Emergency Medical Services Outcomes Project I (EMSOP I): Prioritizing Conditions for Outcomes Research

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Over the past several years, out-of-hospital EMS have come under increased scrutiny regarding the value of the range of EMS as currently provided. We used frequency data and expert opinion to rank-order EMS conditions for children and adults based on their potential value for the study of effectiveness of EMS care. Relief of discomfort was the outcome parameter EMS professionals identified as having the most potential impact for the majority of children and adults in the top quartile conditions. Future work from this project will identify appropriate severity and outcome measures that can be used to study these priority conditions. The results from the first year of this project will assist those interested in EMS outcomes research to focus their efforts. Furthermore, the results suggest that nonmortality outcome measures, such as relief of discomfort, may be important parameters in determining EMS effectiveness.

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INTRODUCTION

Over the past several years, provision of out-of-hospital EMS has come under increased scrutiny. Although it is generally acknowledged that safe, timely transport is needed for many individuals experiencing an acute medical problem, experts have questioned the value of the range of out-of-hospital care services currently provided.[1-6] Furthermore, Medicare and Medicaid are refusing to pay for certain EMS interventions that were heretofore unquestioned.[7,8] Although some physicians and EMS professionals are suggesting a radical streamlining of EMS systems, others suggest an expanded role for EMS providers. Under the expanded scope scenario, out-of-hospital providers would deliver more sophisticated

emergency care, nonemergency care, and public health–related services.[9-14] Within the general health care community, there is a persistent concern about the lack of information related to the effectiveness of the procedures used in clinical care.[15-17] This concern is also evident in the field of EMS. Both advocates and critics of current EMS systems agree that what is needed is methodologically sound outcomes research that will identify "what works" in out-of-hospital care.[1,9,11,14,18,19]

In response to questions regarding the effectiveness of EMS, the National Highway Traffic Safety Administration (NHTSA) convened a "Workshop on Methodologies for Measuring Morbidity Outcomes in EMS" in 1994. The workshop focused on the delivery of acute prehospital care and did not address scheduled transports, interfacility transport, or prevention activities. The report from this workshop concluded that the implementation of EMS outcome studies was essential. It was noted, however, that the methods applicable to out-of-hospital care needed to conduct these investigations, particularly those using nonmortality outcome measures, had never been described.[20]

Two major recommendations from this workshop were that conditions/diseases cared for in the prehospital setting should be prioritized (and outcomes research be focused on high-priority conditions) and that measures for risk adjustment and outcome be identified for high-priority conditions. Although no specific method for prioritization was described, the panel thought that any such method should take into account both the frequency of the condition/disease in the prehospital setting, as well as the impact or potential impact of prehospital care on the condition/disease. Furthermore, the panel members believed that all relevant patient outcomes should be considered: the 6 "Ds" of patient outcome (death, disease, disability, discomfort, dissatisfaction, and destitution) for each condition.[20] Subsequently, NHTSA funded a 5-year cooperative project, the Emergency Medical Services Outcomes Project (EMSOP), to facilitate EMS outcomes research and to implement the recommendations from the workshop in 1994. The main objectives of the project are to identify (1) conditions that should take precedence in EMS outcomes research, (2) risk adjustment measures for these priority conditions, and (3) outcome measures for these priority conditions.

The objective for the first year was to identify conditions that could serve as a focus for EMS outcomes research, and could also be used as indexes of EMS systems' overall effectiveness. This approach is consistent with the "tracer" concept originally defined by Kessner and Kalk.[21] The tracer concept is based on the premise that a few carefully selected health problems, when combined in sets, provide a tool for identifying the strengths and weaknesses of a particular practice setting, and can be used as indicators of the general quality of care and system effectiveness. Tracers should be conditions that have a relatively high frequency and high potential for the condition to be beneficially affected by medical care.[22] Tracers have been recommended and used in several areas of medical care including EMS.[23] This article describes the results of the prioritization process used for this project, and the implications of these results to future EMS outcomes research.

