Gap Analysis of EMS Related Research

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This report was developed for the Federal Interagency Committee on Emergency Medical Services (FICEMS) by the Emergency Medical Services for Children National Resource Center (EMSC NRC). Recommendations in the document reflect that of individual members of the FICEMS Data and Research Committee of the Technical Working Group and not any one federal agency's official position and was not formally cleared by individual agencies.

This report was funded by the Health Resources and Services Administration (HRSA), Maternal and Child Health Bureau (MCHB), Emergency Medical Services for Children Program (EMSC) through contract number 240-03-0011.

The report can be cited as follows:

EMSC National Resource Center, Children's National Medical Center. Gap Analysis of EMS Related Research. Report to the Federal Interagency Committee on EMS. 2009. Available at: www.childrensnational.org/emsc.

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Overview

1. Introduction

Evidence for treatments used in the prehospital setting is lacking. Several research agendas have been published outlining the priorities for prehospital research. As part of Federal Interagency Committee on EMS's Data and Research Committee's goal, to "Ensure a comprehensive body of scientific evidence regarding the practice of prehospital EMS", a gap analysis of prehospital research scientific literature was conducted to map existing literature to priorities described in national research agendas. The purpose of this analysis is to assist with the process of making informed decisions regarding policy and funding priorities.

Research agendas used to understand prehospital priorities include:

- Future of Emergency Care: Emergency Medical Services at the Cross Roads: This report from the Institute of Medicine (IOM) discusses the development of emergency medical services, current status, and future recommendations.

- *Emergency Care for Children: Growing Pains*: This report is part of a series on the future of emergency care that describes the pediatric emergency care infrastructure in the US. The report provides several policy and research level recommendations specific to pediatric care.

- *CDC Acute Injury Care Research Agenda: Guiding Research for the Future*: This agenda focuses primarily on evaluation of the public health system in order to help the CDC better achieve its goal of preventing premature death and disability. The report outlines the 13 priority areas for research as identified by this body.

- *National EMS Research Agenda (National Highway Traffic Safety Administration):* This report focuses on improving the delivery of prehospital care. Innovative practices and procedures are a key component of the investigation discussed in this report.

- *National EMS Research Strategic Plan*: This document addresses one of the 2002 National EMS Research Agenda's recommendations to develop an emergency medical services (EMS) research strategic plan. Various clinical issues were highlighted for additional research to evaluate and provide treatment protocols. This strategic plan also recommends studies that address the education of EMS personnel and structure for the delivery of EMS care.

- *Revisiting the Emergency Medicine Services for Children Research Agenda: Priorities for Multicenter Research in Pediatric Emergency Care (Pediatric Emergency Care Applied Research Network):* The authors of this agenda sought to prioritize research topics specifically for PECARN.

- *Priorities for Research in Emergency Medical Services in Children: Results of a Consensus Conference (Seidel):* This agenda developed a list of important categories for future pediatric research for use by other agencies, the government and others interested in pursuing much needed pediatric research.

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- *Knowledge Translation in the Emergency Medical Services: A Research Agenda for Advancing Prehospital Care (Cone)*: This agenda proposes 9 recommendations for improvement of knowledge translation in out-of-hospital medicine. These recommendations range from collecting evidence to utilizing evidence of research studies.

- *Emergency Medical Services Outcomes Project (EMSOP):* This project was developed to study patient outcomes of out of hospital research. Four journal articles were published establishing these framework components for outcomes research:

    - "specific patient conditions that should take precedence in EMS outcomes research;
    - methodologically acceptable outcome models, including the 'Episode of Care' model;
    - core risk-adjustment measures; and
    - specific issues related to pain measurement"[i]

2. Literature Review Process

A PubMed search was conducted using the National Library of Medicine. To capture research conducted in the prehospital environment, MeSH (Medical Subject Headings) search terms of "emergency medical services", "emergency medical technician", "prehospital provider", and "allied health professional" were used. The searches were separated into clinical and non clinical trials as categorized by PubMed. Non clinical articles that were in English with a publication date of the past 10 years were included in the analysis (1998). A publication date limit was not placed on clinical articles. The initial Pub Med search yielded 1035 non clinical articles and 228 clinical articles respectively. For the purposes of this literature review, clinical trials were defined according to the ClinicalTrials.gov website as "biomedical or health-related research studies in human beings that follow a pre-defined protocol." Therefore, non-clinical trials were categorized as those that did not fall into the clinical definition. The final literature review yielded 191 clinical articles and 81 non clinical articles.

Abstracts were reviewed for all articles from the initial search and excluded using the following criteria:

- Studies outside of the United States with results not generalizable to the U.S.;
- Studies published in non peer reviewed journals;
- Animal or early phase clinical trials with results not generalizable to future prehospital clinical trials; and
- Studies only applicable to nurses or physicians.

A full text review of articles was conducted for the 272 clinical trials and non clinical trials, the articles were summarized and included in appendix A and appendix B respectively.

3. Categories

Articles were separated into 10 broad categories:

- Clinical management – cardiac
- Clinical management – neurological
- Clinical management-other

- Clinical management - respiratory
- Disaster Preparedness
- Education and Training
- EMS Operations
- Injury & Trauma
- Pain Management
- Patient Safety

An analysis was conducted to understand whether the literature in these broad categories meets the expectations of each of the research agendas. This analysis is included in the following sections of this document.

4. Overall Analysis

Overall, the literature in the prehospital setting continues to be largely non randomized clinical trials conducted as retrospective observational studies. Non-retrospective research designs are often based in the hospital rather than prehospital setting. The most frequently studied patient areas include cardiac and airway management. The EMS Operations category was unique in that it housed the most pediatric articles and issues such as occupational health and whether EMS providers can treat and release patients at the scene. The majority of the recommendations of research agendas continue to be unmet with a particular need for research in optimal methods of education and competency assessment, patient safety and quality, pediatrics, and trauma management. It is important to note, however, that the above agendas were published between1999 and 2008. So there may not have been a significant amount time to address the research recommendations. Finally, the literature review did not include articles that focused on EMS system issues, policy issues, or cost despite many of the recommendations from the agendas such as the *IOM Series* issuing recommendations that address EMS systems, policy, and cost.

5. Limitations of the Process

An initial search in PubMed for “emergency medical services” yields over 70,000 articles. Keyword limits to “emergency medical technician” reduced the amount significantly and may have inadvertently excluded relevant literature. Further, abstract review may have excluded relevant literature due to human error or a misinterpretation of the article based on a limited abstract. Excluding non-peer reviewed articles eliminated all research published in the “Journal of Emergency Medical Services” (JEMS). Although this journal is considered a trade publication more than a medical journal and tends to include public case reviews and editorials, relevant research studies may have been excluded.

Another limitation of this project was the direction of the Pub Med search. The search was conducted based on the profession (EMT) and the agency (EMS). Conducting the search by condition such as trauma or injury may have yielded additional articles. It is recommended that a follow- up literature review is conducted by condition.

Finally, the number of articles in a Pub Med search changes daily and it is highly possible that if the same search was conducted today it would result in a higher number of articles in the literature review.

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6. Conclusions

The research of prehospital care has failed to keep pace with the research of other medical disciplines and consequently many practical procedures and interventions used to care for and stabilize out-of-hospital emergencies lack a scientific evidence base. Where rigorous research has supported commonly used prehospital care, much of the evidence had been extrapolated from adult emergency care in hospital based emergency department environments. Further, the public health literature and policy statements of many world-class providers and researchers in emergency medicine concede that pediatric patients cannot be treated as merely smaller adults when prescribing medications and administering medical procedures. It follows then that the stabilizing and life-saving emergency procedures effective for adults may be inappropriate perhaps even harmful to younger bodies.

As this analysis reveals, the majority of the literature summarized here takes the form of non-randomized clinical trials conducted as retrospective observational studies, and the prevalence of this study methodology may in part be a function of human subjects protections that have additional protections for research conducted on vulnerable populations such as children and research done in the emergency setting where full informed consent can not be obtained.

In order to improve EMS care, the research must use more rigorous study methodologies involving controlled research design. To support the high priority research identified in the national agendas included in this gap analysis more funding for and novel approaches to prehospital emergency care studies is needed. Novel approaches are needed, too, in the training and educational components of emergency medical systems, and practitioners and patients both may benefit from the involvement of higher education in building workforce competency.

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The table below summarizes the Airway/Respiratory management recommendations from the selected research agendas.

Agenda	Research recommendation(s)
CDC Acute Care Injury Research Agenda (CDC)	No specific recommendations
Cone Prehospital Research Agenda (Cone)	No specific recommendations given
EMSOP Agenda	• Respiratory distress in adults and children
Emergency Care for Children Growing Pains: IOM Report (Growing Pains)	• Implementation of evidence based clinical practice guidelines
Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report)	• Identify a safe and effective technique to manage respiratory distress in the prehospital field • Impact of prehospital ventilation and intubation on patients with head injuries • Outcomes research on the use of medications for asthma
National Research Agenda Emergency Medical Services (NHTSA)	• Pediatric airway management • Efficacy of endotracheal intubation
National EMS Research Strategic Plan (Sayer)	• Management of acute asthma exacerbations • Effective prehospital airway strategies • Effective oxygenation/ventilation strategies • EMS personnel to assess and treat patients with respiratory distress
PECARN Research Agenda (PECARN)	• Respiratory illnesses/asthma
Seidel Article	• Respiratory distress management

The respiratory/airway management category is comprised of 31 articles, primarily clinical, with three of the clinical articles using children as its study population. The study design for clinical articles were primarily cohort, there were a few randomized/nonrandomized controlled studies. Evaluating different airway management interventions whether it was the technique of the paramedic or devices in the prehospital setting was the primary focus of most of the clinical articles and all of the nonclinical articles.

Researchers were interested in studying the effects of neuromuscular blocking agents and sedative administration on intubation success. Specifically etomidate was studied most often. In 2002 Reed, Snyder, and Hogue compared the use of etomidate for paramedic intubations to that of diazepam and found a higher percentage of successful intubations using etomidate. A few years later, the effects of etomidate was studied with the air medical

transportation patient population requiring intubation. Researchers found that etomidate was more likely to decrease the need for paralytic agents for intubation compared to that of midazolam. However, in 2006, using a randomized controlled trial, Jacoby, et al found that there was no clinical difference between etomidate and midazolam for assisted intubation success rates.

Evaluating intubation technique and devices has shown in this literature review to be a priority in both clinical and non clinical research. Unlike other categories the respiratory/air management contains both human and mannequin studies. Clinical studies by Woollard et al, Hoyle et al, and Kurola et al, among others, for example, examined the efficacy of Airtraq, Combitube, and standard laryngeal tube intubation. Rocca et al assessed the airway management skills of a sample of paramedics by reporting the rate of success in intubating patients. The study found that paramedics had a 90% success rate with intubation and that success was higher in medical intubations verses trauma. More telling was the study that evaluated the effects of misplaced tracheal intubations. Timmermann, Russo, Eich et al evaluated the incidence of misplaced tracheal intubations in the prehospital setting which included air transportation and found that close to 11% of the misplacements were in the bronchus and nearly 7% in the esophagus. The study also found that 7 out of 10 patients died with an unrecognized esophageal intubation within the first 24 hours of treatment.

Intubation was the focus of 2 of the 3 pediatric articles in this literature review. Harrison, Thomas, and Wedel assessed success rates of pediatric intubations in patients less than 13 years of age who received a neuromuscular blockade and found an over 90% success rate in ages ranging from younger than 3 years of age to 12 years. Gausche-Hill et al evaluated the efficacy of endotracheal intubation (ETI) compared to bag valve mask ventilation and found no statistically significant difference between the two methods of ventilation in terms of hospital discharge and neurological difference. Both of these articles met the NHTSA agenda recommendation of pediatric airway management and Seidel's research recommendation of respiratory distress management in the pediatric population. The pediatric article by Gausche Hill was the only study in this literature review that addressed NHTSA's research recommendation of evaluating the efficacy of endotracheal intubation in the prehospital setting.

The adult articles met most of the above research agenda recommendations. The National EMS Research Strategic Plan issued the most specific recommendations which were met by most of the articles in this literature review. The recommendation that was not completely addressed in this literature review was evaluating personnel's ability to assess and treat patients with respiratory distress. Articles evaluated the prehospital provider's ability to administer treatments, but not the ability to effectively assess patients. The 2006 IOM report's recommendation of identifying safe and effective technique to manage respiratory distress was addressed in multiple adult and one pediatric article.

Limitations of the included studies are:

- Insufficient sample size
    - insufficient power
- Hawthorne effect
- Specificity of results to a limited population
    - novel definition of outcome variable
- Failure to control observer bias
    - no blinding
    - inadequate randomization
- Self-reported data

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Missing from the literature were rigorous follow up studies that evaluated the efficacy of performing prehospital endotracheal intubations in the adult and pediatric population, an evaluation of the assessment skills of EMS personnel, asthma medication outcomes research, and studies that addressed evidenced based practice guidelines in airway management for both the pediatric and adult population. Many of the research recommendations from the above agendas were redundant, for example PECARN, Seidel, and the EMSOP agenda all recommend research in respiratory distress or illness such as asthma. The problem of asthma and other respiratory illnesses suffered by children puts particular significance on the need to study pediatric airway management according to the above research recommendations. Another observation is that the EMSOP agenda, Seidel article, and 2006 IOM Report all recommend an examination of respiratory distress as a broad clinical diagnosis, but do not focus on any specific airway management intervention.

One research topic that was not addressed in the above agendas, but may continue to be a focus of research is the effects of faster access to defibrillation. This was addressed in two of the adult articles in this literature review. Both of these are articles were published in the Resuscitation journal; the article by White, Hankings, and Bugliosi looked at the use of early defibrillation of patients with ventricular fibrillation by paramedics and police and found that the circulation restoration and lack of neurological damage were dependent on how quickly defibrillation was delivered. A few years later Waalewijn, Vos et al looked for possible predicators for survival for patients who experienced out of hospital cardiac arrest. Three prediction models were developed and found that early defibrillation, not advanced CPR, can restore circulation.

In addition to the recommendations noted in the discussion above to further build on existing resuscitation research, it is recommended that research studies either include pediatric patients in its study population or are devoted entirely too studying children. While ideally the future research should consider a randomized study design, it is important to note the importance of retrospective or other non clinical design in the pediatric population.

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The table summarizes the Cardiovascular research recommendations from the selected research agendas

Agenda	Research recommendation(s)
CDC Acute Care Injury Research Agenda (CDC)	No specific research recommendations
Cone Prehospital Research Agenda (Cone)	No specific research recommendations
EMSOP Agenda	• Outcomes research in pediatrics and adults.
Emergency Care for Children Growing Pains: IOM Report (Growing Pains)	No specific research recommendations
Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report)	• Effectiveness of cardiopulmonary resuscitation (CPR) techniques, such as chest compression-only CPR. • Outcomes research on the use of 12-lead electrocardiograms (ECGs) for patients with a myocardial infarction. • Outcomes research for the use of medications for cardiac conditions (myocardial infarction, congestive heart failure).
National Research Agenda Emergency Medical Services (NHTSA)	• Use of Amiodarone for cardiac arrest.
The National EMS Research Strategic Plan	• Evaluate new resuscitation strategies including drug treatments • Evaluate initiating hypothermia treatment prior to hospital arrival
PECARN Research Agenda (PECARN)	• Improvement of health outcomes following cardiac arrest
Seidel Article	• Pediatric resuscitation

A total of 44 adults articles were analyzed against the above research agenda recommendations. Using the inclusion criteria, 33 adult clinical articles and 10 adult non clinical articles focused on the cardiovascular system in the prehospital setting. Of the featured research agendas, The 2006 IOM Report offered the most specific research recommendations. Most clinical articles focused on researching medications for cardiac conditions. Epinephrine, for example was the medication studied most often with in prehospital cardiac arrest.

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The study by Wenzel, Krismer et al met both the 2006 IOM Report recommendation for outcomes research in the use of medications for cardiac conditions and the EMSOP recommendation to look at study outcomes in children and adults. The study compared vasopressin and epinephrine use in out of hospital cardiopulmonary resuscitation with the primary outcome of survival to hospital admission and a secondary outcome of survival to hospital discharge. Similarly, the study conducted by Mitchell, Guly, Rainer, et al examined adult patients who experienced out of hospital cardiac arrest and were treated by paramedics with cardioactive drugs. Finally, the 1999 randomized controlled study of Kudenchuck, Cobb, Copass, et al sought to determine the efficacy of intravenous amiodarone given to adults experiencing out of hospital cardiac arrest. This was one of two articles that specifically addressed the National Highway Traffic Safety Administration research recommendation to evaluate the use of amiodarone for cardiac arrest, although it is important to mention that it was the article published two years prior that led to NHTSA's research recommendation to study the drug further. The second article was a retrospective study by Goebel et al that looked at the usage of adenosine by paramedics over a 10 year period when treating patients with a "presumed" paraoxysmal supraventricular tachycardia (PSVT). This study found that adenosine was used incorrectly 20% of the time because of the inaccurate diagnosis of PSVT.

Paramedic use electrocardiogram (ECG) in the prehospital setting for patients suffering from myocardial infarction was a focus of several clinical and non clinical articles. Overall the clinical articles showed paramedic use of ECG's for diagnosing of myocardial infarction as having a positive outcomes effect. The seven articles had varying study designs and looked at outcome measures such as: proportion of patients who met the 90 minutes recommended guideline for door to door balloon times, mortality, time to percutaneous reperfusion, etc. Generally through retrospective studies, the non clinical articles had similar conclusions. For example, articles by Garvey et al and Le May et al built upon each other by addressing the impact of correctly identifying segment elevation myocardial infarction (STEMI) through the use of 12 lead ECG in the prehospital setting and whether advanced care paramedics that identify the STEMI can apply interventions that clinically impact the outcome of care.

