to include in the leader set perhaps is not surprising given the vast array of EMS system designs in the US, and the accompanying variations in how physicians are incorporated into the administrative structures of those systems.

Lastly, the review was limited to articles relevant to US EMS systems. The purpose of this study was to identify the role of the physician within EMS systems in the US. To the knowledge of the authors, physician participation within EMS systems varies greatly across the world. Therefore, as this project was performed to identify the scientific nature of EMS medicine within the US, it was felt best to exclude articles that defined EMS medicine in other countries. While this technically limited the breadth of the data set, had articles from international EMS systems been included, the data set would



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Figure 2—Number of peer-reviewed, non-peer-reviewed, and position statements/governmental reports related to the physician’s role in EMS, 1978 to 2008

Period	Peer-Reviewed	Non-Peer-Reviewed	% Peer-Reviewed
78–87	39	15	72%
88–97	70	21	77%
98–07	73	18	80%

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Table 4—Growth of peer-reviewed articles compared to non-peer reviewed articles  
 $p = 0.271$

have been confounded by the variance in the role of physicians in these systems. Further study into the role of physicians in EMS medicine outside of the US may be warranted.

**Conclusions**

This review demonstrates that over the past 30 years, there has been significant growth in the number of published articles

Period	Quantitative	Qualitative	% Quantitative
78–87	12	27	31%
88–97	36	34	51%
98–07	26	47	36%

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Table 5—Proportion of quantitative versus qualitative articles in the peer-reviewed set  
 $p = 0.972$

identifying the unique role of the physician in EMS medicine, specifically with regards to roles in leadership, clinical development and practice. This growing body of evidence consistently is evolving to include increasing numbers of peer-reviewed/quantitative articles. Collectively, these articles lend credence to the scientific basis of the physician subspecialty of EMS medicine.

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## Appendix—Articles published in peer-reviewed journals

Author	Title	Year	Quantitative
Alicandro	Impact of interventions for patients refusing EMS transport	1995	X
Alonso-Serra	Physician medical direction in EMS	1998	
Applebaum	Impact of physician-staffed mobile intensive care unit	1985	X
Arntz	Efficiency of a physician-operated mobile intensive care unit	1992	X
Aufderheide	Planning, implementation, and monitoring for prehospital 12-lead ECG	1996	
Augustine	Physician at the scene of an emergency	1985	
Ayres	Current controversies in prehospital resuscitation	1990	
Baker	Special event medical care	1985	X
Benitez	Role of physician in prehospital management of trauma	2002	
Bissell	Change in the scope of practice of paramedics	1999	X
Born	Disasters and mass casualties	2007	
Bowman	Perspectives on being a wilderness physician	2001	
Boyd	Medical control and accountability of EMS systems	1979	
Boyle	Physician integration into mass gathering medical care	1993	X
Briese	Reassessing training levels for prehospital EMS personnel	1983	
Burke	Synergistic management: The task of the flight nurse	1983	
Burstein	Refusal of out-of-hospital medical care: Effect of physician on transport	1998	X
Champion	The effect of medical direction on trauma triage	1988	X
Coimbra	Recognizing/accepting futility	2007	
Cone	Convergent volunteerism	2003	
Cone	Patient initiated refusals of prehospital care	1995	X
Cooper	Involving and educating base station physicians in paramedic programs	1980	
Cooper	The surgeon and emergency medical services for children	1995	
Cowley	Close encounters of the Cowley kind	1978	
Crimmins	Communicating DNR orders to ambulance personnel	1991	
Curiel	Murder or mercy? Hurricane Katrina and the need for disaster training	2006	
Custalow	Unique curriculum for emergency medicine residents as medical directors	2000	
Davis	The utilization of quality assurance methods in emergency medical services	1993	X
Delaune	In-flight medical events and aircraft diversions	2003	X
Delbridge	Variability in out-of-hospital trauma care	2007	
De Lorenzo	A proposed model for a residency experience in mass gathering medicine	1993	
Dice	The role of military emergency physicians in an assault operation in Panama	1991	
Domeier	The development and evaluation of a paramedic-staffed mobile ICU	1996	X
Dove	A metropolitan airport disaster plan-coordination of a multihospital response	1982	
Dracup	The physician's role in minimizing prehospital delay in AMI	1997	
Eastridge	Trauma system development in a theater of war	2006	