MATERIALS AND METHODS

The first objective was addressed in 4 phases. During phase 1, a list of EMS conditions was developed. In phase 2, frequency data were obtained for all the conditions identified. In phase 3, the relevance of various outcomes and the potential impact of EMS on these outcomes, for each condition, was determined. In phase 4, a summary index score was developed and the conditions ranked according to this index score.

Listing conditions and determining frequencies

An EMS condition was defined as an illness, injury, or combination of signs and symptoms that caused an EMS activation. A preliminary list of such conditions was identified using the NHTSA Uniform Data Conference data element items "Provider Impression" (data element 50), "Signs and Symptoms Present" (data element 52) and "Injury Site and Type" (data element 53).[24]

The investigators next sought population-based data on the frequency distribution of the conditions. A review of the literature and a preliminary evaluation of various local EMS databases failed to provide the desired frequency data. Having concluded that local databases were unsuitable because of inconsistent data definitions, inconsistent data formatting, and variation in inclusion criteria, EMS Data Systems, Inc (Phoenix, AZ) was selected. EMS Data Systems collects data from various EMS systems across the country using optically scanned data entry forms and data sets similar to that promulgated by NHTSA. All patient data in this database are anonymous. For this project, states were selected by EMS Data Systems based on the willingness of the state EMS agency to participate in this project. Data from July 1, 1995, through June 30, 1996, were obtained from Alabama,

Mississippi, Oklahoma, Illinois, and 11 central California counties. Data from Alabama and Mississippi were statewide. Oklahoma data were statewide with the exception of Tulsa and Oklahoma City. Illinois data were not statewide; however, officials did not provide information regarding the specific regions included. California data included the counties of Sacramento, Placer, Yolo, Kings, Tulare, Santa Barbara, Stanislaus, San Joaquin, Shasta, Matin, and Sonoma. Only data from ground emergency responses to scenes (other than medical facilities) that resulted in a transport to an emergency department were included in the analysis. EMS Data Systems' contracting agencies use data elements similar to those proposed by the NHTSA Uniform Data Conference; however, data are customized according to contracting agency preference. Data elements unique to 1 region or state were recoded based on decision rules developed by EMS Data Systems (eg, "abdominal distress," "GI problems," "vomiting," and "nausea/vomiting" were all recoded to the data element "unspecified illness, GI"). These rules were reviewed by the investigators before their implementation.

Data were obtained for all age groups. Age groupings used by the National Center for Health Statistics were used as a guide (<1 year, 1 to 4 years, 5 to 14 years, 15 to 24 years, 25 to 34 years, 35 to 44 years, 45 to 64 years, 65 years and older) to determine an age at which to divide the data into "children" and "adults." Children were defined as younger than 15 years of age and adults as those 15 years or older. The condition "Trauma" was divided into major trauma and minor trauma on the basis of the value of the Revised Trauma Score (RTS) field in the EMS Data Systems database.[25] An RTS of I 1 or less was considered major trauma and an RTS of more than 11 was considered minor trauma.[25] Seventy-five percent of trauma patients had RTS scores. The ratio of major to minor trauma in each age range was determined for patients with complete RTS scores. The frequency distribution of major and minor trauma for these cases, for each age range, was then assigned to those cases with missing RTS.

Data from EMS Data Systems were collected from EMS agencies that represented Basic, Intermediate, and Advanced (Paramedic) EMT transport services. Data are entered on scannable sheets at agency sites. These sheets are then sent to EMS Data Systems where they are scanned into a computer file. A total of 391,360 cases were analyzed. The data were obtained from various regions of the country comprising more than 13 million people. The age and gender distributions of the sample were similar to those of the United States: male, 49%; female, 51%; 14

years or younger, 22%; 15 to 65 years of age, 65%; age older than 65 years, 13%. The distribution by race/ethnicity was somewhat different compared with the US population: white, 75% (compared with 80% in the United States); and nonwhite, 25% (20% in the United States). Regional data were unavailable for Illinois and thus were excluded from demographic analysis. The correlation of the rank order of conditions, based on frequency alone, between geographic regions was determined using the Spearman rank correlation coefficient.