Although the literature review yields clinical and non clinical articles that address CPR techniques, only a few specifically address the Emergency Medical Services at the Crossroads recommendation to evaluate the effectiveness of different CPR techniques in the prehospital setting. Also none of the articles reviewed build upon previous research leaving many questions unanswered. Most recently Hallstrome et al compared resuscitation outcomes with cardiac arrest patients with the addition of an automated LDB-CPR technique was added to the standard CPR protocol. This study was not completed because of interim results showing lower hospital discharge survival outcome and lower survival neurological status in the LBD-DPR group. Cobb et al evaluated the effects of providing 90 seconds of CPR to patients in ventricular fibrillation prior to receiving defibrillation and found that survival improved slightly in patients who received CPR for 4 minutes or longer. Finally, Kellum et al looked at outcomes of survival and neurologically intact survival when comparing the treatment for cardiocerebral resuscitation (CCR) to that of CPR and found that with patients who suffered a cardiac arrest, CCR had a significantly higher survival outcome.

Many of the clinical and non clinical articles met EMSOP's research recommendation of outcomes research in cardiac care. Other agendas outside of the Future of Emergency Medical Services were barely addressed in terms of prehospital research. No pediatric articles met the inclusion criteria for either clinical or non clinical studies.

While this category yielded a fair amount of articles, the research topics were random and did not build upon previous research work. For example, further research is recommended following the studies showing that 12-lead electrocardiograms may be useful for guiding the care of prehospital MI patients.

The primary limitations of the research articles included:

- Incomplete control of the intervention;
- Lack of randomization or improper randomization;
- Lack of generalizability;
- Small sample size;
- Missing or incomplete data; and
- Hawthorne effect and detection bias

One topic research that was not addressed in the above agendas, but may continue to be a focus of research is the effects of faster access to defibrillation. This was addressed in two of the adult articles in this literature review. Both of these are articles were published in the Resuscitation journal; the article by White, Hankings, and Bugliosi looked at the use of early defibrillation of patients with ventricular fibrillation by paramedics and police and found that the circulation restoration and lack of neurological damage were dependent on how quickly defibrillation was delivered. A few years later Waalewijn, Vos et al looked for possible predicators for survival for patients who experienced out of hospital cardiac arrest. Three prediction models were developed and found that early defibrillation, not advanced CPR, can restore circulation.

In addition to the recommendations noted in the discussion above to further build on existing resuscitation research, It is recommended that research studies either include pediatric patients in its study population or are devoted entirely to studying children. While ideally the future research should consider a randomized study design, it is important to note the importance of retrospective or other non clinical design in the pediatric population. Education and training was identified as a topic in the following research agendas.

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The table below summarizes the Disaster Preparedness recommendations from the selected research agendas

Agenda	Research recommendation(s)
CDC Acute Care Injury Research Agenda (CDC)	• Identify and evaluate how acute injury is affected by disaster or mass casualty events
Cone Prehospital Research Agenda (Cone)	No specific research recommendation
EMSOP Agenda	No specific research recommendation
Emergency Care for Children Growing Pains: IOM Report (Growing Pains)	No specific research recommendation
Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report)	No specific research recommendation
National EMS Research Strategic Plan (Sayre)	• Develop a formal research structure into outcomes associate with different levels of EMS response to events such as: terrorist attacks and natural disasters
National Research Agenda Emergency Medical Services (NHTSA)	No specific research recommendation
PECARN Research Agenda (PECARN)	No specific research recommendation
Seidel Article	No specific research recommendation

When most of the above research agendas were published, federal agencies and national organizations were just beginning to assess the gaps in disaster related research literature. While there are limited specific research recommendations from the above agendas, there are numerous policy and system recommendations that potentially impact the delivery of EMS services and the delivery of patient care during a disaster or mass casualty event. The analysis below compares current published literature to the recommendations for specific research. Policy and training recommendations that were most notable in the two IOM reports are not addressed here.

The two adult articles included in this analysis looked at both the health care providers and community members directly involved in the disaster event. These articles evaluated different components of the disaster to include: the triage system, the severity of rescue worker illness and injury, and the preparedness of health care professionals.

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Zoraster et al addressed the CDC's research recommendation to study the effects of mass casualty on EMS systems through the evaluation of the field triage model used during the Los Angeles country train crash of January 2005. This was the only article that addressed a specific research recommendation. Berrios et al met the 2006 IOM report's policy recommendations to research the ability to provide emergency care and effective relief during a natural disaster through studying the prevalence and patterns of injury and illnesses among rescue workers during the 2001 World Trade Center disaster. Although the recommendation focused on natural disaster, the injury and illness patterns among rescue workers during this man made event could be applicable to any disaster or mass casualty event.

The reported limitations of the studies were:

- incomplete date collection;
- lost data collections forms;
- difficultly collecting accurate data related to a chaotic environment and transient study population
- possibility that findings from the staged environment would not translate into the "real world"

The major difference between this analysis and others in the report is the lack of recommendations from the various research agendas. The Seidel and PECARN articles do not give specific recommendations related to pediatric disaster preparedness. The Seidel article, however, discusses organizational policies which could be applied to the area of disaster preparedness. For example, the article focuses on the benefits of a well organized system in regards to special circumstances and settings. The 2006 IOM report focuses on improving overall system, education, and training policies. These policies recommend restructuring current programs/interventions already in place and tailoring pre-existing programs to disaster responses. In addition, the IOM report recommends further pediatric specific education and training for personnel responding to disasters. While these are not research recommendations, they will require evidence based practices.

Thus, further research is recommended in the area of disaster preparedness for both adults and children. Specifically, research should focus on:

- Education and training of disaster and EMS personnel to include evaluating the current models of mass casualty event field triage and core competencies needed for prehospital providers and hospital personnel
- Systems efficacy to include: surge capacity, staffing, and strategies to minimize parent-child separation
- Outcomes of patients being treated and released by EMS personnel
- Developing a unique structure of research that is specific for disasters or mass casualty events

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The table below summarizes the Education and Training recommendations from the selected research agendas.

Agenda	Research recommendation(s)
CDC Acute Care Injury Research Agenda (CDC)	• Studies that focus on methods to encourage the adoption of science based programs, policies, and laws by health care providers that reduce intentional and unintentional injuries
Cone Prehospital Research Agenda (Cone)	• Research that focuses on when and how best practices are adopted by EMS personnel. • Research that focuses on how to best educate EMS personnel on clinical recommendations and best practices.
EMSOP Agenda	• Research on the training for EMS personnel.
Emergency Care for Children Growing Pains: IOM Report (Growing Pains)	• No specific research recommendations
Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report)	• Studies that look at the development of standardized protocols for pediatrics and adults.
National Research Agenda Emergency Medical Services (NHTSA)	• Studies that look at the development of EMS researchers and the pedagogy of research for EMS personnel.
PECARN Research Agenda (PECARN)	• Studies that focus on education practices and training outcomes.
National EMS Research Strategic Plan (Sayre)	• Research that analyzes how to use new technologies to improve EMS education including how one retains knowledge and skills. • Validate prehospital provider entry level competence assessments • Determine best ways to produce, measure, and assure continuing competence for EMS personnel • Research ways to improve critical thinking and decision making skills
Seidel Article	• Develop methods to provide professional education/training and retraining to maximize skill acquisition and retention to improve practice patterns and patient outcomes.

Using the inclusion criteria, 18 adult and 3 pediatric clinical articles addressed education and training. Researchers selected healthcare providers (mostly prehospital providers) as the primarily study population and were interested in evaluating knowledge retention following the introduction of a training module. The articles that used patients as the study population evaluated different clinical areas including: airway management, stroke, diagnostic accuracy, drug administration, and general triage. Most studies used a pre-post design to evaluate knowledge retention. Four adult articles; Wollard et al, Soysal et al, Arreola-Risa et al, and Sarikaya et al were international studies with results generalizable to the United States system of care.

Nearly 90% of the articles addressed recommendations from either the 2006 IOM report, EMSOP, or the PECARN research agenda. Heegaard et al and Riley et al were the only articles that attempted to address Seidel's research recommendation to develop methods to provide professional education/training and maximize skill retention. In Heegaard, the researchers developed an ultrasound training program for air medical clinicians and evaluated competencies one year later. In Riley the decision-making capacity of EMT's was assessed before and up to one year after the administration of an educational intervention. The research of both Persee et al and Markenson et al specifically addressed EMSOP and Cone's recommendations by designing a study that examined the effect of a paramedic specific education/training program and quality improvement on patients. The latter study specifically examined the adoption of best practices by using improved patient outcome to quantify EMT-B and physician agreement on assessment of bronchospasm severity. Sanddal et al indirectly assessed quality improvement on patients when they measured the triage performance of prehospital caregivers. The article by Spaite et al addressed Cone's recommendation to study how to best educate EMS personnel by evaluating their comfort with and knowledge about special health care needs children before and after receiving a continuing education program. Limitations of this study included the low survey response rate which prevented generalizing the success of the intervention among prehospital providers.

The reported limitations of the articles were:

- small sample size of the studied population;
- self selection bias, which was found in most of the pediatric articles;
- lack of outcome data from the intervention; and
- failure to assess both skill retention and knowledge retention.

Further research using randomized controlled trials is needed to build upon the current studies and should:

- evaluate skills competency;
- determine optimal educational methods; and
- examine the outcomes of education and training programs.

Using the inclusion criteria, sixteen adult and five pediatric non-clinical articles addressed education and training. Of the three most recent articles published in 2007, two addressed the need for higher education to take a larger role in EMS training and recruitment. Articles by Lineback and Margolis recommended increased funding at the community college level or an EMS curriculum in an accredited institution to formalize and increase the quality of training of the EMS workforce. Two articles with a pediatric focus, Stevens and Alexander (2005) and Sanddal and Loyacono (2004) described positive influence that training EMTs on pediatric emergencies had on pediatric EMS competency. Articles written by Tobin et al and Jaslow and Ufberg (2003) examined the practice of paramedics in the urban environment using surveys that probed for their attitudes towards injury prevention and drug administration. Articles by Melby and Ryan (2005), Reisdorff et al, Ellison et al and two papers authored by Spaite and colleagues examined the quality of prehospital interactions between paramedics and four unique patient populations, the elderly, children, children with special health care needs and stroke victims. The aim of each paper was to expose the deficiency of EMT training targeted toward these groups and promote specialized training and simplified medical procedures for the prehospital setting.

The remaining articles in the education and training category examined EMT competency for performing life-saving prehospital procedures such as sternal intraosseous access and CPR, and training prehospital providers to recognize sentinel signs of domestic violence. Jezeirski (1999) and Hall et al promote training EMS providers to screen for domestic violence because of the opportunity EMTs have as first responders to observe and gather fresh forensic evidence.

Nearly half of the articles addressed recommendations from one of the IOM reports, *Emergency Care for Children Growing Pains: IOM Report* or *Future of Emergency Care: Emergency Medical Services at the Crossroads*, while the Cone Agenda's recommendation to research when and how best practices are adopted by EMS personnel was addressed in only 5 articles. It is noteworthy, however, that two of these articles push for an innovative approach to domestic violence screening i.e. prehospital screening by EMTs.

David Spaite and his colleagues twice connected pediatric special health care in the prehospital setting with the PECARN research agenda and Seidel research recommendation to evaluate the practical outcomes after EMTs have completed specialized training. Funk et al and Sanddal and Loyacano (2004) continued with this same post-test design to rate the effectiveness of an EMT training program following the NHTSA and EMSOP research agendas.

The literature found for the education and training category leaned heavily on the use of survey instruments to identify skills deficiencies in the EMS workforce. These tools were adequate for determining the attitudes of EMTs towards EMS education, specialized training for elder care, care of special needs children, the current state of trauma care competency, death education training and feelings towards pediatric emergencies providing a solid foundation for pilot studies and more rigorous study designs to determine optimal ways to produce a highly skilled and prepared EMS system.

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The table below summarizes the EMS Operations recommendations from the selected research agenda

Agenda	Research recommendation(s)
CDC Acute Care Injury Research Agenda (CDC)	• Evaluate how decisions are made regarding the value of preventive services • Evalute how injury management decisions are made for specific population • Evaluate the effects of acute injury beyond mortality such as morbidity, quality of life, functional status, and cost of acute injury.
Cone Prehospital Research Agenda (Cone)	No specific research recommendations
EMSOP Agenda	No specific research recommendation
Emergency Care for Children Growing Pains: IOM Report (Growing Pains)	• Develop evidence based model prehospital care protocols for the treatment, triage, and transport of adults and children.
Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report)	• Develop and validate evidence-based protocols for treatment, triage, and transport of patients. • Evaluate the impact and safety of EMS treat and release policies • Evaluate the effectiveness of new communication techniques and information technology • Evaluate the impact of technology on error reduction and improved decision making
National Research Agenda Emergency Medical Services (NHTSA)	• Assess EMS dispatching • Research EMS occupational health
National EMS Research Strategic Plan (Sayre)	• Develop and validate medical necessity criteria for dispatch, transport, and treatment • Identify disparities in EMS care in regards to (EMS personnel education, system design and resources, workforce diversity, health of the population) • Develop and evaluate performance improvement measures related to patient outcome • Develop improved severity measures that can be used clinically by EMS personnel or researchers for comparing outcomes of care. • Assess informed consent in EMS Research • Create a generalizable model for positioning EMS resources for optimal response and outcomes using new technology such as GIS • Analyze how to use new technologies to improve EMS education including how to retain knowledge and skills • Evaluate prehospital diagnostic tools and treatments e.g. blood substitutes and hemostatic dressings. • Identify strategies that facilitate ethical conduct of research without impeding important investigations.
PECARN Research Agenda (PECARN)	No specific research recommendation
Seidel Article	• Measure and improve quality of EMS care to include care provided by prehospital providers

The category of EMS operations contained close to sixty articles focusing on adult clinical trials and three articles with a pediatric focus. This category was unique in that it addressed a variety of issues such as occupational health, ethics, EMS technology, and treat –and- release at the scene. Study designs used in each article varied between four methods: cohort, cross-sectional, or case series. The most common study design was a cross-sectional study, while the least common study design was case control. Three of the studies took place outside the United States, but their results were considered generalizeable.

While the 2006 IOM Report and the National Research Agenda made the most recommendations, the only area of overlap between the agendas involved treatment and patient care, which are addressed by the IOM Reports and the Seidel agenda.

The majority of studies, thirty-two, focused on three broad categories: occupational health, specific treatment and patient care, and transportation. The only agenda to address occupational health was the *National Research Agenda Emergency Medical Services* (NHTSA), which listed this category a topic to focus on for future research. Thirteen articles examined the occupational health of emergency service providers measuring anxiety and stress associated with schedule changes, violent encounters during field response, and transport of critical cases. Seven of these studies defined physical maladies of the musculoskeletal system affecting providers.

One non-clinical study addressed ethical issues related to EMS meeting the research recommendations of the *CDC Acute Care Injury Research Agenda* and Cone Agenda. The article by Sandman and Nordmark did identify the ethical conficts ecountered in the field and how EMS personnel are handling a growing number of prehospital ethical conflicts normally seen in the hospital setting. These conflicts concern the patient/provider relationship, the patient's self-determination, the patient's best interest, the provider’s professional ideals, and the provider’s professional role and self-identity. Although this category yielded only one study, informed consent in EMS research has been highlighted as a need for further research. In addition, it is recommended that future studies address the influence of sociogeographical or educational factors on ethical conflicts in the prehospital setting.

Both the Seidel agenda and the *National EMS Research Strategic Plan* (Sayre) recommend research on the effects of EMS operations on the quality of patient care. Billittier et al, Pace et al, Guru et al, Wirtz et al, and Kurola et al examined EMS operations with respect to quality of patient care. While the EMSOP Agenda does not offer specific research recommendations related to EMS Operations, the agenda urges outcomes research in pediatric and adult cases of emergency care and the work of Stiell et al, Roudsari et al, Burton et al, Kurola et al, Wirtz et al, and Cone et al address this research recommendation.

Three of articles addressing EMS technology examined specific medical procedures used in the prehospital setting and tested their efficacy against alternative time-saving or complication reducing procedures. The article by Garvey and McLeod (2006) weighed the temporal benefits of early fibrinolytic therapy indicated by prehospital ECG diagnosis of myocardial infarction, and the work of Pavlopoulos et al evaluated the temporal benefits of telemedicine to prehospital diagnosis. The work of Freeman et al advises that EMS providers use a novel device designed to reproduce favorable atmospheric pressure conditions for the patient helping to arrest the progression of high altitude sickness. The articles by Garvey and McLeod (2006) and Weitzel et al approximate ideal study designs that result in evidence in this category for implementing one procedure or device over another, and for the early administration of therapy. The Gamow bag promoted by Freeman et al is an example of a newly evaluated patient stabilization device with ties to the research recommendations of the National EMS Research Strategic Plan (Sayre agenda). This agenda specifically promotes research into new resuscitation strategies such as new CPR techniques, ubiquitous defibrillators and therapeutic hypothermia. Use of the Gamow bag and early

application of fibrinolytic therapy indicated by prehospital ECG are also examples of innovative use of established tools and treatments advised by the Sayre and CDC agendas. The work of Pavlopoulos et al fits the 2006 IOM Report recommendation to develop interoperable data systems because it describes the advantages of data-driven telemedicine in the prehospital environment.

The existing literature did not report research on any new innovative devices or procedures but instead examined novel uses of established technology. The use of telemedicine in the prehospital setting, for example, may hold great promise for improving emergency care by allowing the emergency physician remote, so-called on-line, control of the scene of the emergency. The agendas of Cone et al, PECARN and Seidel et al produced no specific recommendations for this category.

While recently there has been increase media interest in the safety, cost, status and necessity of air medical transport, the research agendas of the 2006 IOM Report, the IOM Report (Growing Pains) and Sayre had previously recommended the assessment of patient transport systems. Jones et al, for example, noted nationwide deficiencies in air medical transport systems abilities to handle high risk obstetric cases. Benner et al, however, described high agreement between air medical transport crew and ED staff diagnosis of serious head and spinal cord injuries. Together these two studies underscore the Sayre agenda's recommendation to "gather cost-effectiveness data for air medical transport."