**Appendix** (*continued*)—Articles published in peer-reviewed journals (*continues*)

Author	Title	Year	Quantitative
Eckstein	Out-of-hospital pediatric airway management	2004	
Edlich	An overview of revolutionary advances in emergency medical care in the US	2004	
Edlich	An organized approach to trauma care: Legacy of R Adams Cowley	2004	
Eliaiek	Medical director for air medical transport programs	1995	
Erder	On-line medical command in theory and practice	1989	X
Falk	Medical direction of emergency medical service systems	1993	
Feldstein	Disaster emergency medical service	1986	
Fiser	Emergency medical services for children and pediatric subspecialty practice	1995	
Fox	Redefining the emergency physician's role in DNR decision making	1992	
Gausche-Hill	The role of the emergency physician in EMS for children	2003	X
Grange	On-site physicians reduce ambulance transports at mass gatherings	2003	X
Hall	Potential liabilities of medical directors for actions of EMTs	1998	
Haller	Emergency medical services for children: What is the pediatric surgeon's role	1987	
Hamman	Helicopter transport of trauma victims: Does a physician make a difference	1991	X
Hatley	Flight paramedic scope of practice: Current level and breath	1998	X
Haynes	Letting go: DNR orders in prehospital care	1985	
Hitt	Prehospital care telemetry	1984	
Hobgood	Do EMS personnel identify, report, and disclose medical errors	2006	X
Holliman	Comparison of interventions—Standing orders vs. medical command	1994	X
Holliman	Decrease in medical command errors with use of "standing orders"	1994	X
Holliman	Medical command errors in an urban advanced life support system	1986	X
Holroyd	Medical control. Quality assurance in prehospital care	1986	
Hoyt	Online medical control and initial refusal of care	2001	X
Hurd	Physician roles in aeromedical evacuation: USAF operations	2006	
Iseron	Prehospital DNR orders	1989	
Jaslow	Disasters: Experience and planning	2005	
Jones	Emergency physician-verified out-of-hospital intubation	2004	X
Jones	Into the fray: Integration of EMS and SWAT teams	1996	X
Kallsen	An EMS curriculum for emergency medical residencies	1984	
Kaye	Prehospital rapid-sequence intubation: A pilot training program	2003	
King	Pediatric and neonatal transport teams with and without a physician	2007	X
Klein	Effects of on-line medical control in atraumatic illness	1997	X
Knapp	A call to action: The IOM report on EMS for children	1995	
Knott	EMS in rural areas: The supporting role of state EMS agencies	2003	X
Krug	Twenty years of emergency medical services for children	2005	
Kulp	Preparing pre-hospital coverage for a papal visit	1980	
Lahaie	Recruiting ambulance volunteers: Rural physicians can help	1991	

**Appendix** (continued)—Articles published in peer-reviewed journals (continues)

Author	Title	Year	Quantitative
Larkin	New York physicians respond to terror, tragedy, and trauma	2001	
Lavery	A survey of advanced life support practice in the United States	1992	X
Lavery	Taking care of the "good guys:" Medical support for law enforcement	2000	
Leaning	Physicians, triage, and nuclear war	1988	
Lyons	Increased flight surgeon role in military aeromedical evacuation	1995	
Lyznicki	Developing a consensus framework for disaster response	2007	
Ma	EMS medical coverage at PGA tour events	2002	X
MacDonald	Transfer of intra-aortic balloon pump-dependent patients by paramedics	2005	X
Maio	Quality assurance in emergency medical service systems in Michigan	1991	X
Markenson	Preparing health professions students for public health emergencies	2005	
Martchenke	Prehospital communications during the Loma Prieta earthquake	1995	X
Martinez	The world trade center attack. Doctors in the fire and police services	2001	
Martinez	New vision for the role of emergency medical services	1998	
Matera	Medical direction of prehospital care	1994	
McArdle	Integration of EMS and special weapons and tactics (SWAT) teams	1992	
McDonald	Injury prevention activities in US trauma centers: Are we doing enough	2007	X
McDonald	Medical control of mass gatherings	1993	X
McEvoy	EMS and emergency physicians	1997	
McFee	Preparing for an era of weapons of mass destruction (WMD)	2002	
McKenas	The role of corporate medical departments in commercial aviation	2002	
McSwain	Disaster medical care: Mardi Gras	1982	
McSwain	Medical control of prehospital care	1984	
McSwain	Medical control: What is it	1978	
McSwain	Prehospital care from Napoleon to Mars	2005	
Mechem	The outcome of hypoglycemic patients who refuse ambulance transport	1998	X
Moody	Practice guidelines and performance measures in EMS for children	2002	
Morgan	Liability immunity as a legal defense for recent EMS system litigation	1995	
Morhaim	Prehospital care: Emergency medical services	1986	
Mucha	Trauma prophylaxis: Every physician's responsibility	1986	
Nelson	You're the flight surgeon. Mishaps and fatalities	2004	
Norton	On-scene time for patients initially refusing treatment or transport	1991	X
O'Connor	The effect of a quality improvement feedback loop on paramedic skills	1994	X
Palafox	The 1989 Loma Prieta earthquake: Issues in medical control	1993	X
Parrillo	Medical care at mass gatherings: Considerations for physician involvement	1995	X
Patterson	Use of ED diagnosis to determine medical necessity of EMS transports	2006	X
Peckinpugh	The advanced pedi-bag program: A hospital-EMS partnership	2000	
Pepe	Effect of full-time specialized physician supervision on an EMS system	1993	X