Determining relevance and potential effect

To ensure that all potential outcomes were considered, the investigators used the 6 "Ds" of patient outcome for each condition.[26] The main goal was to determine the relevance of a particular outcome category to a specific condition, as well as to determine the potential effect that EMS intervention might have on that particular outcome category for a specific condition.

Lacking meaningful data, the investigators obtained expert opinions regarding the relevance and potential impact of EMS using a questionnaire. Respondents were asked to complete 2 questionnaires, 1 for patients younger than 15 years of age and another for patients 15 years of age or older. Each questionnaire included the following 2 questions: (1) For each of the following conditions, how would you rate the relevance of the following 6 outcome categories? and (2) For each of these conditions, how would you rate the potential impact of EMS (including both basic and advanced EMT care) on each outcome? The 6 outcome categories were defined as survival (death), impaired physiology (disease), limit disability (disability), alleviate discomfort (discomfort), satisfaction (dissatisfaction), and cost-effectiveness (destitution). Table 1

Table 1.
Definition of outcome categories.

Term	Definition
Survival	Mortality directly attributable to the condition.
Impaired physiology	Objectively measurable signs of altered physiology.
Limit disability	A change in the functional status of the patient in terms of ability to live independently and go about their daily lives at home, work, or recreation.
Alleviate discomfort	Uncomfortable symptoms such as pain, nausea, vertigo, or shortness of breath.
Satisfaction	Expectations of patients and families are met by services provided.
Cost-effectiveness	The financial consequences of health care to the patient and society.

includes definitions of these terms as provided on the questionnaire. Respondents were instructed not to consider the effect of ED care on outcome when making their determinations: if care delivered in the ED may have an effect on outcome but prehospital care may have little impact on outcome, the rating for a specific outcome measure should be low. Respondents were asked to rate the relevance and potential impact of EMS for each condition/outcome category on a 5-point scale ranging from (1) low to (5) high (Figure). No specific definition of relevance or impact was provided. No specific definition of the EMS interventions to be considered was provided. There were 27 items for the pediatric questionnaire and 27 items for the adult questionnaire, each item representing 1 of the EMS conditions identified in phases 1 and 2.

Questionnaires were sent to 42 experts including 23 physicians and 19 EMS system professionals (Table 2). These individuals included investigators and consultants of the EMSOP project (RFM, HGG, DWS, JSD, CGC, JLC, DRM, EJM, PJO, and IGS), as well as other individuals, identified by the primary investigators of EMSOP (RFM, HGG, DWS). These other individuals selected were persons with whom 1 or more of the principal investigators had worked in day-to-day EMS operations, research projects, national association committees, and/or state or federal advisory panels. All of these individuals had leadership roles at the state or national level and/or a significant record of EMS research. All respondents had significant experience in the delivery of prehospital care or direct and indirect medical oversight of such care.

Mean relevance scores (average ratings by all experts for the 6 Ds), mean impact scores, and their SD were determined for each condition and for each age category. Mean relevance and impact scores were average ratings by all experts for the 6 Ds. Weighted scores for each condition were then calculated by multiplying the relevance score by the impact score. Generally, these weighted subjective ratings were normally distributed, allowing the use of parametric methods of analysis where desired.

Developing a summary measure

For each condition, a standard normal deviate (position of score on a standard normal distribution with mean of 0 and SD of 1) was calculated. This transformation gives all variables the same mean and standard deviation.[27] The frequency count and weighted score for each condition and age category were then multiplied together (in order to have positive signs after multiplication, negative z scores were eliminated by the linear transformation of adding 4 to each score). Using this summary index score, the conditions were rank-ordered for each age category.