Limitation of EMS operations articles included:

- Source of data collection
- Improper definitions of categorical variables
- Minimal background information provided on study design
- Small sample size

Recommendations for future research:

- Expand on the National Research Agenda to evaluate all aspects of occupational health for emergency service providers.
- Focus future research on aspects of air transport including time intervals to treatment, the appropriateness of transport method and the relationship between ground emergency service providers and air emergency service providers.
- Review interventions with the aim of reducing time to treatment.
- Examine elements of the 911 dispatch system in conjunction with transport.
- Improve uptake of technology to further patient care
- Informed consent in EMS research

The National EMS Research Strategic Plan (Sayre) offered the most recommendations regarding EMS Operations addressing the occupational health and safety of prehospital personnel, a recommendation of the National Research Agenda Emergency Medical Services report (NHTSA). Between 1998 and 2005 eight articles in the journal *Prehospital Emergency Care* examined correlates to compromised EMT job safety such as assaultive patients, concealed weapons and adverse health outcomes of current practice such as hearing loss and other occupational injuries, ambulance accidents, and reduced EMT service time.

Research related to actual scope of practice, items of interest in the IOM Report (Growing Pains), Emergency Medical Services at the Crossroads (2006 IOM Report), National Research Agenda Emergency Medical Services (NHTSA), and the Seidel article, included optimized partnering among EMS

workers, and prehospital provider competencies for drug administration, diagnostic (triage) accuracy, transport decision-making, IV placement and family-involved care.

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The table below summarizes the Injury and Trauma recommendations from the selected research agendas

Agenda	Research recommendation(s)
CDC Acute Care Injury Research Agenda (CDC)	• Research should focus on adopting science based recommendations and guidelines for care of the critical injured (including strategies to translate, disseminate, and implement findings) • Develop and evaluate acute injury treatment strategies that will result in evidence-based management protocols • Identify and evaluate the impact of acute injury care on mass casualty/disaster events • Assess short/long term outcome measures for patients treated in pre-hospital/hospital acute injury care settings
Cone Prehospital Research Agenda (Cone)	No specific recommendation
EMSOP Agenda	No specific recommendation
Emergency Care for Children Growing Pains: IOM Report (Growing Pains)	• Focus research on pediatric injury
Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report)	• Effectiveness of EMS system dealing with injuries
National EMS Research Strategic Plan (Sayre)	• Research techniques for rapid induction of hypothermia in the prehospital and benefits • Strategies for injury management • Research treatment of hemorrhagic shock • Use of spinal immobilization • Strategies for treatment of acute traumatic brain injury including airway management
National Research Agenda Emergency Medical Services (NHTSA)	• Measures to reduce injury and promote prevention
PECARN Research Agenda (PECARN)	• Identified injury prevention as a priority research topic
Seidel Article	• Continued research on public education in injury prevention

Based on the inclusion criteria, this category includes eleven adult articles and one pediatric article. Injury and trauma issues covered by these articles include spine immobilization, traumatic brain injury, care provided by personnel (including pediatric patients), and penetrating abdominal injuries in adults. Agendas addressed by these articles include the CDC Acute Care Injury Research Agenda (CDC), the 2006 IOM Report, the National EMS Research Strategic Plan (Sayre), National Research Agenda Emergency Medical Services (NHTSA), and the Seidel Article.

The article by Burton et al examines the use of a spine immobilization protocol for trauma patients. The study showed that when a spine assessment protocol to select patients for immobilization was used, providers neglected to immobilize fewer than 1 in 32,000 patients in need of stabilization for spinal fracture. This paper addressed the research recommendations of the CDC Acute Care Injury Research Agenda (CDC) and the National EMS Research Strategic Plan (Sayre).

Four articles addressed traumatic brain injury (TBI). Two articles by Davis et al examined the use of the Glasgow Coma Scale (GCS) for predicting the outcomes of patients requiring neurosurgical intervention or intubation. Bochicchio et al compared airway management of these patients in the field with those not intubated and Davis et al in their third paper examined rapid sequence intubation (RSI) of TBI sufferers. The latter two studies showed that field intubation negatively delayed surgery and increased rates of hypoxia and mortality. All of these studies address the recommendations of the CDC Acute Care Injury Research Agenda (CDC), 2006 IOM Report, and the National EMS Research Strategic Plan (Sayre).

The standard of care provided by EMS personnel was studied in four articles. Osterwalder et al, Hale et al, Liberman et al, and Garner et al examined EMS care stratified by staff structure and competency. Osterwalder, Liberman, and Garner examined patient outcomes (mortality and treatment received) based on staffing. Liberman using mortality as an outcome measure showed that death rates fell in patients treated with BLS compared with those treated with ALS. Osterwalder et al, again using mortality as an outcome measure, showed no difference between the death rate of patients treated by emergency physicians and the death rate of those treated by EMTs. Garner showed that the addition of a physician to a flight crew would increase survival numbers from eight to nineteen per 100 patients compared to survival numbers of crews staffed with a paramedic. Hale et al compared wound assessment by EMT-Bs to physicians; the comparison resulted in 100% sensitivity and specificity for their ability. The CDC Acute Care Injury Research Agenda (CDC) and 2006 IOM Report were addressed by these studies.

One pediatric article (by Qazi et al) examined trauma team activation. This cohort study had a specificity of 87.7% and sensitivity of 50% for paramedic judgment for trauma team activation. This article does not address research recommendations for pediatric patients in the selected agendas.

Trauma was addressed for adults in two articles by Bickell et al; both articles focused on penetrating abdominal injuries. One focused on fluid resuscitation while the other examined the use of pneumatic anti-shock garments (PAGS). Delayed fluid resuscitation resulted in improved outcomes following surgery while the use of PAGS did not significantly impact patient care our outcomes. Agendas addressed by these articles include the CDC Acute Care Injury Research Agenda (CDC), the 2006 IOM Report, and the National EMS Research Strategic Plan (Sayre).

Limitations of the studies include:

- Data not collected prospectively but by chart review
- Inability of validating field assessments (GCS and Trauma Score and Injury Severity Score)
- Insufficient sample size
- Lack of randomization
- Subjective prehospital care assessments
- Results not generalizable to other populations

Based on this analysis, further study is needed in regards to injury and trauma including a greater focus on pediatric patients. Although injury prevention is a recommendation in three of the selected agendas, it is not addressed in any of the included articles. Other recommendations for further research

include:

- Assess short/long term outcome measures for patients treated in pre-hospital/hospital acute injury care settings
- Research treatment of hemorrhagic shock
- Strategies for injury management
- Development of injury treatment protocols

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The table below summarizes the Neurological Management recommendations from the selected research agendas

Agenda	Research recommendation(s)
CDC Acute Care Injury Research Agenda (CDC)	No specific recommendation.
Cone Prehospital Research Agenda (Cone)	No specific recommendation.
EMSOP Agenda	• Management of seizures in children
Emergency Care for Children Growing Pains: IOM Report (Growing Pains)	No specific recommendation
Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report)	• Impact of prehospital ventilation and intubation on patients with head injuries
National Research Agenda Emergency Medical Services (NHTSA)	No specific recommendation
National EMS Research Strategic Plan (Sayer)	• Pediatric seizure management therapy • Innovative interventions and neuroprotective agents to prevent lethal brain swelling due to traumatic brain injury (TBI). • Strategies for management of TBI including airway management/ventilation strategies • Evaluate effectiveness of prehospital stroke therapy
PECARN Research Agenda (PECARN)	• Seizure management in children
Seidel Article	• Management of seizures in children • Management of brain injury in children

8 adult and one pediatric study addressed the management of neurological conditions. Stroke including early drug intervention and stroke protocol identification was the primary focus of the clinical and non clinical articles followed by the treatment of seizures. The single pediatric article focused on the use of midazolam for the treatment of seizures in the prehospital setting.

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The EMS Research Strategic Plan (Sayer) offered specific recommendations that were addressed in the majority of articles. Crocco et al studied a hypothetical scenario where prehospital providers administered sodium as a neuroprotective agent for stroke victims. Saver et al evaluated the functional outcomes of stroke patients who received intravenous magnesium as a neuroprotective agent in the prehospital setting and showed a positive functional outcome for stroke patient 3 months after therapy. Although these two studies evaluated neuroprotective agents in the prehospital setting, the Sayer agenda recommended neuroprotective agents to be studied for traumatic brain injury patients. Riopelle et al evaluated the effectiveness of maintaining an adequate supply of recombinant tissue plasminogen activator (rtPA) to stroke patients within a specified mile radius served by a tertiary facility. The article showed that the geography of this region did not effect access to treatment for stroke patients. Finally Vilke et al assess the effectiveness and safety of using IV and IM midazolam to pediatric seizure patients in the prehospital setting. The study showed patients that received the medications from paramedics reported improvement and that greater success was seen with IV administration compared to IM.

The single pediatric article addressed recommendations from EMSOP, National EMS Research Strategic Plan, PECARN and Seidel research agendas. The literature review shows that the studies did not many adult neurological conditions. Kellum et al, for example, touched on neurologic damage associated with cardiac arrest, a research concept of the National EMS Research Strategic Plan (Sayer) applicable to all heart emergency patients, but failed to examine the mitigating potential of induced hypothermia. The same agenda calling for neuroprotective agent evaluation in treating traumatic brain injury (TBI) patients was incompletely examined in Kidwell et al which focused on temporal influences of agent administration and not the drug class's ability to reduce brain swelling in TBI cases.

The reported limitations of the adult and pediatric articles were:

- use of an observational design with historical controls.
- failure to sample and analyze subgroups
- insufficient sample size
- failure to blind the people evaluating the intervention's outcome
- convenience sampling rather than random sampling in at least 4 studies.

Based on this analysis, further research is needed for the clinical management of neurological conditions in the prehospital setting including:

- the impact of prehospital ventilation and intubation of patients with head injuries,
- new treatments such as therapeutic hypothermia, and
- new immobilization strategies for sufferers of spinal injuries.

It’s recommended that future studies use a randomized design and that additional studies are needed to further examine temporal effects when the protocols for administering seizure medication are modified. Finally two articles addressed paramedic assessment skills of stroke. Rajajee and Sayer’s highlighted EMS responses to stroke warning signs and Bray et al studied an education al intervention and use of a stroke tool to facilitate the paramedic’s diagnosis of stroke. Although the above agendas did not address paramedic assessment skills, follow up research may be needed in this area.

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The table below summarizes additional Clinical Management recommendations from the selected research agendas.

Agenda	Research recommendation(s)
CDC Acute Care Injury Research Agenda (CDC)	• Identify/evaluate health measures to assess short and long term outcomes for those treated in the prehospital and hospital acute care setting.
Cone Prehospital Research Agenda (Cone)	• Adherence to evidence-based guidelines directed care in the prehospital setting • Examine the effectiveness of common practices from a risk/benefit and cost/benefit perspective • Examine how prehospital providers analyzes and implements scientific evidence
EMSOP Agenda	No specific research recommendation
Emergency Care for Children Growing Pains: IOM Report (Growing Pains)	• Implement evidence based clinical practice guidelines
Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report)	• Outcomes research for the use of medications for specific conditions such as diabetes
National Research Agenda Emergency Medical Services (NHTSA)	No specific research recommendations
PECARN Research Agenda (PECARN)	No specific research recommendations
Seidel Article	No specific research recommendations

This category included a variety of studies that addressed issues such as the treatment of diabetes in the prehospital setting, the management of motion sickness during transport, and the creation of a new role for prehospital providers at mass gatherings. Only 5 articles were included in this category and the topics were random. An evaluation of the role of prehospital providers in glucometry testing touched upon the 2006 IOM Report's research recommendation, but the articles did not study outcomes research for a specific medication to treat diabetes. However, Barton et al specifically addressed the recommendation by studying the effectiveness of intranasal naloxone for patients that exhibited altered mental status or suspected opioid overdose. Although Bertalanffy et al did not study a specific medication; the use of Korean hand acupressure was evaluated through a randomized controlled trial for the treatment of motion sickness during prehospital transport. The study found that those treated with the acupressure experienced less motion sickness.

Limitations of the included articles were:

- lack of randomization
- incomplete documentation
- unable to generalize results to other populations
- no external validation of survey tool

- recall bias
- no follow up
- sampling bias
- insufficient sample size

It is recommended that future studies address the above research recommendations. Although studies by Strote et al and Lerner et al did not specifically meet the 2006 IOM Report's recommendation to study a specific medication for diabetes, the studies touched upon the issue of the role of prehospital providers with glucometry testing that may need to be studied further.

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The table below summarizes the Pain Management recommendations from the selected research agendas

Agenda	Research recommendation(s)
CDC Acute Care Injury Research Agenda (CDC)	• Development and evaluation of protocols and interventions along the short- and long-term outcomes; specifically for the effects of pain and pain management
Cone Prehospital Research Agenda (Cone)	• Research should explore the effectiveness of frequent practices from the risk/benefit and cost/ benefit perspectives to identify harmful practices and tailor interventions • Focusing on the assessment of patients, clinical decisions and the delivery of appropriate care • Research best practices for development and validation
EMSOP Agenda	• Research on the effects of EMS care in regards to discomfort relief (i.e. pain) • Studies on methods to measure pain • The feasibility and validity of verbal pain-rating scales as administered by out-of-hospital providers • Applicability of pain measurement tools for various conditions • Researchers must develop an easy and efficient valid infant pain scale for use by out-of-hospital care providers
Emergency Care for Children Growing Pains: IOM Report (Growing Pains)	No specific recommendations
Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report)	No specific recommendations
National EMS Research Strategic Plan (Sayre)	• Develop strategies for identification and management of pain
National Research Agenda Emergency Medical Services (NHTSA)	• Research the efficacy of field therapies • Proper and efficient patient care • Systematic approach to pain management (i.e. replenishing pain medication supplies)
PECARN Research Agenda (PECARN)	• Pain and anxiety management
Seidel Article	• Prevention and relief of physical pain

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Six adult articles (one that included pediatric patients over the age of ten) and one pediatric-specific article are included in the section based on the inclusion criteria. The adult articles focused on hip fractures, pain assessment through tools, and provider perception; the pediatric article focused on the treatment of pain. The CDC Agenda, Seidel Article, Cone Prehospital Research Agenda, EMSOP Agenda, National Research Agenda Emergency Medical Services (NHTSA), and the 2006 IOM Report were addressed by these articles.

Pain management for hip fractures was studied in two articles (Lang et al and Barker et al). While both studies utilized a randomized control study design, the focus differed as Lang examined the use of transcutaneous electrical nerve simulation while Barker examined acupressure. Both studies showed that the intervention reduced pain, along with anxiety scores. This addresses the recommendations from the National Research Agenda Emergency Medical Services (NHTSA), National EMS Research Strategic Plan (Sayre), EMSOP Agenda, CDC Agenda, and Cone Prehospital Research Agenda; however, hip fractures were the only condition studied in regards to pain management.

Lord et al and Luger at el examined pain assessment using a cohort study design. Use of the visual analogue scale (VAS) was examined by Lord and found that even without analgesia patients had a reduction in VAS score. Providers were also surveyed in the study. Overall providers felt that patients overrate pain severity and that their own perception of the pain a patient experiences is accurate. However, the article by Luger found that EMS personnel underestimate pain. The VAS, along with a verbal pain score, was used in this study. Both of these articles address the EMSOP agenda, National Research Agenda Emergency Medical Services (NHTSA), and Cone Prehospital Research Agenda (Cone).

Providers were studied in the articles by Hennes et al and Jones et al; both utilized a cross-sectional study design. The study by Hennes found a discrepancy between pain assessment and practice of pain relief; specifically documentation and use of analgesic was lower for pediatric patients compared to adults. The work by Jones adds areas where knowledge for pain management could be improved through further training. These two articles address multiple recommendations; although pediatric patients were included the recommendations for research in regards to this population were not addressed.

Pediatric patients are specifically studied in the article by Watkins et al; this is the only article to address the recommendation from the PECARN Research Agenda and Seidel Article. Pain management was studied for the use of analgesia in the prehospital setting. Over half of the study population received prehospital analgesia and providers did not perceive age as a factor for the use of analgesia.

Of the research agendas, the EMSOP Agenda had the greatest focus on researching pain assessment tools. Patient discomfort, including pain, was identified through a consensus process which led to further evaluation of current research for prehospital pain management. Although multiple pain measurement tools exist, not all are appropriate for the prehospital setting or for all conditions, nor have they been thoroughly studied in the prehospital setting as cited in the EMSOP Agenda. Pain relief was also recommended in the CDC agenda and National EMS Research Strategic Plan (Sayre); this was also a priority in both the PECARN agenda and Seidel Article which have a pediatric focus.

Limitations of the included studies are:

- Insufficient sample size
- Cross-over effect
- Variability in study times
- Data collection done at hospital for a study on transport
- Lack of comparison to standard intervention (e.g. analgesic drugs)

- Study instrument not validated

Since the early 2000's, pain management has been a stated priority for many healthcare institutions. This becomes evident as most of the articles are published after 2003. Despite the research agenda recommendations for increased research into pain management and more aggressive treatment by all healthcare providers, the literature review yielded relatively few pediatric and adults research articles related to this topic. It is recommended to conduct research based on all of the recommendation in the above table. In particular, some of the studies should focus on the research recommendations from the agendas.

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The table below summarizes the Patient Safety recommendations from the selected research agendas

Agenda	Research recommendation(s)
CDC Acute Care Injury Research Agenda (CDC)	• Develop and evaluate interventions to improve patient safety in health care settings using strategies that have helped prevent and control injuries
Cone Prehospital Research Agenda (Cone)	No specific recommendations
EMSOP Agenda	No specific recommendations
Emergency Care for Children Growing Pains: IOM Report (Growing Pains)	Best practices for improving patient safety in prehospital and ED care in the following areas: • Medication identification technology • Pediatric specific technologies and equipment for emergency and trauma care • Performance measures pre/post the implementation of information systems. • Evidence of the effectiveness of simulation base training • Efficacy, safety, and health outcomes of medications for children age 0-18 years • Crowding, communication, and provider resources.
Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report)	• Identify safest and most effective method for airway management in the prehospital environment • Safety and impact of routing non-emergency 9-1-1 calls to nurse advice lines • Safety and impact of treat and release policies versus EMS transport
National Research Agenda Emergency Medical Services (NHTSA)	• Research that focuses on reducing medical errors
National EMS Research Strategic Plan (Sayre)	• Research to determine errors that take place in the prehospital setting.
PECARN Research Agenda (PECARN)	• Reduce medication errors
Seidel Article	No specific recommendations

Based on the inclusion criteria, eight adult and one pediatric study addressed patient safety. Included in the adult count was a study looking at the safety and efficacy of paramedics using intranasal naloxone on patients 14 years and older in the prehospital field. Most of the adult articles centered on airway management and the difficulty paramedics experienced while intubating patients in the prehospital setting. The sole pediatric article focused on the ability of paramedics to accurately estimate patient weight in the field.