**Appendix** (*continued*)—Articles published in peer-reviewed journals (*continues*)

Author	Title	Year	Quantitative
Pepe	Emergency medical services	1994	
Pepe	Impact of intense physician supervision on effectiveness of an EMS system	1988	
Pepe	Out-of-hospital resuscitation research: Strategies for controlled clinical trials	1993	
Pepe	Role of the physician in the prehospital setting	1986	
Pesik	Terrorism and the ethics of emergency medical care	2001	
Peterson	Commentary: Medical direction for out-of-hospital EMS	2002	
Peterson	Motor vehicle safety: Current concepts and challenges for EM physicians	1999	
Pierson	Airline passenger misconduct: Management implications for physicians	2007	
Pointer	Effect of standing orders on field times	1988	X
Pointer	The emergency physician and medical control in ALS	1985	
Polsky	Guidelines for medical direction of prehospital EMS	1993	
Pons	Medical control of prehospital care	1984	
Pons	An advanced emergency medical system at National League Football games	1980	X
Poulton	Physician's role in aeromedical transport questioned	1987	X
Poulton	Medical directors of critical care air transport services	1987	
Powers	Organization of a hospital-based decontamination plan using the IC structure	2007	
Pozen	Effectiveness of a prehospital medical control system	1981	X
Rausch	Development of a palliative care protocol for emergency medical services	1991	
Ray	Emergency medicine resident involvement in EMS	2007	X
Raymond	A mandatory off-line medical control workshop for ALS medical directors	1988	
Reed	Prehospital considerations of sildenafil-nitrate interactions	1999	X
Reynolds	The nuts and bolts of organizing and initiating a pediatric transport team	1992	
Rhee	Is the flight physician needed in helicopter emergency medical services	1986	X
Ricci	Assessment of prehospital and hospital response in disaster	1991	X
Rinaca	EMS agenda for the future: Virginia providers' perspectives	1999	X
Rinnert	A descriptive analysis of air medical directors in the United States	1999	X
Roudsari	International comparison of prehospital trauma care systems	2007	X
Sachs	Limiting resuscitation: Emerging policy in the emergency medical system	1991	
Sanders	An analysis of medical care at mass gatherings	1986	X
Sayre	The use of neuromuscular blocking agents by air medical services	1992	X
Schmidt	Do patients refusing transport remember risks after initial ALS assessment	1998	X
Schwartz	The role of the physician in a helicopter emergency medical services	1990	X
Shah	Description and evaluation of a pilot EMS diversion control program	2006	X
Shanaberger	Medical control physicians and DNR orders	1988	X
Shealy	The gaping hole: Physicians are missing from disaster preparedness training	2006	
Shelton	Medical direction of interfacility transports	2000	
Snow	Physician presence on a helicopter emergency medical service	1986	X

**Appendix** (continued)—Articles published in peer-reviewed journals (continues)

Author	Title	Year	Quantitative
Soler	The ten-year malpractice experience of a large urban EMS system	1985	X
Spaite	Physician in-field observation of prehospital ALS personnel	1993	X
Stark	Patients who initially refuse prehospital evaluation and/or therapy	1990	X
Stewart	A computer-assisted quality assurance system for an EMS	1985	X
Stewart	Design of a resident in-field experience for an EM residency curriculum	1987	X
Stewart	Prehospital care: Education, evaluation and medical control	1980	
Stone	A statewide study of EMS oversight: Medical director involvement	2000	X
Stone	The air medical crew: Is a flight physician necessary	1991	
Storer	Physician medical direction of EMS education programs	1998	
Stratton	Withholding CPR in the prehospital setting	1990	
Stueland	An assessment of prehospital provider needs in Wisconsin	1995	X
Stueland	A self-assessment of Wisconsin prehospital provider needs	1997	X
Stults	EMT-defibrillation in rural America	1986	
Sucov	The outcome of patients refusing prehospital transportation	1992	X
Suffoletto	Use of prehospital-induced hypothermia after out-of-hospital cardiac arrest	2008	X
Suy	Emergency medical assistance during a mass gathering	1999	
Swor	Training of EMS medical directors	1988	X
Tadmor	The art and science of surge	2006	
Tang	Medical direction and integration with existing EMS infrastructure	2003	
Thanel	Near drowning. Rescuing patients through education as well as treatment	1998	
Thomas	Air ambulance regulations: A model	1986	
Thomas	Medical director for air medical transport programs	2002	
Thomas	Paramedical perceptions of challenges in out-of-hospital intubation	2007	
Thompson	Physician-staffed mobile ICUs	1985	
Tortella	Physician medical direction and advanced life support in the United States	1995	X
Uddin	Emergency preparedness: Addressing a residency training gap	2008	
Van Buren	Understanding and using prehospital emergency systems	1988	
Varkey	Confronting bioterrorism: Physicians on the front line	2002	
Walker	Role of the flight surgeon in fighter squadron Arctic deployments	1997	
Wasserberger	Base-station prehospital care: Judgment errors and deviation from protocol	1987	X
Williams	Just when you thought medical director liability	2001	
Wirtz	Unrecognized misplacement of ETI tubes by ground prehospital providers	2007	X
Woodward	Should parents accompany pediatric interfacility ambulance transports	2001	X
Woodward	The state of pediatric interfacility transport	2002	
Wuerz	On-line medical direction	1995	X
Wydro	Legislative and regulatory description of EMS medical direction	1997	X
Yancey	Injury prevention and emergency medical services	2002	