The internal consistency of the total score (summed over the 6 Ds) for each condition was determined by calculating Cronbach's α. Correlations between raw impact and relevance scores were determined using the Spearman rank correlation coefficient.

Agreement of rankings between respondents was measured in 2 different manners. First, respondents were divided into 3 mutually exclusive categories: (1) physicians and nonphysicians who were investigators or co-investigators, (2) other physician respondents, and (3) nonphysician responders. Rankings were calculated within groups, then correlations among the 3 were calculated (Spearman rank correlation). Second, the average

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Figure.

Sample item from questionnaire.

For this condition, how would you rate the potential impact of the following 6 outcome categories for patients <15?

Condition	Survival	Impaired Physiology	Limit Disability	Alleviate Discomfort	Satisfaction	Cost-Effectiveness
Respiratory distress	oLow	oLow	oLow	oLow	oLow	oLow
Patients with shortness of breath or evidence of respiratory difficulty who continue to have spontaneous breathing. May include asthma, COPD, CHF. Excludes respiratory arrest.	o	o	o	o	o	o
	oMed	oMed	oMed	oMed	oMed	oMed
	o	o	o	o	o	o
	oHigh	oHigh	oHigh	oHigh	oHigh	oHigh

COPD, Chronic obstructive pulmonary disease; **CHF**, congestive heart failure.

correlation among rankings by all respondents was calculated.

A sensitivity analysis was conducted by calculating index scores and ranking conditions using only survival scores and then using only discomfort scores. The rankings from each calculation were then compared with the original index score ranks that used all outcome categories, and Spearman rank correlation coefficients were calculated.

Selection of priority conditions

After data analysis, the investigators and consultants for EMSOP met to determine what conditions were to be recommended as priorities for EMS outcomes research for adults and for children. Criteria for selection were based on summary index scores, the proportion of EMS transports represented, and the feasibility of identifying risk adjustment measures and outcome measures for these conditions within the time and resource constraints of the project. It was decided to examine the top quartile conditions for both adults and children to determine whether the conditions within these quartiles would fulfill selection criteria.

RESULTS

Thirty-seven individuals (88%) returned questionnaires (21 physicians and 16 nonphysicians). Tables 3 and 4 depict the conditions ranked by the summary index score for children and adults, respectively. Percent frequency and weighted scores are also provided. Average correlation between different geographic areas based on frequency alone, were .70 for pediatric transports and .72 for adult transports. For both children and adults, minor trauma is the condition with the highest frequency of patients transported from scene to ED. When the distribution of index scores is divided into quartiles, both age groups have the same conditions listed for 6 of the 7 in the top quartile ranks. Seizure (children) or chest pain (adults) accounted for the seventh condition on the list. For adults in the study population, the top quartile represents 65.5% of all emergency transports. For children, the top quartile represents 85.8% of all emergency transports.

Tables 5 and 6 show the mean outcome category scores for each top quartile condition for children and adults, respectively. For adults, "survival" had the highest scores for 4 conditions and "discomfort" for 3. For children, "survival" had the highest score for 4 conditions, "discomfort" for 2, and "satisfaction" for 1. Cronbach α values

for total scores on the relevance scale for children and adults were .81 and .77, respectively. For impact, the α values were .87 and .86. Correlation between impact and relevance scores was .96 for children and .95 for adults. Correlation coefficients among members of the 3 respondent categories ranged from .94 to .98. Average correlation coefficients between all respondents was .98 for pediatric conditions and .98 for adult conditions. Correlation coefficients for rankings based on survival alone, compared with rankings using all outcome categories, were .98 for children and .97 for adults. Using only discomfort, the correlation of rankings was .69 and .71. The project investigators and consultants decided it was feasible that risk adjustment measures and outcome measures for the top quartile conditions could be identified within the time and resource constraints of the project. It was therefore recommended that these sets of EMS conditions should be priorities for EMS outcome research.