By focusing on the complications of maintaining proper airway in the prehospital environment, the adult articles met the broad recommendations of the CDC and NHTSA agendas and addressed the more specific recommendations of the 2006 IOM report. What these articles failed to do was to identify

safe and effective methods (i.e. best practices) for airway management, though they did identify system characteristics that could potentially lead to intubation errors.

Although the authors did not intend to recommend the best methods for intubating patients in the pre-hospital setting, Bair et al did characterize the techniques most frequently used by prehospital providers to confirm intubation. Frakes et al examined endotracheal tube placement during transport by flight crews but similarly made no specific recommendations. It is noteworthy that Frakes' team reported a lower misplacement rate than reported in previous literature.

By quantifying the frequency of accurately estimated pediatric weight Vilke et al met the broad NHTSA, CDC, and IOM Growing Pains recommendations. Although none of the articles included here identified specific methods for improving patient safety, Vilke's pediatric article indirectly recommended the use of the Broselow tape to estimate pediatric weights by demonstrating its accuracy. In addition, the article by Wills et al satisfied Sayre's recommendation to study EMS system issues that affect patient safety by describing those systemic issues potentially prone to errors. This study assessed the rate of over triage as a consequence of protocols that promote helicopter transport of patients to a trauma center and assessed the temporal issues of helicopter transport and the likelihood of improved outcomes.

Finally, Barton et al began to address the *IOM's Growing Pains* recommendation to research the efficacy, safety, and health outcomes of medications for children under 19 years by studying the intranasal administration of naloxone to treat suspected opioid overdose in patients under 15. Their study design, however, prevented researchers from comparing the efficacy of intranasal administration with traditional intravenous administration.

The reported limitations of the pediatric and adult studies:

- insufficient sample size in two of the articles;
- lack of randomization or blinding;
- self reporting which potentially diminished the accuracy of the study results
- inconsistent operational definition in two of the studies which compromised data categorization

Further pediatric and adult research, specifically, randomized controlled trials that demonstrate sources of errors and ways to reduce error, is needed in the area of patient safety. Studies to completely answer the research questions of Bair, Vilke, and Barton should:

- recommend specific intubation confirmation techniques to be utilized by prehospital providers in the field;
- identify and recommend methods for accurately measuring pediatric weights in the field, and
- evaluate whether the weight estimation tool leads to safer medication dosing and administration in the prehospital field;
- design a randomized controlled trial that studies the efficacy of using intranasal naloxone versus intravenous naloxone in the field.

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Appendix A: Literature Review: Clinical Studies

Clinical Management: Cardiac							
Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
National Research Agenda Emergency Medical Services, 2006 IOM Report	Bobrow BJ, Clark LL, Ewy GA, et al. Minimally interrupted cardiac resuscitation by emergency medical services for out-of-hospital cardiac arrest. Journal of the American Medical Association 2008; 299(10):1158-1165.	**Study Design Type:** Non-randomized controlled trial **Sample Size:** 5,751 **Population Studied:** Patients with out-of-hospital cardiac arrests	To investigate whether the survival of patients with out-of-hospital cardiac arrest would improve with minimally interrupted cardiac resuscitation (MICR), an alternate emergency medical services (EMS) protocol. A before and after analysis and protocol compliance analysis were performed to evaluate this objective.	Intervention: Patients receiving care from EMS personnel trained in MICR (n=668) Control: Patients receiving care from EMS personnel not trained in MICR (n=218)	**Outcomes Measured:** Survival-to-hospital discharge **Results:** In the before and after analysis, survival-to-hospital discharge increased from 1.8% (4/218) before MICR training to 5.4% (36/668) after MICR training. In the protocol compliance analysis, survival was significantly better among patients who received MICR (9.1% [60/661]) than those who did not (3.8% [69/1,799])	1) MIRC intervention was not tested in a randomized controlled trial. 2) The MICR training may have may have motivated EMS personnel to provide better care independent of the specific MICR protocol. 3) MICR was compared with the approach used by fire departments in their community during a period when the American Hospital Association (AHA) Guidelines were updated. Some of the non-MICR fire departments were following the 2000 AHA Guidelines while others were following the 2005 AHA Guidelines. 4) Ascertainment bias – Possibility that the most enthusiastic and skilled EMS personnel provided MICR and the least enthusiastic or least skilled EMS personnel did not.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=18334691

Clinical Management: Cardiac							
Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
						Additionally, EMA personnel may have preferentially provided MICR to the patients most likely to survive.	
2006 IOM Report, EMSOP	Le May MR, So DY, Dionne R, et al. A citywide protocol for primary PCI in ST-segment elevation myocardial infarction. New England Journal of Medicine 2008;358(3):231-240.	**Study Design Type:** Case series **Sample Size:** 344 **Population Studied:** Patients with ST-segment elevation myocardial infarction referred for percutaneous coronary interventions (PCIs)	To determine whether there is a difference in door-to-door balloon times between patients who referred directly from the field by paramedics trained in interpretation of electrocardiograms and patients who were referred by ED physicians to a designated primary percutaneous coronary intervention (PCI) center.	Paramedic referred pathway: advanced care paramedics evaluated patients with chest pain at scene. If pain was attributed to myocardial ischemia, patients were administered chewable aspirin and sublingual nitroglycerin. Patients with pain onset 12 hours or less before presentation and elevated ST segment were transferred directly to cardiac care center. Interhospital transfer pathway: patients arriving in ED either by self transport or ambulance were triaged by nurse and evaluated by ED physician. Those with pain onset 12 hours or less and	**Outcomes Measured:** Primary endpoint: proportion of patient who has door-to-door balloon times within the 90 minute recommended guideline. Secondary endpoints: mortality, reinfarction, stroke, cardiogenic shock, and major bleeding. **Results:** The median door-to-door balloon time was shorter in patients referred from the field (69 minutes) than in patients needing interhospital transfer (123 minutes). Door-to-door balloon times < 90 minutes were achieved in 79.7% of patients referred from field; and in 11.9% of	Results do not apply to areas in which ambulance services are suboptimal or to regions in which transfer distances are unusually long.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=18199862

Clinical Management: Cardiac							
Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
				elevated ST segment were transferred to the cardiac care center.	those transferred from emergency departments.		
CDC Acute Injury Care Research Agenda, EMSOP Agenda	McLean S, Egan G, Connor P, et al. Collaborative decision-making between paramedics and CCU nurses based on 12-lead ECG telemetry expedites the delivery of thrombolysis in ST elevation myocardial infarction. Emergency Medicine Journal 2008;25(6):370-374.	**Study Design Type:** Cohort **Sample Size:** 11,840 **Population Studied:** Patients who telephoned the ambulance service with "chest pain"	To describe a prehospital thrombolysis (PHT) and expedited inhospital thrombolysis (IHT) program in southeast Scotland using prehospital 12-lead electrocardiograms (ECG) recordings transmitted by telemetry and autonomous paramedic-administered thrombolysis with decision support being provided by coronary care nurses.	PHT and IHT programs	**Outcomes Measured:** Type and time of patient presentation and symptoms-, call-, and door-to-thrombolysis times. **Results:** Of the patients transported by the Scottish Ambulance Service (SAS) who received thrombolysis either before arriving at the hospital or through telemetry-facilitated IHT, there were no significant differences in symptoms-to-call time, SAS response time, or time from symptoms-to-hospital arrival.	The statistically significant differences in SAS on-scene time and travel time may have been a type I error caused by the relatively small sample size. Also, long term outcome data are None reported but may have been useful in determining the benefits of prehospital 12-lead ECGs.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=18499828
National Research Agenda: Emergency Medical Services	Estner HL, Gunzel C, Ndrepepa G, et al. Outcome after out-of-hospital cardiac arrest in a physician-staffed emergency medical system according to the Utstein style.	***Study Design Type:*** Case Series **Sample Size:** 539 **Population Studied:**	To investigate the impact of a physician on the outcome of patients after out-of-hospital cardiac arrests (OHCA).	Resuscitation attempt on patients according to Utstein style by physician, layperson, or EMS personnel.	**Outcomes Measured:** Patient discharged alive from the hospital. **Results:** Of 412 patients with an OHCA, 180	Limited study population. Physician-staffed ALS systems were not included in the study because of lack of data. German legal restrictions limited	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17452155

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	American Heart Journal 2007;153(5):792-799.	Patients with out-of-hospital cardiac arrests (OHCA) in the community of Dachau in whom resuscitation was attempted between January 2000 and January 2006			(43.7%) were admitted to the hospital, and 47 (11.4%) were discharged alive. Resuscitation was started by a physician in 117 (28.4%) patients, by a layperson in 118 (28.6%), or by an EMS personnel in 177 (43.0%). A total of 18 patients (18.6%) were treated by physicians, 13 (8.0%) were treated by EMS personnel, and 16 patients (16.5%) resuscitated by laypersons were discharged from hospital.	the assessment of MD-staffed ALS units. Protocols to determine the cause of arrest are too presumptive.	

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2006 IOM Report, CDC Acute Injury Care Research Agenda	Gross BW, Dauterman KW, Moran MG, et al. An approach to shorten time to infarct artery patency in patients with ST-segment elevation myocardial infarction. American Journal of Cardiology 2007;99(10):1360-1363.	**Study Design Type:** Case Series **Sample Size:** 233 **Population Studied:** Adult patients with diagnosis of ST-elevation myocardial infarction (STEMI)	To evaluate a regional strategy (protocol) to decrease time to percutaneous coronary intervention (PCI) for patients with ST-elevation myocardial infarction (STEMI).	Implementation of protocol for paramedics and referring hospitals to directly triage patients with STEMI to a pre-alerted percutaneous coronary intervention (PCI) hospital.	**Outcomes Measured:** Time to PCI reperfusion and in-hospital mortality as compared to other patterns of arrival **Results:** An interval of 90 minutes from hospital door-to-PCI was achieved in 58.3% of paramedic-diagnosed and -triaged patients compared to 37.5% of PCI hospital walk-ins and 5.2% of interhospital transfers. Thus, there were substantial time savings in time to PCI for paramedic-identified patients. Overall mortality was 0% in paramedic-identified patients and PCI hospital walk-ins compared to 4.3% for interhospital transfers.	Generalizability of results Observational study design.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17493460

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2006 IOM Report; EMSOP	Stiell IG, Walker RG, Nesbitt, LP, et al. A randomized comparison of fixed lower versus escalating higher energy levels of defibrillation in out-of-hospital cardiac arrest. Circulation. 2007; 115:1511-1517.	**Study Design:** Randomized controlled trial **Sample size:** 221 **Population Studied:** out of hospital cardiac arrest receiving at least 1 shock via biphasic automated external defibrillator devices	Compare fixed lower and escalating higher energy regimens in out of hospital cardiac arrest	AED, escalating higher energy (200-300-360 J)	**Outcome Measured:** Termination of ventricular fibrillation (VF) and the initiation of an organized rhythm within 60 seconds. Secondary outcome is the termination of ventricular fibrillation for at least 5 seconds after the shock, regardless of the resulting rhythm **Results:** Both lower and higher energy groups presenting initially with asystole rhythm equally responded rapidly with defibrillation. Rates of conversion to an organized rhythm and VF termination are significantly affected by the energy level of subsequent shocks.	Small sample size; the study did not control defibrillation waveforms or energy regimen during the ALS tier of care	http://circ.ahajournals.org/cgi/reprint/115/12/1511
National Research Agenda Emergency Medical Services	Bjorklund E, Stenestrand U, Lindback J, et al. Pre-hospital thrombolysis delivered by	**Study Design Type:** Case Series **Sample Size:** 5,375	To determine the impact of pre-hospital thrombolysis (PHT) on the outcomes of patients suffering	Prospective review of data on two intervention groups: Intervention group 1: Received pre-	**Outcomes Measured:** Time-to-treatment, mortality, incidence of complications and procedures.	The treatment strategy wasn't assigned randomly, and this leaves the possibility that unknown	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16624832

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	paramedics is associated with reduced time delay and mortality in ambulance-transported real-life patients with ST-elevation myocardial infarction. European Heart Journal 2006;27(10):1146-1152.	**Population Studied:** Ambulance-transported patients younger than age 80 with a final diagnosis of acute myocardial infarction (AMI), treated with thrombolysis and with information on time to thrombolysis.	from ST-elevation myocardial infarction (STEMI)	hospital thrombolysis (n=1690) Intervention group 2: Received in-hospital thrombolysis (n=3685)	**Results:** For PHT patients, the median time from symptom onset to treatment was 113 minutes compared to a median time of 165 minutes for in-hospital thrombolysis patients. One-year mortality was 7.2% for PHT and 11.8% for in-hospital thrombolysis. PHT was strongly associated with decreased likelihood of heart failure.	differences in baseline characteristics influenced the results.	
EMSOP, 2006 IOM Report	Hallstrom A. Rea TD, Sayre MR; et al. Manual Chest compression vs. use of an automated chest compression device during resuscitation following gout of hospital cardiac arrest: A randomized trial. JAMA.2006; 295(22):2620-2628.	**Study Design:** randomized trial **Sample Size:** 1071 **Population Studied:** adults with cardiac arrest that occurred prior to EMS arrival	To compare resuscitation outcomes following out of hospital cardiac arrest when an automated LDB-CPR was added to standard EMS CPR care.	The use of LBD-CPR during cardiac arrest.	**Outcome Measured:** Primary-survival with spontaneous circulation 4 hours after "911"call. Secondary: survival to hospital discharge and neurological status (chart obtained cerebral performance score) of survivors. **Results:** Interim results stopped the study prior to its	There was no standardized point of care for the implementation of LBD-CPR. No evaluation of the quality of manual CPR (rate, depth) or the difference in manual vs. LBD-CPR compressions differed later in the course of resuscitation.	http://jama.ama-assn.org/cgi/content/full/295/22/2620

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					completion. The 4 hour survival outcome was similar between both groups in primary cardiac arrest patients. LBD-CPR group had a lower hospital discharge survival outcome and a lower survival with neurological status outcome.		
National Research Agenda Emergency Medical Services, CDC Acute Injury Care Research Agenda	Kellum MJ, Kennedy KW, Ewy GA. Cardiocerebral resuscitation improves survival of patients with out-of-hospital cardiac arrest. American Journal of Medicine 2006;119(4):335-340.	**Study Design Type:** Cohort **Sample Size:** 125 **Population Studied:** Patients with out-of-hospital cardiac arrest (OHCA)	To compare the outcomes of treatment based on new guidelines for cardiocerebral resuscitation (CCR) to those of cardiopulmonary resuscitation (CPR)	CPR, CCR	**Outcomes Measured:** Survival, neurologically intact survival **Results:** CPR: 18 of 92 patients survived. 14 of 92 survived neurologically intact; CCR: 19 of 33 patients survived, 16 of 33 survived neurologically intact. CCR has significantly higher survival and neurologically intact survival rates.	Observational report with historical controls; all but one of the project patients was defibrillated within 10 minutes of the 911 call so results may not be valid after 10 minutes; the effect of CCR protocol on survival when OHCA is not witnessed cannot be determined; possible that improved rates are due to the Hawthorne effect	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16564776
CDC Acute Injury Care Research Agenda	Morrison LJ, Visentin LM, Kiss A, et al. Validation of a rule for termination of resuscitation in out-of-hospital	**Study Design Type:** Cohort **Sample Size:** 1,240	To evaluate a clinical prediction rule recommending termination of basic life support resuscitative efforts		Application of clinical prediction rule by EMTs providing basic life support resuscitation to out-	The validation rule was determined by a retrospective lit. review that yielded higher survival rate. Population studied	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16885551

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	cardiac arrest. New England Journal of Medicine 2006;355(5):478-487.	**Population Studied:** Patients who were treated for an out-of-hospital arrest of presumed cardiac cause and were given basic life support by an emergency medical technician (EMT) trained in the use of an automated external defibrillator	by emergency medical technicians (EMTs) during out-of-hospital cardiac arrests when there is no return of spontaneous circulation, no shocks are administered, and the arrest is not witnessed by emergency medical-services personnel.		of-hospital cardiac arrest patients. Reference standard: follow-up patient data for all presumed out-of-hospital cardiac arrest cases.	was restricted to a single level of EMT training.	
National Research Agenda Emergency Medical Services	Ong ME, Jaffey J, Stiell I, et al. Comparison of termination-of-resuscitation guidelines for basic life support: defibrillator providers in out-of-hospital cardiac arrest. Annals of Emergency Medicine 2006;47(4):337-343.	**Study Design Type:** Cohort **Sample Size:** 13,684 **Population Studied:** Out-of-hospital cardiac arrest patients attended by a basic life support-defibrillator (BLS) defibrillator providers	To compare the performance of 3 termination-of-resuscitation guidelines for basic life support-defibrillator (BLS) providers when applied to cardiac arrest patients in the Ontario Prehospital Advanced Life Support ALS study.	Three termination-of-resuscitation guidelines (referred to as Marsden, Petrie, and Verbeek rules)	**Outcomes Measured:** Termination-of-resuscitation status **Results:** The three rules would have resulted in field termination of resuscitation in 9.4% (Petrie rules), 50.5% (Verbeek rules), and 18.5% (Marsden rules) of cases. Termination of resuscitation was recommended for 1 patient (Petrie rules), 3 patients (Verbeek rules), and 1 patient (Marsden rules), who survived. All 3 termination-of-resuscitation rules	The termination of resuscitation guidelines proposed are in the form of a time sequence algorithm, which is difficult to replicate retrospectively. Thus, the results for Marsden rules may be less representative than for Petrie or Verbeek rules, which do not have these time-sequence limitations. Call-response intervals and other intervals are difficult to estimate in the field, and	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16546618