DISCUSSION

Using empirical data combined with expert opinion, the investigators identified conditions that should take precedence in EMS outcomes research. For adults, the top quartile conditions account for 65% of adult emergency transports and for children, 85% of emergency transports. Making these conditions EMS research priorities will focus scarce resources on conditions that not only affect a substantial portion of EMS patients, but which also have the potential of providing the greatest benefit. Among outcome categories, discomfort had the highest weighted score for the top 3 adult first quartile conditions and for the first and third highest ranking children's first quartile conditions.

These findings suggest the importance of studying the effect of EMS care on nonmortality EMS outcome measures, in particular, the relief of discomfort.

The importance of EMS research that addressed outcomes, rather than just process measures, was discussed by Bergner et al.[28] Cayten and Evans[29] pointed out the importance of conducting EMS evaluation research, emphasizing the importance of outcomes-based research. Cayten and Evans also introduced the concept of "tracer" conditions for EMS. These conditions would be used to evaluate the effectiveness of care within these systems. These conditions are relatively frequent, and are conditions for which appropriate EMS care would be beneficial. Use of tracer conditions would result in EMS systems studying only a few conditions, rather than 20 or 30.

Although there is essentially universal agreement that rapid out-of-hospital defibrillation improves survival for out-of-hospital cardiac arrest, the impact of EMS on survival for other conditions has yet to be substantiated.[18,30,31] Furthermore, almost no work has evaluated the effect of EMS care on nonmortality outcome measures. Therefore, although frequency distributions for EMS conditions from preexisting data were identified, the investigators were unable to determine the effect of EMS on outcomes for specific conditions from preexisting data. This latter effort required the use of expert opinion, a method that has been used by others in health services research when empirical data are lacking.[21,23]

The summary index scores gave equal weight to frequency of a condition and subjective opinion regarding the relevancy and potential effect of EMS care on the outcome of the condition. Relying only on frequency data for ranking would have been an unwise decision because this may have resulted in a failure to identify a condition that EMS intervention could significantly affect. For example, if adult conditions had been ranked only by their relative frequency, cardiac arrest, 1 of the only EMS conditions having significant scientific support for effect on survival, would not have been ranked within the top quartile.

Within the limitations of the methodology, this process is both valid and reliable for determining relevance and

Table 2.
Questionnaire respondents and their affiliations.

Respondent	Affiliation	Location
Bob Bailey, MA	North Carolina Office of EMS	Raleigh, NC
Ron G Benoit, BS, EMT-P	University of Arizona	Tucson, AZ
Nicholas Benson, MD	East Carolina University	Greenville, NC
Dale J Berry, EMT-P	Huron Valley Ambulance	Ann Arbor, MI
Richard A Bissell, PhD	University of Maryland, Baltimore County	Baltimore, MD
Marni J Bonnin, MD	Medical Center East Hospital	Birmingham, AL
Lawrence H Brown, EMT-P	SUNY Health Sciences Center	Syracuse, NY
William E Brown, Jr, RN, MS, NREMT-P	National Registry of EMTs	Columbus, OH
C Gene Cayten, MD, MPH	New York Medical College	Valhalla, NY
John L Chew, Jr, MS	The EMSSTAR Group	Annapolis, MD
David C Cone, MD	Allegheny University of the Health Sciences	Pittsburgh, PA
Drew E Dawson, EMT-P	Montana EMS Bureau	Helena, MT
Theodore R Delbridge, MD, MPH	University of Pittsburgh	Pittsburgh, PA
Jeffrey S Desmond, MD	University of Michigan	Ann Arbor, MI
Herbert G Garrison, MD, MPH	East Carolina University	Greenville, NC
Michael R Gunderson, EMT-P	Institute for Prehospital Medicine	Tempe, AZ
Keith Holtermann, RN, MBA, MPH	George Washington University	Washington DC
Richard C Hunt, MD	East Carolina University	Greenville, NC
B Tilman Jolly, MD	George Washington University	Washington DC
Jon R Krohmer, MD	Kent County EMS	Grand Rapids, MI
Ronald F Maio, DO, MS	University of Michigan	Ann Arbor, MI
Dan Manz, BS, EMT-I	Vermont EMS Division	Burlington, VT
Steven A Meador, MD, MPH	Hershey Medical Center	Hershey, PA
David R Miller, BA	Health Span Transportation Services	St Paul, MN
Keith Neely, MPA, EMT-P	Oregon Health Sciences University	Portland, OR
Patricia J O'Malley, MD	Massachusetts General Hospital	Boston, MA
W Taylor Payson, BA, MBA, EMT-P	Critical Air Medicine	Tucson, AZ
Ronald G Pirrallo, MD, MHSA	Medical College of Wisconsin	Milwaukee, WI
Michael R Sayre, MD	University of Cincinnati	Cincinnati, OH
Dena L Smith, EMT-P	MSU/Kalamazoo Center for Medical Studies	Kalamazoo, MI
Daniel W Spaite, MD	University of Arizona	Tucson, AZ
Ian G Stiell, MD, MSc	Ottawa University	Ottawa, Ontario
Robert A Swor, DO	William Beaumont Hospital	Royal Oak, MI
Vincent P Verdile, MD	Albany Medical College	Albany, NY
Roger White, MD	Mayo Clinic	Rochester, MN
Richard Wuerz, MD	Brigham & Women's Hospital	Boston, MA
Michael Yee, EMT-P	University of Pittsburgh	Pittsburgh, PA

effect. The high Cronbach α values support the appropriateness of combining all the outcome category scores into a summary score. The Cronbach α can take on values between −1.0 and 1.0, and a suggested lower acceptable bound is .7.[32] The high correlation between relevance and impact scores indicates that outcome categories for which respondents thought EMS might have a higher impact were also outcome categories that were more relevant for a specific condition. Even though no specific definitions for relevance or impact were supplied, the Spearman correlation coefficients between respondents, both individually and among the members of the 3 groups, indicated very high interrater reliability. The sensitivity analysis performed suggests that, even if various weighting of outcome parameters were used, the conditions in the top ranking quartile would remain substantially consistent. However, there could be some difference of opinion among those in the field of EMS regarding those conditions that should be research priorities.

This work has significant implications for the field of EMS research. First, EMS researchers now have information that can be used to focus research efforts. Furthermore, governmental and other agencies can use this information to develop EMS funding priorities. In addition, it appears that nonsurvival outcome measures, in particular discomfort, are very important. For example, for the top 3 conditions in adults (minor trauma, respiratory distress, and chest pain) and for the first and third ranked condition for children (minor trauma and respiratory distress), discomfort was the outcome parameter with the highest score. For adults and children, these conditions represent 60% of all transports. This suggests that EMS researchers, while acknowledging the importance of survival, must also consider relief of discomfort. In fact, Callaham[1] implies that relieving discomfort may be the most important task that EMS providers perform for the majority of their patients. The investigators want to emphasize, however, that these findings in no way prove that EMS interventions actually have an impact. The findings are based only on expert opinion. Future research is warranted to determine whether these opinions are indeed correct.

Table 3.

Ranking for conditions—children.