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					had high sensitivity and negative predictive value. However, the specificity and transport rates varied greatly.	recordings can be unreliable, especially if timing is unsynchronized. The study looked at applying termination-of-resuscitation rules only in a pure BLS defibrillator response system. Therefore, the conclusion of this study may not apply to EMS systems that have a mix of advanced life support and BLS. It is uncertain whether the actual implementation of these rules might create results different from those observed with the retrospective, "hypothetical implementation" of them.	
National Research Agenda: Emergency Medical Services, 2006 IOM Report	Rea TD, Helbock M, Perry S, et al. Increasing use of cardiopulmonary resuscitation during out-of-hospital ventricular fibrillation arrest: survival implications of guideline changes.	**Study Design Type:** Cohort **Sample Size:** 3,124 **Population Studied:** Persons who had	To determine if a new ventricular fibrillation protocol for cardiac arrest due to heart disease would increase survival-to-hospital discharge rates versus the old protocol.	A new ventricular fibrillation protocol for cardiac arrest.	**Outcomes Measured:** Survival-to-hospital discharge **Results:** Survival-to-hospital discharge was significantly greater during the	The study was not a randomized trial, and the improvement could have been due to a nonspecific Hawthorne effect or other temporal developments. The study also had	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17159062

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	Circulation 2006;114(25):2760-2765.	bystander-witnessed out-of-hospital ventricular fibrillation cardiac arrest because of heart disease			intervention period compared with the control period (46% [61/134] versus 33% [122/374]) and corresponded to a decrease in the interval from shock to start of chest compressions (28 versus 7 seconds). Adjustment for covariates did not alter the survival association.	limited information regarding CPR process on a subset of patients. The study was unable to capture potentially important aspects of CPR, such as ventilation volume and rate or compression depth and rate. Although there was good evidence that the intervention changed the timing and relative quantity of CPR, the change in the protocol may also have influenced unmeasured CPR characteristics that may have contributed to the observed survival improvement.	
National Research Agenda: Emergency Medical Services	Scliopou J, Mader TJ, Durkin L, et al. Paramedic compliance with ACLS epinephrine guidelines in out-of-hospital cardiac arrest. Prehospital Emergency Care 2006;10(3):394-396.	**Study Design Type:** Cross-sectional study **Sample Size:** 75 **Population Studied:** Victims of cardiac	To determine the baseline rate of adherence to current American Heart Association (AHA) guidelines with regard to use of epinephrine in out-of-hospital cardiac arrests.	Time of first epinephrine dose, interval from first dose to each subsequent dose, and time of hospital arrival	**Outcomes Measured:** Noncompliance with AHA guidelines on epinephrine use **Results:** Epinephrine administration in accordance with current advanced	The accuracy of the raw data entered by prehospital providers may introduce a limitation to the study because it is often completed later and not during the event.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16801287

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		arrest			cardiac life support guidelines occurred in 14% of out-of-hospital cardiac arrest patients.		
National Research Agenda Emergency Medical Services	Van de LA, Saurbier B, Kalbhenn Jet al. Primary percutaneous coronary intervention in acute myocardial infarction: direct transportation to catheterization laboratory by emergency teams reduces door-to-balloon time. Clinical Cardiology 2006;29(3):112-116.	**Study Design Type:** Case Control **Sample Size:** 137 **Population Studied:** Patients with ST-elevation myocardial infarction (STEMI)	To evaluate the effectiveness of early percutaneous coronary intervention (PCI) team activation and direct transfer from the emergency team to the catheterization laboratory for patients with acute ST-segment elevation myocardial infarction (STEMI)	Early PCI team activation and direct transfer from the emergency room to the catheterization laboratory so that the PCI team can carry out adjunctive therapies, such as intra-aortic balloon counterpulsation	**Outcomes Measured:** In door-to-balloon time **Results:** Median door-to-balloon time was reduced by 27 minutes, primary interventional success was achieved in 92% of patients, and preclinical emergency diagnoses were correct in 95% of patients.	The number of patients included is too small to prove a relevant clinical benefit from the described improvement in logistics at this stage. However, the dynamic cooperation between interventional center and preclinical emergency medicine resulting from this concept highly motivates providers of modern therapy for acute coronary syndrome.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16596833
2006 IOM Report	Van 't Hof AW, Rasoul S, van de WH, et al. Feasibility and benefit of prehospital diagnosis, triage, and therapy by paramedics only in patients who are candidates for primary angioplasty for acute myocardial	**Study Design Type:** Cohort **Sample Size:** 467 **Population Studied:** Patients with acute myocardial infarction (MI)	To evaluate the feasibility and benefit of prehospital infarct diagnosis and triage in the ambulance by paramedics only compared to the outcomes achieved with triage at a referral non-percutaneous	Prehospital infarct diagnosis and triage in the ambulance (versus diagnosis and triage at a referral non-PCI center)	**Outcomes Measured:** Accuracy of diagnosis, time to treatment, the quality of reperfusion, left ventricular function, and clinical outcome **Results:** Acute myocardial	The study is a post hoc analysis of patients recruited in the On-TIME trial and not a randomized comparison between prehospital triage in the ambulance versus triage at the referral center;	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16781231

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Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	infarction. American Heart Journal 2006;151(6):1255.		coronary intervention (PCI) center		infarction was accurately diagnosed in 95% of patients in the ambulance group, compared to 99% in the referred group. Fifty-nine percent of patients in the ambulance group had pharmacologic pretreatment initiated in the ambulance within 90 minutes after the onset of the symptoms, compared to 43% in the referred group. Multivariate analysis showed to ambulance triage was associated with a left ventricular ejection fraction >40% and a favorable long-term clinical outcome.	however, randomization would be unethical because it would deliberately prolong time to treatment in one arm. Also, the multivariate analysis might correct differences in baseline characteristics between the groups, but this statistical correction might not overcome the problem of undetectable confounders and is less reliable in a relatively small-sized trial with a low incidence of the outcome parameter of interest.	
CDC Acute Injury Care Research Agenda	Welsh RC, Travers A, Senaratne Met al. Feasibility and applicability of paramedic-based prehospital fibrinolysis in a large North American center. American Heart Journal 2006;152(6):1007-	**Study Design Type:** Cohort **Sample Size:** 1,095 **Population Studied*:*** Patients with ST segment elevation	To investigate feasibility, applicability, safety, and efficacy of de novo paramedic-based prehospital fibrinolysis (PHF) program.	PHF program	**Outcomes Measured:** Time-to-treatment, systematic electrocardiographic (ECG) analysis, peak creatine kinase, inhospital clinical events, and mortality	The study is not randomized and only looks at patients within a single health care region. Also, selective randomization and treatment of lower risk patients may have occurred, but	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17161044

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	1014.	myocardial infarction (STEMI)			**Results:** Time-to-treatment was reduced with PHF versus inhospital. Despite higher baseline Thrombolysis in Myocardial Infarction Scores and greater ECG territory at risk, prehospital patients achieved more favorable outcomes in terms of peak creatin kinase, Q wave at discharge, and intracranial hemorrhage. Inhospital mortality for PHF versus inhospital patients was 3.4% versus 4.8%, but this relationship was not statistically significant.	there were only minor imbalances in patient characteristics across the comparison groups.	
EMSOP	Durcharme A, Doyon O, Roulea JL, et al. Impact of care at a multidisciplinary congestive heart failure clinic: a randomized trial. CMAJ. 2005; 173 (1) 40-45.	**Study Design:** randomized control trial **Sample size:** 230 **Population Studied:** Adults with acute congestive heart failure	Determine the impact of care at a multidisciplinary specialized outpatient congestive heart failure clinic compared with standard care.	Congestive heart failure/multi disciplinary specialized heart failure outpatient clinic	**Outcome Measured:** hospital admission rates (for any reason) and total number of hospital days at 6 months. Secondary outcomes were total number of ER visits; self assessed quality of life and total mortality.	Detection bias because of the set up of the intervention group- this led to increased contact compared to the standard group. Possibility of ascertainment bias because follow up	http://content.nejm.org/cgi/content/full/341/12/871

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					Results: Compared to the standard group, patients in the intervention group experienced a statistically significant decline in the number of repeat hospital admissions and hospital days. Quality of life (self assessed) was improved in the intervention group while remaining unchanged in the standard group.	with standard group was less.	
National Research Agenda: Emergency Medical Services	Handel DA, Gallo P, Schmidt M, et al. Prehospital cardiac arrest in a paramedic first-responder system using the Utstein style. Prehospital Emergency Care 2005;9(4):398-404.	**Study Design Type:** Cohort **Sample Size:** 87 **Population Studied:** All patients who suffered out-of-hospital cardiac arrest in the city of Reading, Ohio, from January 1998 to December 2003.	To describe the characteristics of patients found to have cardiac arrest and to evaluate the characteristics predictive of survival after cardiac arrest in a paramedic first-responder model.	Out-of-hospital cardiac arrest.	**Outcomes Measured:** Survival. **Results:** Survival to disposition from the ED was 31% (n=26). Survival to discharge from 14% (n=12). Survival to 30 days was 7% (n=6).	Limitations include a small sample size, a relatively homogeneous demographic composition, involvement of only one EMS system, and availability of only 30-day mortality rates.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16263672
National Research Agenda Emergency Medical Services	Hayashi H, Ujike Y. Out-of hospital cardiac arrest in Okayama city	**Study Design Type:** Case Series	To evaluate the outcomes for out-of-hospital cardiac arrest (OHCA) and	Outcome report for out of hospital cardiac arrest (OHCA) according	**Outcomes Measured:** Etiology (cardiac or non-cardiac);	Small "n" values limit accuracy of the evaluation of OHCA	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=C

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	(Japan): outcome report according to the "Utsutein Style". Acta Med Okayama 2005;59(2):49-54.	**Sample Size:** 363 **Population Studied:** Patients with out-of-hospital cardiac arrest (OHCA) considered for cardiopulmonary resuscitation (CPR)	cardiopulmonary resuscitation (CPR) during a 1-year period after the reorganization of defibrillation by Emergency Life-Saving Technicians (ELSTs) with standing orders of CPR.	to the "Utstein Style"	witnessed or non-witnessed; initial cardiac rhythm (VF, Asystole or pulseless activity, PEA). "Witnessed VF in cardiac etiology" is the most precise category **Results:** Of the cardiac arrests, 49.3% of were of cardiac etiology; of the 43.9%, 34.6% were witnessed by bystanders; of the 34.6% of witnessed OHCA, 32.3% had VF as the initial cardiac rhythm		itation&list_uids=16049555
2006 IOM Report	Price L, Keeling P, Brown G, et al. A qualitative study of paramedics' attitudes to providing prehospital thrombolysis. Emergency Medicine Journal 2005;22(10):738-741.	**Study Design Type:** Cross-sectional study **Sample Size:** 20 **Population Studied:** Paramedics	To explore paramedics' attitudes to administering prehospital thrombolysis (PHT)	Paramedics' attitudes to administering PHT as provided by interviews	**Outcomes Measured:** **Results:** Paramedics' positive and negative views on administering PHT and their willingness to do so as provided by interviews	Process for selecting and consenting interviewees not described Decline rate for being interviewed not given.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16189044
National Research Agenda Emergency Medical Services, Cone Prehospital Research Agenda,	Wik L, Kramer-Johansen J, Myklebust H, et al. Quality of cardiopulmonary	**Study Design Type:** Case Series **Sample Size:**	To measure the quality of out-of-hospital cardiopulmonary resuscitation (CPR)	CPR target values for compressions, ventilations, and CPR-free intervals	**Outcomes Measured:** Adherence to international guidelines for CPR	EMS providers exhibited knowledge deterioration at a higher rate than	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15

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2006 IOM Report	resuscitation during out-of-hospital cardiac arrest. Journal of the American Medical Association 2005; 293(3):299-304.	176 **Population Studied:** To measure the quality of out-of-hospital cardiopulmonary resuscitation (CPR) performed by ambulance personnel, as measured by adherence to CPR guidelines.	performed by ambulance personnel, as measured by adherence to CPR guidelines.		**Results:** Chest compressions were not given 48% of the time without spontaneous circulation. There was a mean compression rate of 64/min. Mean compression depth was 34 mm, and a mean of 11 ventilations were given per minute. The study concluded that chest compressions were not delivered half of the time, and most compressions were too shallow.	other CPR studies which used manikins.	657322
National Research Agenda Emergency Medical Services	Hess EP, White RD. Recurrent ventricular fibrillation in out-of-hospital cardiac arrest after defibrillation by police and firefighters: implications for automated external defibrillator users. Critical Care Medicine 2004;32(9 Suppl):S436-S439.	**Study Design Type:** Cohort **Sample Size:** 67 **Population Studied:** Individuals with witnesses of ventricular fibrillation (VF) arrest in the Rochester, MN, ambulance public service area who had defibrillatory	To determine the prevalence and frequency of recurrent ventricular fibrillation (VF) in patients defibrillated by police and firefighters only and to determine its relation to survival.	Presence of recurrent ventricular defibrillation in patients defibrillated by police and firefighters only.	**Outcomes Measured:** Patient survival to neurologically intact discharge. **Results:** VF recurred in 35 of the 67 patients (52%) while being cared for by police or firefighters. Of these 35 patients, no relation was found between prevalence or frequency of VF	This study was limited by design to assessment of recurrent VF in the setting of defibrillation by first responders only to quantitate VF recurrence while patients are being care for by first responders, before ALS paramedic intervention, including additional shocks delivered by paramedics. The	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15508674

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		shocks delivered by police and firefighters and return of spontaneous circulation with shocks only			recurrence and survival.	study was also limited by its retrospective, observational design, inclusion of only a single center, and relatively small sample size.	
2006 IOM Report Centers for Disease Control and Prevention	Kurola J, Harve H, Kettunen T, et al. Airway Management in Cardiac Arrest-comparison of the Laryngeal Tube, Tracheal Intubation and Bag-valve Mask Ventilation in Emergency Medical Training. Resuscitation. 2004, 61(2);149-53.	**Study Design:** Randomized controlled trial **Sample Size:** 58 EMTs **Population:** 1st semester EMTs in Finland	Study aims to compare initiation speeds and efficacy of ventilation using a laryngeal tube (LT), endotracheal intubation (ETI), and bag-valve mask (BVM).		Even with little experience EMTs completed insertion of LT or performed an ETI. Less time was needed for the LT than the ETI, and the LT "provided better minute ventilation during CPR".	Results from using manikins may not apply to live patients in the prehospital setting. Aspiration risk, for example, cannot be assessed. Inconsistencies in the measurement of minute ventilation are inherent among the different devices despite efforts to synchronize ventilation and compression in each study group.	http://www.ncbi.nlm.nih.gov/sites/entrez/15135191
National Research Agenda Emergency Medical Services,	Provo TA, Frascone RJ. 12-lead electrocardiograms	**Study Design Type:** Case Control	To determine whether prehospital 12-lead	PTLs	**Outcomes Measured:** Scene times	Limitations included failure of the sites to consistently	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&d

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Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
Cone Prehospital Research Agenda	during basic life support care. Prehospital Emergency Care 2004;8(2):212-216.	**Sample Size:** 101 **Population Studied:** Patients with potential acute myocardial ischemia	electrocardiograms (PTLs) could be considered a basic life support (BLS) skill		**Results:** Receiving physicians agreed that 59 of 63 patients needed the PTL and found them moderately helpful. Scene times increased by 5.0 minutes when a PTL was added to the evaluation.	assign subjects to the appropriate treatment category per protocol. Another limitation was the fact that the physicians were not accustomed to seeing PLTs on patients brought in by ambulance and many times did not learn of their existence at all or after one had already been performed in the ED.	b=pubmed&dopt=Citation&list_uids=15060859
2006 IOM Report, EMSOP	Wenzel V, Krismer AC, Arntz HR, et al. A comparison of vasopressin and epinephrine for out-of-hospital cardiopulmonary resuscitation. New England Journal of Medicine.2004; 350:105-13.	**Study Design:** double-blind, prospective, randomized controlled clinical trial **Sample Size:** 1219 **Population Studied:** adults experiencing out of hospital cardiac arrest	Assess effects of vasopressin and epinephrine on survival among adults who suffered an out of hospital cardiac arrest and present with ventricular fibrillation, pulseless electrical activity or asystole.	The use of vasopressin and epinephrine during resuscitation.	**Outcome Measured:** Primary Outcome: Survival to hospital admission; secondary outcome is survival to hospital discharge. **Results:** Effects of vasopressin were similar to that of epinephrine in the management of ventricular fibrillation and pulseless electrical activity. Patients with asystole were more likely to survive to	Limitations include fewer randomizations that originally intended, primary end point of survival to hospital admission not realistic for this type of trial. Clinical care for resuscitated cardiac patient varies among hospitals.	http://content.nejm.org/cgi/content/full/350/2/105

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Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					hospital admission and to hospital discharge if they were treated with vasopressin than if they received epinephrine as initial therapy.		
EMS Research Strategic Plan, EMSOP	Lerner EB, Billittier AJ, Newman MM, et al. Automated external defibrillator (AED) utilization rates and reasons fire and police first responders did not apply AEDs. Prehospital Emergency Care 2002 Oct-Dec;6(4):378-82.	**Study Design:** Cross-sectional **Sample Size:** 21 communities; 2,456 out-of-hospital cardiac arrests (OHCA). **Population:** First responders in participating communities (willing to provide data) on	Using data from participating communities, examine OHCAs for rate of AED use and reasons AEDs were not used by first responders.		AEDs were not used on 1,025 patients (42%). Fire first responders use AEDs 63% of the time while police first responders used them 34% of the time. Use of the transport ambulance defibrillator was the primary reason an AEDs was not used.	Limitations include incomplete data collection and overestimation of AED use.	http://www.ncbi.nlm.nih.gov/sites/entrez/12385601
	Brillhart AM, Rea TD, Becker L, et al. Time to first shock by emergency medical technicians with automated external defibrillators. Prehospital Emergency Care 2002 Oct-Dec;6(4):373-7.	**Study Design:** Retrospective cohort **Sample Size:** 177 **Population:** Patients that were treated with an automatic external defibrillator (AED) by EMS personnel during ventricular fibrillation (VF) cardiac arrest from	To determine the time from arrival by EMS personnel to AED application and first shock for patients in VF arrest.		Time to 1st shock was bimodal occurring at $\leq$ 90 seconds and $\geq$ 113 seconds. Unwitnessed arrest and preparation (shaving the chest) were reasons for delay in time to first shock. Limits of this study include generalizabilty to		http://www.ncbi.nlm.nih.gov/pubmed/12385600

Clinical Management: Cardiac							
Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
		January 1999 to December 2000.			other systems and inability to make associations based on the data.		
National Research Agenda Emergency Medical Services	Herlitz J, Starke M, Hansson E, et al. Early identification of patients with an acute coronary syndrome as assessed by dispatchers and the ambulance crew. American Journal of Emergency Medicine 2002; 20(3):196-201.	**Study Design Type:** Cohort **Sample Size:** 859 **Population Studied:** Patients who were transported by ambulance owing to symptoms raising any suspicion of acute coronary syndrome.	To evaluate the possibility of early identification of patients with an acute coronary syndrome who are transported by ambulance.	Baseline characteristics of patients (demographics), cause of symptoms as judged by dispatchers and ambulance crews, priority by dispatchers and ambulance crews, symptoms, status on admission of ambulance, electrocardiogram (ECG) pattern on admission to the emergency department, ECG findings on admission of the ambulance and on admission to the emergency department	**Outcomes Measured:** Factors associated with or predictors of an acute coronary syndrome and acute myocardial infarction (AMI). **Results:** Independent risk indicators for development of AMI were: male sex, cold and clammy on admission of the ambulance crew, and showing ECG signs of myocardial ischemia on admission to the emergency department. Independent predictors for development of an acute coronary syndrome were: male sex, a history of angina pectoris, cold and clammy on admission of the ambulance crew, and ECG signs of myocardial ischemia	A 12-lead ECG was recorded before hospital admission only in a minority of patients. There was missing information in a substantial number of patients in many of the variables. The final diagnosis was based on discharge diagnosis as decided by the responsible physician. This diagnosis was not validated by the research team.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11992339

Clinical Management: Cardiac							
Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					admission to the emergency department.		
CDC Acute Injury Care Research Agenda, National Research Agenda Emergency Medical Services	Verbeek PR, Vermeulen MJ, Ali FH, et al. Derivation of a termination-of-resuscitation guideline for emergency medical technicians using automated external defibrillators. Academic Emergency Medicine 2002;9(7):671-678.	***Study Design Type:*** Cross-sectional study ***Sample Size:*** 769 ***Population Studied:*** Primary cardiac arrest patients	To determine the association between characteristics of cardiac arrest and survival to hospital discharge following failed resuscitation by defibrillation-trained emergency medical technicians (EMT-Ds), and to propose an out-of-hospital termination-of-resuscitation (TOR) guideline for EMT-Ds.	Return of spontaneous circulation (ROSC), shock given prior to transport, and cardiac arrest witnessed by EMS personnel	***Outcomes Measured:*** Survival-to-hospital discharge ***Results:*** ROSC at any time had the strongest association with survival. A shock prior to transport and cardiac arrest witnessed by EMS personnel were also independently associated with survival. These variables were incorporated into a termination-of-resuscitation guideline, which was 100% sensitive in identifying survivors and had 100% negative predictive value for identifying non-survivors of out-of-hospital cardiac arrest in the study population.	The patients examined were served by a single urban EMS system using local EMT-D resuscitation protocols that may not be identical to other systems. The proportion of cardiac arrest survivors in the sample was low (1.9%) but consistent with other large urban centers. EMS response intervals were not included as a variable in the guidelines. The sample was limited to patients who received exclusively EMT-D care. It is possible that some cases may not have been reported and that the sample was not representative of all cardiac arrest patients encountered by the EMS system.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12093706
National Research Agenda Emergency	De M, V, Stiell IG, Wells GA, et al.	***Study Design Type:***	To assess EMS-witnessed cardiac	Hospital data on patients suffering	***Outcomes Measured:***	The cohort method doesn't allow	http://www.ncbi.nlm.nih.gov/sites/entre

Clinical Management: Cardiac							
Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
Medical Services, CDC Acute Injury Care Research Agenda	Cardiac arrest witnessed by emergency medical services personnel: descriptive epidemiology, prodromal symptoms, and predictors of survival. OPALS study group. Annals of Emergency Medicine 2000;35(2):138-146.	Cohort ***Sample Size:*** 610 ***Population Studied:*** Patients suffering from an emergency medical system (EMS)-witnessed cardiac arrest	arrest and to determine predictors of survival in this group.	from EMS-witnessed cardiac arrest. Survival to hospital discharge for EMS-witnessed arrest.	Predictors of patient survival. ***Results:*** Independent predictors of survival: Use of Nitroglycerin prior to EMS arrival; prodromal chest pain symptoms; dyspnea; unconsciousness on arrival of EMS. Patients complaining of chest pain were more likely to experience ventricular fibrillation/ventricular tachycardia, and were 5 times more likely to survive than dyspneic patients.	researchers to infer causality. Missing/incomplete data. Some symptoms may have been disregarded when more significant comorbid symptoms occurred. Impossible to determine the exact mechanism of arrest.	z?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10650231
National Research Agenda Emergency Medical Services	Mitchell RG, Guly UM, Rainer TH, et al. Paramedic activities, drug administration and survival from out of hospital cardiac arrest. Resuscitation 2000;43(2):95-100.	***Study Design Type:*** Cohort ***Sample Size:*** 4,583 ***Population Studied:*** Adult patients who had sustained an out of hospital cardiac arrest of	To examine the impact of administration of cardioactive drugs on the outcome from out of hospital cardiac arrest.	Administration of cardioactive drugs by paramedics	***Outcomes Measured:*** Return of spontaneous circulation, admission to and discharge from hospital ***Results:*** There was no difference in outcome between	Subject selection bias. Study design may mask positive outcomes. Primary and secondary responses to paramedic intervention were not completely examined.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10694168

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Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
		cardiac etiology and were treated by paramedics			Period 1 (paramedics were not administering the cardioactive drugs) and Period 2 (paramedics were administering the cardioactive drugs) for all three parameters: return of spontaneous output 30.1% versus 35%, admission to hospital 18.9% versus 24.5% and discharge 5.8% versus 6.5%.		
National Research Agenda Emergency Medical Services, CDC Acute Injury Care Research Agenda	Cobb LA, Fahrenbruch CE, Walsh TR et al. Influence of cardiopulmonary resuscitation prior to defibrillation in patients with out-of-hospital ventricular fibrillation. Journal of the American Medical Association 1999; 281(13):1182-1188.	**Study Design Type:** Cohort **Sample Size:** 1,117 **Population Studied:** Patients with out of hospital ventricular fibrillation	To evaluate the effects of providing 90 seconds of CPR to persons with out-of-hospital VF prior to delivery of shock by first-arriving EMTs	Modification of the protocol for use of AEDs, emphasizing approximately 90 seconds of CPR prior to delivery of a shock	***Outcomes Measured:*** Survival and neurological status at hospital discharge determined by retrospective chart review as a function of early (<4 minute) and later >4 minute response intervals ***Results:*** Survival improved from 24% to 30%. The benefit was primarily in patients for whom the initial response was 4 minutes or longer. Among survivors, the proportion	Confounding factors such as spontaneous improvement or undetected differences in the characteristics of patients may have influenced outcomes	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10199427

Clinical Management: Cardiac							
Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					having favorable neurological function at hospital discharge increased from 71% to 79%		
NHTSA, 2006 IOM Report, EMSOP	Kudenchuk PJ, Cobb, LA, Copass, MK, et al. Amiodarone for resuscitation after out of hospital cardiac arrest due to ventricular fibrillation. New England Journal of Medicine. 1999; 341(12) 871-878.	**Study Design:** randomized controlled study **Sample size**: 504 **Population Studied:** Adults with non traumatic out of hospital cardiac arrest with ventricular fibrillation or pulseless ventricular tachycardia.	Determine efficacy of intravenous amiodarone in patients with out-of-hospital cardiac arrest due to shock-refractory ventricular fibrillation or tachycardia.	Administration of intravenous amiodarone.	**Outcome Measured:** Admission to hospital with a stable, organized rhythm and blood pressure with or without vasopressors. **Secondary outcome:** Adverse effects, the number of precordial shocks required after amiodarone was administered or placebo, the total length of resuscitation, and need for additional anti arrhythmic medications. **Main findings**: Amiodarone significantly improved the rate of survival to admission to the hospital after shock-refractory cardiac arrest regardless of cardiac rhythm**.**	The treatment of patients after hospitalization was not standardized; the dose of amiodarone was a best estimate, and the placebo was amiodarone's diluents' which may have exacerbated adverse effects.	http://content.nejm.org/cgi/content/full/341/12/871

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Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
National Research Agenda Emergency Medical Services, 2006 IOM Report	Soo LH, Gray D, Young T, et al. Resuscitation from out-of-hospital cardiac arrest: is survival dependent on who is available at the scene? Heart 1999; 81(1):47-52.	**Study Design Type:** Cohort **Sample Size:** 1,547 **Population Studied:** Patients suffering from cardiac arrest that had resuscitation attempted by Nottinghamshire Ambulance Service crew between 1991 and 1994	To determine whether survival from out-of-hospital cardiac arrest is influenced by the on-scene availability of different grades of ambulance personnel and other health professionals.	Out-of-hospital cardiac arrest resuscitation attempts by the Nottinghamshire Ambulance Service with varying grades of ambulance personnel.	**Outcomes Measured:** Survival to hospital admission and survival to hospital discharge. **Results:** Approximately 14.3% of patients suffering from out-of-hospital cardiac arrest survived to reach the hospital alive and only 6.1% were eventually discharged from the hospital. Paramedic resuscitation of patients with out-of-hospital cardiac arrest caused by cardiac disease saw an increased likelihood of surviving to hospital discharge than when resuscitation was provided by an ambulance technician. The patient had the best chance of survival when resuscitated by a paramedic assisted by a medical practitioner.	Retrospective study. Inconsistent data collection in the beginning of the study. Possible case selection bias.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10220544
EMSOP, 2006 IOM Report, EMS	Verbeek PR, Turner D, Lane J, et al. A	**Study Design:** Controlled,	To compare time to first shock from	Time to shock from contact was	http://www.ncbi.nlm.nih.gov/pubmed/103		

Clinical Management: Cardiac							
Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
Research Strategic Plan	comparison of two automated external defibrillator algorithms. Academic Emergency Medicine. 1999 June;6(6):631-6.	crossover comparative time study **Sample Size:** 36 (18 pairs) **Population:** Firefighters trained in two AED algorithms	contact by firefighter pairs trained in two AED algorithms. Algorithm I (A-I) followed the American Heart Association recommendations of performing CPR while the AED is set up; algorithm II (A-II) initiated CPR following the set up of the AED and delivery of the first shock.	significantly less for A-II compared to A-I. For A-I, 2.0 cycles of ventilations were administered prior to the first shock. Limitations for this study include not randomizing the algorithms, firefighter bias for familiarity with the algorithm, and conducting the simulation in an ideal setting (ample space, no distractions, etc.)	86681		
2006 IOM Report	Banerjee S, Rhoden WE. Fast-tracking of myocardial infarction by paramedics. Journal of the Royal College of Physicians of London 1998; 32(1):36-38.	**Study Design Type:** Cohort **Sample Size:** 25 **Population Studied:** Patients fast-tracked to a coronary care unit (CCU) by ambulance paramedic staff who had undergone training	To study the effectiveness of a fast-track method of admitting patients with myocardial infarction directly to the coronary care unit.	Training of paramedic staff to recognize anyone likely to have had a myocardial infarction among patients with chest pain.	**Outcomes Measured:** Proper diagnosis of myocardial infarction. Average time from call for help to thrombolysis. Number of fast-tracked patients who fulfilled the criteria for CCU admission. **Results:** Myocardial infarction was diagnosed in 14 of 25 fast-tracked patients. 13 of those were treated with thrombolysis	Subjects included patients with more severe myocardial infarction who were more likely to be fast-tracked to CCU. Small sample size.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=9507439

Clinical Management: Cardiac							
Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					with an average time from call for help to thrombolysis treatment that was much shorter than that of patients who were not fast-tracked. 21 of the 25 fast-tracked patients qualified for CCU admission as measured by the criteria.		
2006 IOM Report, EMSOP	Stiell, IG, Herbert PC, Weitman BN; et al. High Dose epinephrine in adult cardiac arrest. New England Journal of Medicine.1992; 327(15) 1045-1050.	**Study Design:** randomized clinical trial **Sample Size**: 650 **Population Studied:** adults who suffered cardiac arrest and received epinephrine.	Compare survival rate of patients receiving the standard 1 mg of epinephrine for cardiac arrest versus high dose (7 mg) of Epinephrine.	**Intervention Examined:** high dose (7mg) epinephrine at 5 minute intervals, maximum 5 doses.	**Outcome Measured:** Successful resuscitation with the return of the patient's pulse and blood pressure for at least one hour. Main results: The mean number of doses per patient in both study groups was 2.5 with the high dose group receiving 17.8 mg and the standard group receiving 2.5 mg. No difference in the proportion of patients meeting the primary outcome (return of pulse and blood pressure for one hour). The study showed that	The study excluded patients that suffered cardiac arrest in the prehospital setting and received full advance life support care in the field. The study did not discuss the relationship between the location of the arrest and rate of survival.	http://www.ncbi.nlm.nih.gov/pubmed/1522840

Clinical Management: Cardiac							
Applicable Research Agenda	**Citation**	**Study characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					there was no improvement in survival, nor neurological outcome in patients receiving high dose epinephrine following a cardiac arrest. Patients that received epinephrine more than 10 minutes post the arrest had the worse outcomes.		

Clinical Management: Neurological							
	Citation	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
Cone Prehospital Care Research Agenda, National Research Agenda Emergency Medical Services	Bray JE, Martin J, Cooper Get al. An interventional study to improve paramedic diagnosis of stroke. Prehospital Emergency Care 2005; 9(3):297-302.	**Study Design Type:** Cohort **Sample Size:** 61 **Population Studied:** Paramedics in emergency medical service units servicing a university teaching hospital.	The aim of the Faster Access to Stroke Therapy (FAST) study was to determine the effect of educational intervention and the use of a prehospital stroke tool on the paramedic diagnosis of stroke.	FAST study paramedics received stroke education and instruction in the use of a prehospital stroke assessment tool (MASS) to assist in stroke diagnosis (n=18). Control: Non-FAST study paramedics received no education or additional training (n=43)	**Outcomes Measured:** Improved success in identifying stroke. **Results:** The sensitivity for the FAST study paramedics in identifying stroke improved from 78% to 94% after receiving the stroke education session and with use of the MASS tool. There was no change in stoke diagnosis for the non-study paramedics 78% to 80%.	This study was limited by the inability to examine specificity of paramedic diagnosis. Also, due to limitations in resources, blinding of the abstractor and random independent reviews of data with analysis of reliability and agreement were unable to be performed.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16147479
CDC Acute Injury Care Research Agenda	Saver JL, Kidwell C, Eckstein M, et al. Prehospital neuroprotective therapy for acute stroke: results of the Field Administration of Stroke Therapy-Magnesium (FAST-MAG) pilot trial. Stroke 2004;35(5):e106-e108.	**Study Design Type:** Clinical trial **Sample Size:** 28 **Population Studied:** Patients with acute, ambulance-transported stroke, both ischemic and hemorrhagic	To demonstrate that paramedic initiation of intravenous magnesium sulfate in the field in focal stroke patients is feasible, safe, and yields significant time-savings compared with in-hospital initiation of neuroprotective therapy.	Active magnesium sulfate	**Outcomes Measured:** Time savings and improved patient status **Results:** The interval from paramedic arrival on scene to study agent start was: field-initiated, 26 minutes versus in-hospital initiated (historic controls), 139 minutes.	Small sample size. Stroke diagnosis in the field by paramedics was supported by on-line medical direction and results may not transfer to EMS systems lacking this support. Deterioration of patient condition en route and variation in travel time to ED were not controlled.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15017009

Clinical Management: Neurological							
	Citation	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					Paramedics rated patient status on hospital arrival as improved 20%, worsened 5%, and unchanged 75%. Good functional outcome at 3 months occurred in 60%. No serious adverse events were associated with field therapy initiation.		
CDC Acute Injury Care Research Agenda, National Research Agenda Emergency Medical Services	Crocco T, Gullett T, Davis SM, et al. Feasibility of neuroprotective agent administration by prehospital personnel in an urban setting. Stroke 2003;34(8):1918-1922.	**Study Design Type:** Cohort **Sample Size:** 222 **Population Studied:** Stroke victims	To determine the effects of prehospital administration of NA	Peripheral Stroke Assessment Sheet: checklist to determine patient eligibility to receive a theoretical neuroprotective agent (NA), time intervals during EMS response, and patients' neurologic assessment over time	**Outcomes Measured:** Hypothetical administration of NA. Treatment time reduction. **Results:** EMS personnel reported they would administer an NA for 75 of 222 patients. Average treatment time reduction was 12.04 minutes.	Results cannot be applied to EMS systems that employ volunteer personnel or in EMS systems that evaluate fewer stroke patients. NA administration was theoretical.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12843348
National Research Agenda Emergency Medical Services	Alldredge BK, Gelb AM, Isaacs SM, et al. A comparison of lorazepam, diazepam, and placebo for the treatment of out-of-hospital status epilepticus. New	**Study Design Type:** Clinical trial **Sample Size:** 205 **Population Studied:**	To determine whether the administration of benzodiazepines by paramedics is an effective and safe out-of-hospital treatment for status epilepticus and to	Intervention group 1: 2 or 4 mg lorazepam (n=66) Intervention group 2: 5 or 10 mg diazepam (n=68)	**Outcomes Measured:** Termination of status epilepticus by the time of arrival at the emergency department. **Results:**	The interval between the study treatment and the assessment of response varied among patients with the time of arrival at the ED. The failure to establish a	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11547716