Condition	Frequency (%)	Weighted Score	SD	Index Score
Minor trauma	51.3	9.6	4.52	34.3
Major trauma	7.9	17.1	4.79	25.7
Respiratory distress	10.0	15.0	5.00	24.4
Airway obstruction	1.1	17.9	4.58	22.6
Respiratory arrest	.4	16.3	5.02	20.6
Cardiac arrest	.8	14.4	4.88	19.1
Seizure	14.1	9.0	3.49	19.0
Shock	<.1	13.9	4.41	18.2
Allergic reaction	.5	13.1	4.77	17.7
Environmental exposure	.6	12.2	4.49	17.0
Diabetes complication	.3	12.2	5.29	16.8
Cardiac problem	.2	11.2	5.14	15.9
Poisoning/overdose	3.0	8.9	3.57	14.7
Hemorrhage	<.1	10.0	4.28	14.6
Chest pain	.9	9.4	5.47	14.4
Altered level of consciousness	1.5	8.7	3.52	14.0
Fever	2.3	7.6	4.22	13.2
Pregnancy/labor/childbirth	.6	8.1	4.69	13.2
Stroke/cerebrovascular accident	<.1	7.6	5.05	12.5
Abdominal pain	1.2	6.7	3.50	12.0
Abdominal distress	1.4	5.9	3.22	11.3
Hypertension	<.1	6.1	3.56	11.1
Drug/alcohol problem	.2	5.8	3.24	10.9
Gynecologic problem	.1	5.7	3.68	10.7
Syncope/near-syncope	.7	5.3	3.49	10.5
Dizziness	.2	4.5	2.84	9.7
Behavioral problem	.6	4.3	2.58	9.6

Table 4.

Ranking for conditions—adults.

Condition	Frequency (%)	Weighted Score	SD	Index Score
Minor trauma	36.1	10.3	4.64	33.3
Respiratory distress	13.0	15.3	4.82	27.3
Chest pain	10.2	14.8	4.56	24.8
Major trauma	3.6	17.1	4.86	22.3
Airway obstruction	.2	17.6	5.14	20.1
Cardiac arrest	2.2	15.9	5.57	20.1
Respiratory arrest	.2	16.3	5.22	18.9
Cardiac problem	3.3	13.3	4.39	18.3
Shock	.4	14.7	4.60	17.7
Diabetes complication	2.3	12.8	4.97	17.1
Allergic reaction	.4	13.8	4.90	16.9
Environmental exposure	.3	12.3	4.62	15.5
Stroke/cerebrovascular accident	2.7	10.3	5.31	15.0
Seizure	4.8	9.0	3.64	14.9
Altered level of consciousness	3.7	9.1	4.17	14.4
Hemorrhage	.3	10.4	3.76	13.8
Poisoning/overdose	1.8	9.0	3.80	13.4
Pregnancy/labor/childbirth	1.0	9.4	3.97	13.3
Abdominal pain	4.1	7.2	3.72	12.7
Hypertension	1.0	7.9	3.35	11.9
Syncope/near-syncope	1.8	7.0	4.64	11.4
Abdominal distress	2.9	6.4	3.23	11.4
Gynecologic problem	.3	6.7	3.06	10.6
Fever	.5	6.3	3.38	10.3
Drug/alcohol problem	.3	6.0	3.52	10.0
Dizziness	1.1	5.5	3.28	9.8
Behavioral problem	1.6	4.6	2.68	9.2

Two major areas of limitations of this project are appropriate to address: misclassification of conditions and external validity. Definitions of conditions from national recommended standards[24] were used, and in turn, a data source (EMS Data Systems) collecting data based on these standards was identified. The reliability and accuracy of these standards have never been evaluated. It is possible that some patients were assigned the incorrect condition designation, which could have affected the frequency distributions and, ultimately, the final rank order. The finding that the relative condition frequencies for geographic areas was similar (average correlation between different geographic areas based on frequency alone was .70 for pediatric transports and .72 for adult transports) suggests that conditions were identified in a consistent fashion and misclassification, if it occurred, did not significantly change the rank order of conditions. Another concern regarding misclassification is that RTS was missing for 25% of trauma cases. This group of patients was assumed to have the same distribution of minor and major trauma as the trauma cases with RTS. Although misclassification might have resulted in minor or major trauma taking different positions in the top quartile, it would not affect either one in regard to being in or out of the top quartile and therefore would not have altered the conclusions of this study.