Clinical Management: Neurological							
	Citation	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	England Journal of Medicine 2001;345(9):631-637.	Adults with out-of-hospital diagnosis of status epilepticus	determine whether lorazepam is superior to diazepam.	(In the intervention groups, the initial doses of 2 mg of lorazepam or 5 mg of diazepam were administered a second time if seizures recurred or continued four minutes or more after the first injection. Thus, some patients received a total of 4 mg lorazepam or 10 mg diazepam.) Control group: Placebo (n=71	Status epilepticus was terminated on arrival at the emergency department in more patients treated with lorazepam (59.1%) or diazepam (42.6%) than patients given placebo (21.1%).	benchmark for this outcome measure could bias results.	
2006 IOM Report	Riopelle RJ, Howse DC, Bolton C, et al. Regional access to acute ischemic stroke intervention. Stroke 2001;32(3):652-655.	**Study Design Type:** Clinical trial **Sample Size:** 403 **Population Studied:** Patients affected by acute ischemic stroke	To enhance therapeutic effectiveness by ensuring equitable access to recombinant tissue plasminogen activator (rtPA) for patients affected by acute ischemic stroke within a 20,000 km2 population referral base served by a tertiary facility.	Regional Acute Stroke Protocol (RASP)	**Outcomes Measured:** Improving patient access to rtPA **Results:** At 12 months, approximately 403 ischemic strokes have occurred in the region, the RASP has been activated 191 times, and 42 patients received rtPA. The authors concluded that acute stroke patients had improved access to	Study design excluded subjects outside of the time window for RASP implementation.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11239182

Clinical Management: Neurological							
	Citation	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					interventions for stroke care, and that the geography of the region was not a barrier to access to interventions for patients with acute stroke.		
CDC Acute Injury Care Research Agenda	Kidwell CS, Saver JL, Schubert GB, et al. Design and retrospective analysis of the Los Angeles Prehospital Stroke Screen (LAPSS). Prehospital Emergency Care 1998;2(4):267-273.	**Study Design Type:** Cohort **Sample Size:** 83 **Population Studied:** Patients with hyper acute stroke	To demonstrate that the Los Angeles Prehospital Stroke Screen (LAPSS) sensitively identifies acute stroke patients.	Prehospital identification of acute stroke victims using the LAPSS and determination of the reduction in time before administration of neuroprotective agents	**Outcomes Measured:** Successful identification by the LAPSS instrument. Potential reduction in time to therapy **Results:** Of the 41 patients with ischemic infarcts, 38 (93%) would have been accurately identified by the LAPSS. For the 38 patients, 1 hour and 50 minutes would have been saved had neuroprotective drugs been administered by paramedics at the time of transport	Retrospective analysis; time saving may have been delayed due to completion of study enrollment papers; examinations were preformed by physicians rather than paramedics; study could not provide specificity of the LAPSS because nonstroke patients were not assessed.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=9799012
National Highway Traffic Safety Administration (NHTSA), Seidel	Vilke GM, Sharieff GQ, Marino A, et al. Midazolam for the treatment of out-of-hospital pediatric seizures.	**Study Design Type:** Cohort **Sample Size:** 86	To assess the effectiveness and safety of intravenous (IV) and intramuscular (IM) midazolam in the	Administration of midazolam for seizures	**Outcomes Measured:** Post-intervention reevaluation of pediatrics	Limitations to this study include small sample size and the retrospective nature of the review of paramedic records.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11962570

Clinical Management: Neurological							
	Citation	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	Prehospital Emergency Care. 2002;6(2):215-217.	**Population Studied:** Pediatrics treated by paramedics with midazolam for seizures	treatment of pediatric seizures by paramedics.		**Results:** Improvement was reported for 91% of patients. Greater success was reported with I V drug administration as compared with 80% with IM administration.	Objective measures of the patients' respiratory efforts were not evaluated either in the hospital or in prehospital settings given limitations of the retrospective protocol for data collection.	

Clinical Management: Other							
	Citation	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
National Research Agenda Emergency Medical Services, 2006 IOM Report	Strote J, Cloyd D, Rea T, et al. The influence of emergency medical technician glucometry on paramedic involvement. Prehospital Emergency Care 2005;9(3):318-321.	**Study Design Type:** Cohort **Sample Size:** 1,411 **Population Studied:** Emergency medical technicians (EMTs)	To evaluate the influence of emergency medical technician (EMT) glucometry on paramedic involvement in a two-tiered emergency medical services (EMS) response system.	EMT glucometry	**Outcomes Measured:** Influence on paramedic involvement **Results:** Glucometry prompted EMTs to upgrade the triage level and request paramedic evaluation for 5% of patients; glucometry caused EMTs to downgrade the triage level, canceling already dispatched paramedics for 5% of patients; and glucometry allowed EMTs to function without paramedics when they otherwise would have called for assistance for 11% of patients.	This study was not a randomized controlled trial. The subjective report on decision making may have significantly under- or overestimated the actual effect.. Studying the use of glucose may have increased its use. Some cases of glucose use may not have been reported. And, it is unclear as to whether these results can are generalizable to areas outside of the area studied.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16147482
National Highway Traffic Safety Administration, Institute of Medicine Report, Centers for Disease Control and Prevention	Bertalanffy P, Hoerauf K, Fleischhackl R, et al. Korean hand acupressure for motion sickness in prehospital trauma care: a prospective randomized, double-blind trial in a geriatric population.	**Study design:** randomized controlled trial **Sample size:** 100 **Population Studied:** geriatric patients with minor trauma	To test Korean acupressure to K-K9 (middle phalanx of the fourth finger) for relief of motion sickness during transport greater than 20 minutes in geriatric patients.	Korean acupressure to K-K0 compared to sham acupressure point	Those treated with Korean acupressure at K-K9 experienced less motion sickness than those in the control group. The treatment group was more satisfied with the transport experience and care provided.	Laboratory measurements for endorphins, serotonin, and others were not done to confirm results.	http://www.ncbi.nlm.nih.gov/pubmed/14693623

Clinical Management: Other							
	Citation	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	Anesthesia and Analgesia. 2004; 98:220-3.						
National Highway Traffic Safety Administration, Institute of Medicine Report, Centers for Disease Control and Prevention, Sayre Agenda	Lukins J, Feldman M, Summers J et al. A Paramedic-Staffed Medical Rehydration Unit at a Mass Gathering. Prehospital Emergency Care. 2004, 8(4); 411-416.	Study Design: Prospective observational study Sample Size: 143 people Population: Greater than 450,000	To evaluate the medical effectiveness of providing a rehydration unit to reduce heat-related illnesses at mass gatherings.	Paramedics providing care at a paramedic staffed medical rehydration unit	The medical rehydration unit resulted in a 21% reduction in patients requiring services at the main field hospital. This research suggests offering a rehydration unit at mass gatherings may create a new role for paramedics in treating heat related illnesses.	Incomplete documentation on study charts, lack of follow up post discharge from rehydration unit, there fore it is not known if subsequent EMS care was needed for the treated patients, study conducted at one mass gathering, results may not be generalizable to other communities.	http://www.ncbi.nlm.nih.gov/pubmed/15626003
National Research Agenda Emergency Medical Services	Lerner EB, Billittier AJ, Lance DR, et al. Can paramedics safely treat and discharge hypoglycemic patients in the field? American Journal of Emergency Medicine 2003;21(2):115-120.	**Study Design Type:** Case Series **Sample Size:** 36 **Population Studied:** Insulin-dependent diabetic adult patients whose hypoglycemia resolved after administration of thiamine and 50% dextrose before transport by paramedics	To determine whether paramedics can safely treat and discharge insulin-dependent diabetic patients experiencing uncomplicated hypoglycemic events.	Follow-up of patients presenting with blood glucose <80mg/dL and altered mental status resulting from hypoglycemia treated with thiamine and 50% dextrose by paramedics prior to transport. Patients were given written questionnaire/interview was conducted 24 to 48 hours after discharge	**Outcomes Measured:** Return of mental status Blood glucose > 95 mg/dL **Results:** No complications were reported after discharge in 92% of patient encounters; two patients developed recurrent hypoglycemia but treated themselves; one patient with multiple recent events was found unresponsive the	The inclusion of only voluntary paramedics and the resulting convenience sampling, may have introduced bias into the study. A limit in sample size also resulted from this study design. No information was available on the overall capture rate of hypoglycemic patients.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12671811

Clinical Management: Other							
	Citation	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					morning after treatment and was admitted to a long-term care facility. Among the patients who developed complications, no protocol violations were found. Forty-three percent of all patients were inappropriately discharged without satisfying all of the inclusion and exclusion criteria.		
National Research Agenda Emergency Medical Services	Barton ED, Ramos J, Colwell Cet al. Intranasal administration of naloxone by paramedics. Prehospital Emergency Care 2002;6(1):54-58.	**Study Design Type:** Cohort **Sample Size:** 30 **Population Studied:** Patients who presented with altered mental status (AMS), as "found down" (FD), or with suspected opioid overdose (OD)	To prospectively test the effectiveness of intranasal (IN) naloxone administration by paramedics.	Administration of IN naloxone to AMS, FD, or OD patients using a disposable Mucosal Atomizer Device (MAD).	**Outcomes Measured:** Patient response to naloxone. **Results:** Eleven of the 30 patients responded to either IN or IV naloxone. 91% of those patients responded to IN naloxone alone with a 3.4 minute response time on average. After a response to IN naloxone, 64% of patients did not need an IV.	* Lack of randomization * Other medications not included in study for comparison.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11789651

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Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Intervention Examined/ Observations Made	Main Findings	Study Limitations	Link to Abstract
National Research Agenda Emergency Medical Services	Woollard M, Lighton D, Mannion Wet al. Airtraq vs standard laryngoscopy by student paramedics and experienced prehospital laryngoscopists managing a model of difficult intubation. Anaesthesia 2008;63(1):26-31.	**Study Design Type:** Cohort **Sample Size:** 79 **Population Studied:** Third-year paramedic students and experienced prehospital practitioners	To compare intubation success rates in third-year paramedic students and experienced prehospital practitioners using the Airtraq or a Macintosh laryngoscope with flexible style in a manikin model of a Cormack and Lehane grade III/IV laryngoscopic view.	Airtraq training	**Outcomes Measured:** Between-device difference in the proportion of students successfully intubating the trachea at the first attempt within a breath-to-breath interval of less than 30 seconds. **Results:** Student paramedics and experienced prehospital laryngoscopists managing a manikin model of a grade III/IV view had increased first-time intubation rates and had lower rates of oesophageal intubation with the Airtraq compared with a standard laryngoscope.	Possible sampling bias due to reliance on volunteers who may have been more enthusiastic to learn more about intubation and more skilled at it versus students who did not volunteer.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=18086067
National Research Agenda Emergency Medical Services, CDC Acute Injury Care Research Agenda	Hoyle JD, Jr., Jones JS, Deibel M, et al. Comparative study of airway management techniques with restricted access to patient airway. Prehospital	**Study Design Type:** Cohort **Sample Size:** 56 **Population Studied:**	To determine which airway endotracheal tube (ET), Combitube (CT), or Laryngeal Mask Airway (LMA) has the shortest time to successful ventilation in three	Subjects were instructed to place an airway in a mannequin in three scenarios: mannequin supine under a table with head abutting a wall, mannequin	**Outcomes Measured:** Successful ventilation. **Results:** EMT-Ps demonstrated significantly faster	Simulations of human beings with mannequins are not ideal.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17613909

Clinical Management: Respiratory

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Intervention Examined/ Observations Made	Main Findings	Study Limitations	Link to Abstract
	Emergency Care 2007; 11(3):330-336.	Emergency medicine (EM) residents, faculty EM physicians, and emergency medical technicians-paramedics (EMT-Ps)	nontraditional prehospital airway scenarios.	sitting upright with access from behind, and mannequin lying on its side with access facing the mannequin.	times to successful ventilation for all scenarios versus physicians, except for the mannequin lying on its side where there was no significant difference. The time to ventilation for all scenarios was less with the LMA versus ER or CT versus ET, except in the sitting scenario where ET and CT were comparable.		
National Research Agenda Emergency Medical Services	Davis DP, Douglas DJ, Koenig W, et al. Hyperventilation following aero-medical rapid sequence intubation may be a deliberate response to hypoxemia. Resuscitation 2007;73(3):354-361.	**Study Design Type:** Case Series **Sample Size:** 32 **Population Studied:** Severe traumatic brain injury (TBI) patients, as determined by the Glasgow Coma Scale (GSC), undergoing rapid sequence intubation (RSI) by aero-medical crews	To document the incidence of hyperventilation by aero-medical providers and explore a possible relationship between hyperventilation and episodes and desaturations or impending hypoxemia	Complications arising from the RSI procedure including episodes of hyperventilation, loss of oxygen saturation signal, desaturations, and hypoxemia.	**Outcomes Measured:** Association between hyperventilation and desaturations, impending hypoxemia, or a loss of the oxygen saturation signal. **Results:** In the 16 patient sample, 28 hyperventilation episodes were identified. There was a significantly higher incidence of hyperventilation with either RSI desaturation,	A small sample size, which makes it impossible to generalize. Researchers used a novel definition for post-intubation desaturation. Brief periods of hypocapnia were included as episodes of hyperventilation. Aero-medical crews had been trained to use quantitative monitoring-recording equipment in response to trial results. There is no outcome data	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17291673

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Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Intervention Examined/ Observations Made	Main Findings	Study Limitations	Link to Abstract
					impending hypoxemia, or loss of the oxygen saturation signal.	included in the study, and therefore it is impossible to determine the impact of hyperventilation or desaturation events on mortality.	
National Research Agenda Emergency Medical Services, Seidel: Priorities in EMSC Research	Stiell IG, Spaite DW, Field B, et al. Advanced life support for out-of-hospital respiratory distress. New England Journal of Medicine 2007;356(21):2156-2164.	**Study Design Type:** Clinical trial **Sample Size:** 8,138 Population Studied: All emergency medical system (EMS) patients 16 years of age and older whose primary symptom was shortness of breath, including those who were assessed by EMS personnel but not transported to the hospital	Assess the incremental benefit with respect to morbidity and mortality that results from the implementation of an advanced-life-support program for the evaluation and management of respiratory distress before patients arrive at the hospital.	EMS response to patients suffering from respiratory distress during two phases: Phase I: The basic-life-support phase (6 months) Phase II: The advanced-life-support phase (6 months)	**Outcomes Measured:** Mortality of patients from the sample population. **Results:** Rate of death among all patients decreased from 14.3% in the basic-life-support phase to 12.4% in the advanced-life-support phase.	The use of a historical control group.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17522399
National Research Agenda Emergency Medical Services	Timmermann A, Russo SG, Eich C, et al. The out-of-hospital esophageal and endobronchial intubations performed by emergency physicians. Anesthesia and Analgesia 2007;	**Study Design Type:** Case series **Sample Size:** 153 **Population Studied:** Patients requiring transport by air and	To determine the incidence of misplaced tracheal tubes when tracheal intubation was performed out-of-hospital by a primary emergency physician.	Consecutive out-of-tracheal intubations performed by primary emergency physicians and subsequent verification of tracheal tube placement on scene by a study physician.	**Outcomes Measured:** Placement of tracheal tube **Results:** The tracheal tube was determined by the study physician to be misplaced in the right mainstem	The incidence of misplaced tracheal tubes may be artificially low; if a patient's death occurs before the arrival of the study physician, the contact between the study physician and patient may not	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17312220

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Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	104(3):619-623.	out-of-hospital tracheal intubation			bronchus in 10.7% of patients and misplaced in the esophagus in 6.7% of the patients. Seven of 10 patients with unrecognized esophageal intubations died within the first 24 hours of treatment.	occur. Another limitation is the lack of reporting of confounding variables.	
National Research Agenda Emergency Medical Services	Wang HE, Abo BN, Lave JR, et al. How would minimum experience standards affect the distribution of out-of-hospital endotracheal intubations? Annals of Emergency Medicine 2007;50(3):246-252.	**Study Design Type:** Cross-sectional study **Sample Size:** 11,771 **Population Studied:** Patients requiring endotracheal intubations	To determine how minimum endotracheal intubation experience standards influence the number and distribution of out-of-hospital endotracheal intubations.	Rescuer endotracheal intubation experience and endotracheal intubation experience standards defined by individual emergency medical services (EMS) agency	**Outcomes Measured:** Number of endotracheal intubations preformed across Pennsylvania, and the absolute and relative changes in total, cardiac arrest, nonarrest, pediatric, and trauma endotracheal intubation when the procedure was limited to on-scene rescuers meeting minimum endotracheal intubation standards and the same relationship when the procedure was limited to EMS agencies meeting minimal endotracheal	This analysis infers experience based on a single calendar year and does not account for cumulative or lifetime endotracheal intubation experience. The number of potential endotracheal intubations may have been underestimated because only basic life support units may have covered the civil divisions with no endotracheal intubations. Also, the design of the data set did not allow the researchers to evaluate	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17597255

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Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					intubation experience standards. **Results:** Limiting endotracheal intubations to rescuers with 3-15 intubations experiences a year would result in relative intubation reductions of 12%-93%. Limiting endotracheal intubations to EMS agencies with 20-150 experiences per year would result in intubation reductions of 15%-73%. Cardiac arrest endotracheal intubations would experience the largest absolute reduction.	unsuccessful endotracheal intubation, but it is not clear how this extra data would have altered the primary findings.	