Concerns regarding external validity include the representativeness of the frequency data and the representativeness of the respondents who completed the instrument to determine relevance and impact. Regarding frequency data, although it would have been ideal to conduct a probability sample from all EMS data bases in the United States, data that defined conditions in the manner required were limited, with the exception of data from EMS Data Systems. It does appear that the population characteristics of the geographic areas providing frequency data were similar to the population characteristics of the entire United States. Therefore, although results from a specific city's EMS system or a specific regional EMS system may be different than these findings, it is unlikely that a probability-based sample from other states or regions would result in rankings of conditions that are substantially different. Furthermore, with regard to pediatric transports, the study results are similar to previous

Table 5.

Weighted score for top quartile conditions by outcome category—children.

Condition	Survival	Impaired Physiology	Limit Disability	Alleviate Discomfort	Satisfaction	Cost-Effectiveness
Minor trauma	3.7	6.8	10.7	16.3	15.3	9.5
Major trauma	20.1	18.1	19.0	16.3	16.7	14.2
Respiratory distress	14.7	18.0	12.6	18.8	16.7	11.7
Airway obstruction	24.3	20.1	18.4	16.9	17.3	13.4
Respiratory arrest	23.5	21.0	20.4	10.5	13.8	13.0
Cardiac arrest	21.2	20.0	19.0	5.9	13.6	12.5
Seizure	7.0	10.9	9.7	9.7	11.1	7.4

Table 6.

Weighted score for top quartile conditions by outcome category—adults.

Condition	Survival	Impaired Physiology	Limit Disability	Alleviate Discomfort	Satisfaction	Cost-Effectiveness
Minor trauma	4.1	6.8	12.2	17.2	15.6	11.0
Respiratory distress	14.9	18.1	13.1	19.4	17.3	12.3
Chest pain	14.2	14.3	12.1	20.5	17.6	12.5
Major trauma	20.1	17.3	19.6	15.9	16.8	14.9
Cardiac arrest	22.4	20.9	19.5	7.3	14.8	14.9
Airway obstruction	24.0	19.3	18.6	18.1	16.4	12.4
Respiratory arrest	23.7	20.4	20.7	11.0	13.4	13.6

studies by Seidel et al[33] and Tsai and Kallsen.[34] The former noted that among patients younger than 18 years of age, 57% of transports were for trauma and 8.5% were for seizures.[33] In the latter study, 54.5% of transports were for trauma and 10% were for seizures among patients younger than 19 years of age.[34]

Regarding the representativeness of respondents, those who completed instruments were not randomly selected. However, the investigators selected individuals representing a range of out-of-hospital care professionals that were geographically diverse, as well as experienced and broadly knowledgeable. It is possible that selecting a different "mix" of individuals could result in a different ranking of conditions. However, the consistency of responses noted both among respondents and between specific groups of respondents suggests that selecting different respondents would have not substantially changed the ranking.

Also of concern is that this study has not specifically addressed interfacility transport, air-medical transport, the treatment and nontransport of patients, or injury/disease prevention activities. It may be that for each of these different areas, priority conditions for EMS outcome research or prevention research would be different than the ones identified. However, the findings from this study are applicable to the overwhelming majority of patients who are currently cared for by EMS personnel. Furthermore, with the exception of prevention activities, the methodology from this study can be readily applied to the areas of EMS activities that this study did not address.

The investigators rank-ordered EMS conditions for children and adults on the basis of their potential value for the study of the effectiveness of out-of-hospital emergency care. The top quartile of these ranked conditions represents 85% of pediatric emergency transports and 65% of adult emergency transports and may be used as priority conditions for future EMS outcome studies. Relief of discomfort is the outcome parameter EMS professionals identified as having the most potential impact for the majority of both adults and children in the top quartile conditions. Future work must include the identification of appropriate measures to address risk adjustment and outcome for these conditions. The objectives of this project in its remaining 4 years are to identify these measures. If further research determines that EMS care for the priority conditions identified affects the outcome of patients, these conditions could be used as a set of indicator conditions useful to EMS systems for monitoring the effectiveness of care.

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