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Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Intervention Examined/ Observations Made	Main Findings	Study Limitations	Link to Abstract
*National Research Agenda Emergency Medical Services, 2006 IOM Report	Jacoby J, Heller M, Nicholas J, et al. Etomidate versus midazolam for out-of hospital intubation: a prospective randomized trial. Ann Emergency Medicine 2006	**Study Design:** Randomized Control Trial **Sample Size**: 110 **Population Studied**: Adults (18 years or older)	To compare intubation success rates for sedative assisted intubation (etomidate versus midazolam) without paralytics in out-of-hospital adult patients.	Use of etomidate versus midazolam.	No clinical difference was determined from the study for etomidate or midazolam.	Limitations include having set dosing, improperly self-reported data points, and limit of the study design to evaluate outcomes.	http://www.ncbi.nlm.nih.gov/pubmed/16713778?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum
Seidel: Priorities in EMSC Research, National Research Agenda Emergency Medical Services	Cady CE, Pirrallo RG. The effect of Combitube use on paramedic experience in endotracheal intubation. American Journal of Emergency Medicine 2005;23(7):868-871.	**Study Design Type:** Cohort **Sample Size:** 5,286 **Population Studied:** Emergency patients over age 16 receiving an advanced airway attempt	To determine the number of endotracheal intubations per paramedic after the implementation of Combitube use and to explore consequences	Advanced airway attempt via endotracheal intubation before and after the implementation of Combitube.	**Outcomes Measured:** Endotracheal intubation experiences per paramedic. Endotrecheal intubation success rate. **Results:** Number of endotracheal intubations per paramedic decreased with introduction of Combitube from 6.9 to 3.7. Success rate of endotracheal	Use of retrospective database. Paramedic attrition and recruitment varied between data collection periods.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16291443

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Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					intubation decreased from 93.5% to 91.6% after the introduction of Combitube.		
National Research Agenda Emergency Medical Services, Seidel: Priorities in EMSC Research	Richmond NJ, Silverman R, Kusick M, et al. Out-of-hospital administration of albuterol for asthma by basic life support providers. Academic Emergency Medicine 2005; 12(5):396-403.	**Study Design Type:** Cohort **Sample Size:** 3,351 **Population Studied:** Patients with asthma	To demonstrate that basic emergency medical technicians (EMT-Bs) are able to effectively administer nebulized albuterol to asthma patients in the out-of-hospital environment.	Basic life support (BLS) asthma protocol and patient assessment	**Outcomes Measured:** Outcomes measures include peak expiratory flow rate (PERF), Borg dyspnea index, use of accessory muscles, ability to speak in full sentences, respiratory and pulse rates, and blood pressure **Results:** One out-of-hospital albuterol treatment was given in 60% of the time, while 40% of the patients received two. The PEFRs increased from 40.4% predicted to 54.8% predicted, for a posttreatment improvement of 14.4% points. Other clinical outcome measures, including dyspnea index, respiratory rate, and	Because of known efficacy of beta-agonists use of clinical controls were not feasible. Since there was no blinding to the study medication, it is possible that posttreatment data collection was influenced by knowledge of the intervention. BLS management of acute asthma patients was not compared with an advanced life support (ALS) or paramedic criterion standard. A large number of the ambulance call reports (ACR) for patients who may have been included in the asthma protocol were not retrieved so selection bias on	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15860692

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Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Intervention Examined/ Observations Made	Main Findings	Study Limitations	Link to Abstract
					use of accessory muscles, also showed improvement.	missing data is potentially a concern.	
2006 IOM Report	Kurola J, Harve H, Kettunen T, et al. Airway Management in Cardiac Arrest-comparison of the Laryngeal Tube, Tracheal Intubation and Bag-valve Mask Ventilation in Emergency Medical Training. Resuscitation. 2004, 61(2); 149-53.	**Study Design:** Randomized Controlled Trial **Sample Size:** 58 EMTs **Population:** 1st semester EMTs in Finland	Study aims to compare initiation speeds and efficacy of ventilation using a laryngeal tube (LT), endotracheal intubation (ETI), and bag-valve mask (BVM).	This study compared ventilation of patients through usage of a LT versus BVM.	Even with little experience EMTs completed insertion of LT or performed an ETI. Less time was needed for the LT than the ETI, and the LT "provided better minute ventilation during CPR".	Results from using manikins may not apply to live patients in the prehospital setting. Aspiration risk, for example, cannot be assessed. Inconsistencies in the measurement of minute ventilation are inherent among the different devices despite efforts to synchronize ventilation and compression in each study group.	http://www.ncbi.nlm.nih.gov/sites/entrez/15135191
National Research Agenda Emergency Medical Services	Rumball C, Macdonald D, Barber P, et al. Endotracheal intubation and esophageal tracheal Combitube insertion by regular ambulance attendants: a comparative trial. Prehospital Emergency Care 2004;8(1):15-22.	**Study Design Type:** Non-randomized-controlled trial **Sample Size:** 357 **Population Studied:** Patients requiring ventilation with endotracheal intubation (ETI) or esophageal tracheal Combitube (ETC)	To analyze basic (non-paramedic) ambulance attendant success rates at endotracheal intubation (ETI) and esophageal tracheal Combitube (ETC) insertion as well as their continuing skill competency over time and whether ongoing practice on mannequins improved skill performance.	Intervention: Basic ambulance attendants that went through ETI and ETC insertion with mannequin practice (ETI-MP and ETC-MP) practice. (n=256) Control Basic ambulance attendants that did not have mannequin practice (ETI-NMP and ETC-NMP) (n=101)	**Outcomes Measured:** Successful insertion and ventilation with ETC or ETI, assessed by receiving physicians. Differences in successful insertion/ventilation between MP and NMP groups. **Results:** The ETI-NMP group had a successful	Small group numbers. Curriculum taught may have differed from other courses. Assessment errors may have resulted from low numbers and limited participant and physician ETC experience.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=14691782

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Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					insertion (intent-to-treat) rate of 63% as compared to a 76% success rate for the ETI-MP group. Success rates for ETC-NMP and ETC-MP were 62% and 68% respectively. ETI success (as-treated) was 75% for ETI-MP and 61% for ETI-NMP.		
National Research Agenda Emergency Medical Services, Seidel: Priorities in EMSC Research, CDC Acute Injury Care Research Agenda	Werman HA, Schwegman D, Gerard JP. The effect of etomidate on airway management practices of an air medical transport service. Prehospital Emergency Care 2004;8(2):185-190.	**Study Design Type:** Cohort **Sample Size:** 147 **Population Studied:** Patients ages 10 and older who required intubation transported by the air medical crew	To study the effect of introducing etomidate on the airway management practices of their air transport crew and specifically considered the need for paralytic agents during rapid-sequence intubation (RSI).	Use of etomidate	**Outcomes Measured:** Method used for intubation, oral intubation success rate, number of attempts for oral intubation, need for paralytic agents, and complications with the procedure. **Results:** Etomidate reduced the use of paralytic agents from 46 to 62 of patients receiving midazolam to 10 of 22 intubated with etomidate.	The power of the study is low due to a short study time. The complications of intubation were self-reported by crew members so it is likely that the true incidence is higher. Additionally, the study was limited in its ability to comment on outcomes due to a lack of inpatient data. The study was also unable to separate out the effects of introducing the drug itself from the effect of an educational program emphasizing orotracheal	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15060854

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Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
						intubation using a RSI.	
National Highway Traffic Safety Administration, Centers for Disease Control and Prevention	Dunford JV, Davis DP, Ochs M, et al. Incidence of transient hypoxia and pulse rate reactivity during paramedic rapid sequence intubation. Ann Emergency Medicine. December 2003; 42(6):721-8**.**	Study Design: Prospective Sample Size: 54 Population: Adults with severe closed head injury	To prospectively record desaturation and pulse rate activity in patients with closed head injury treated with paramedic rapid sequence intubation.	Paramedic initiated rapid sequence intubation	**Outcomes Measured**: Incidence of desaturation and pulse rate reactivity (increase or decrease of more than 20 beats/min) during rapid sequence intubation. 57% (31 of 54) of patients experienced desaturation during rapid sequence intubation. Of those 31 (57%), 84% (26 of 31) were not hypoxic prior to administration of neuromuscular blocking agents. Conclusion: Preoxygenation is necessary prior to paramedics initiating rapid sequence intubation for patients with serious closed head injury	Small study group, incomplete data for analysis which may have resulted in selection bias, and other variables which may have affected RSI performance such as intubation experience of paramedics.	http://www.ncbi.nlm.nih.gov/sites/entrez/14634593
2006 IOM Report	Pinchalk M, Roth RN, Paris PM, et al. Comparison of times to intubate a	**Study Design:** Randomized control trial	To compare time to intubation of a simulated trauma patient in two	Simulated trauma patient (Laerdal ALS Skilltrainer) in supine position and	Intubation was successfully completed in less time when the	Limitations include that manikins do not mimic the same complications as	http://www.ncbi.nlm.nih.gov/pubmed/12710789?ordinalpos=1&itool=EntrezSyste

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Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Intervention Examined/ Observations Made	Main Findings	Study Limitations	Link to Abstract
	simulated trauma patient in two positions. Prehosp Emerg Care 2003 Apr-Jun; 7(2):252-7.	**Sample Size**: 55 **Population Studied**: Paramedics in Pittsburgh.	different positions, supine and elevated 27°.	elevated 27° immobilized on a long spine board.	patient was elevated; the difference was statistically significant.	actual trauma patients, elevating the patient isn't recommended when the ambulance is in motion, and lack of long-term outcome data.	m2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum
CDC Acute Injury Care Research Agenda	Garza AG, Gratton MC, Coontz D, et al. Effect of paramedic experience on orotracheal intubation success rates. Journal of Emergency Medicine 2003;25(3):251-256.	**Study Design Type:** Cohort **Sample Size:** 1,066 **Population Studied:** Adult medical cardiac arrest patients intubated by full-time paramedic field personnel	To determine the effect of paramedic experience on orotracheal intubation success in prehospital adult nontraumatic cardiac arrest patients.	Months of experience of paramedics. Number of patients in whom intubations were attempted, number of intubation attempts, success per intubation attempt, and success per patient.	**Outcomes Measured:** Correlation between months of experience and intubation of cardiac arrest patient success. **Results:** Intubation success rate of 85.3%. Association between intubation success and the total number of patients in whom intubation was attempted per paramedic.	No data on frequency of intubation for the paramedics before the study period. Small amount of data on intubation training for the paramedics. Results do not provide a conclusive basis for initial airway training or intubation maintenance programs.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=14585451
	Ochs M, Davis, D, Hoyt D; et al. Paramedic – performed rapid sequence intubation of patients with severe head injuries. Annuals of Emergency Medicine. 2002; 40(2).	**Study Design**: prospective chart review **Sample Size**: 123 **Population:** adult patients with head injuries.	Illustrate paramedic use of rapid sequence intubation with the use of neuromuscular blocking and sedative agents. The study will focus on the success rate of intubation, physiologic	**Intervention Examined:** The use of neuromuscular blocking and sedative agents. The study will focus on the success rate of intubation, physiologic parameters and complications.	**Outcome Measured:** paramedic intubation success rate, oxygen saturation rates pre and post intubation, arterial blood gas value upon arrival to trauma center, total out of hospital time	Researchers did not study the effect of additional out of hospital time on the outcome measures. All patients with a suspected head injury were included-this includes patients enrolled because of	http://www.ncbi.nlm.nih.gov/pubmed/12140494?ordinalpos=12&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum

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Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
			parameters and complications.		for patients intubated en route versus on scene. **Main findings:** 84% paramedic endotracheal intubation success rate, there were no reports of aspiration during the RSI procedure, no cases of reported deterioration immediately following the administration of succinylcholone or other paralytic medications. Average oxygen saturation rate on arrival to the trauma center was 98%. RSI on scene added 15 minutes to total out of hospital time	alteration in mental status for reasons other than a head injury (ex. Intoxicated patients) No outcome data	
National Research Agenda Emergency Medical Services	Reed DB, Snyder G, Hogue TD. Regional EMS experience with etomidate for facilitated intubation. Prehospital Emergency Care 2002;6(1):50-53.	**Study Design Type:** Cohort **Sample Size:** 67 **Population Studied:** Adults whose prehospital intubations required	To report the preliminary experiences of the Central New York emergency medical services (EMS) region with etomidate for prehospital facilitated intubation.	Use of etomidate for facilitated intubation versus use of diazepam for facilitated intubation	**Outcomes Measured:** Successful intubation **Results:** Of the 409 intubations during the study period, 24 were facilitated (using etomidate) and 19 were	Limitations include a small sample size and self-reporting of airway data by paramedics.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11789650

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Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Intervention Examined/ Observations Made	Main Findings	Study Limitations	Link to Abstract
		medications			successful (79%). The region's prior 19-month experience using diazepam for facilitated intubation resulted in ten (23%) successful intubations of 43 facilitation intubations attempts.		
National Research Agenda Emergency Medical Services	Brown J, Thomas F. What happens with failed blind nasal tracheal intubations? Air Medical Journal 2001;20(2):13-16.	**Study Design Type:** Cohort **Sample Size:** 36 **Population Studied:** Flight nurses and paramedics attempting blind nasal tracheal intubation (BNTI)	To identify the factors associated with blind nasal tracheal intubation (BNTI) failure rates for oral tracheal intubation (OTI) and cricothyroidotomy (cric) performed by flight nurses and paramedics after failed BNTI	BNTIs attempted, subsequent OTI if BNTI is unsuccessful, subsequent cric if OTI is unsuccessful	**Outcomes Measured:** Successful BNTI, successful subsequent OTI, successful subsequent cric **Results:** Twenty-five of 36 successful BNTI, 9 of 11 successful subsequent OTI, 2 successful subsequent cric	Retrospective study with small sample size. The study did not consider the number of insertion attempts per patient nor the discrepancies in time needed to perform BNTI, cric and OTI. The severity of patient injury was not factored in.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11250613
National Research Agenda Emergency Medical Services	Kosowsky JM, Stephanides SL, Branson RD, et al. Prehospital use of continuous positive airway pressure (CPAP) for presumed pulmonary edema: a preliminary case series. Prehospital Emergency Care	**Study Design Type:** Case Series **Sample Size:** 19 **Population Studied:** Patients with respiratory distress transported by a	To describe the prehospital use of a continuous passive airway pressure (CPAP)	CPAP administered via face mask at 10cm H2O	**Outcomes Measured:** Pre- and post-therapy pulse oximetry, mean duration of therapy, avoidance of endotracheal intubation (ETI) **Results:** Mean increase in	Small sample size. A prospective, controlled clinical trial is needed to assess the use of CPAP in the prehospital setting.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11339731

Clinical Management: Respiratory							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	2001;5(2):190-196.	paramedic transport unit to one of three participating emergency departments			pulse oximetry from 83.3% to 95.4%. Mean duration of therapy 15.5 minutes. 12 of 19 patients avoided the need for an ETI completely		
	O'Connor RE, Megargel RE, Schnyder ME; et al. Paramedic success rate for blind nasotracheal intubation is improved with the use of an endotracheal tube with directional tip control. Annuals of Emergency Medicine 2000; 36(4).	**Study Design**: prospective, chart review **Sample Size**: N/A **Population:** paramedics in isolated 3 EMS agencies (5 paramedic units)	To evaluate whether the use of an endotracheal tube with directional tip control (Endotrol tube) improves the success rate of paramedic blind nasotracheal intubation (BNTI)	Intervention Examined: Endotrol tube usage by two paramedic services.	**Outcome Measured:** paramedic blind naso- tracheal intubation success rate, number of intubation attempts. Main findings: The intervention group using the directional control tip ETT had a 72% BNTI success rate compared to the control group using standard BNTI (58%). Overall, 75% of BNTI were successful on the first attempt. In conclusion, Use of ETTs with distal directional control is associated with a higher success rate for BNTI than conventional ETTs.	The paramedics were not randomly assigned to the group. The assignment was based on employer. There was not a standardized definition of when to intubate.	http://www.ncbi.nlm.nih.gov/pubmed/11020679?ordinalpos=44&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum
National Research Agenda Emergency Medical Services	Bradley JS, Billows GL, Olinger ML, et al. Prehospital oral	**Study Design Type:** Non-randomized-	To determine whether basic emergency medical	Intervention: EMTs receiving intubation training (n=87)	**Outcomes Measured:** Successful	EMT-B intubation curriculum was not standardized or	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db

Clinical Management: Respiratory							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	endotracheal intubation by rural basic emergency medical technicians. Annals of Emergency Medicine 1998;32(1):26-32.	controlled trial **Sample Size:** 87 **Population Studied:** Emergency medical technicians with no prior or concurrent paramedic training, historic paramedic controls	technicians (EMT-B) can perform prehospital oral endotracheal intubation with success rates comparable to those of paramedics using historic controls	Historical Control: Data from three previous studies on prehospital intubation success rates (n)	intubation **Results:** Rural EMTs with didactic and airway manikin training failed to achieve prehospital intubation success rates comparable to those of paramedic controls. EMT-B success rate: 49.1%; Paramedic success rate: 76.9-90%	validated; bias could have been introduced if EMT-Bs failed to report any unsuccessful intubation; EMT-B written or practical retraining was at the end of the study and therefore do not know if skills deteriorated over time; study did not determine patient survival or evaluate other outcomes; did not evaluate intubation training that employed practice on humans or cadavers; pediatric patients were not included; patient population restricted to apneic patients with no gag reflex.	=pubmed&dopt=Citation&list_uids=9656945

Clinical Management: Respiratory

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Intervention Examined/ Observations Made	Main Findings	Study Limitations	Link to Abstract
CDC Acute Injury Care Research Agenda	Lowe L, Sagehorn K, Madsen R. The effect of a rapid sequence induction protocol on intubation success rate in an air medical program. Air Medical Journal 1998;17(3):101-104.	**Study Design Type:** Case Series **Sample Size:** 198 **Population Studied:** Patients on whom intubation was attempted by helicopter nurses and paramedics	To examine the percentage of successful intubations before and after implementation of a rapid sequence induction (RSI) in patients treated by fight nurses and paramedics	Retrospective analysis of the effect of an RSI protocol on intubation success rates.	**Outcomes Measured:** Rate of successful intubation prior to implementation of RSI protocol Rate of successful intubation after implementation of RSI protocol **Results:** Success rate of intubation was 78% in pre-RSI group and 84.5% in post-RSI group. No significant difference existed in the number of patients successfully intubated pre-RSI compared to post-RSI. Statistically significant patient characteristics associated with unsuccessful intubation were facial trauma, combativeness, vomiting, and nasal bleeding.	Patients and the provider attempting intubation were not randomly assigned. Future studies should evaluate patient outcomes.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10181919

Clinical Management: Respiratory

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Intervention Examined/ Observations Made	Main Findings	Study Limitations	Link to Abstract
National Research Agenda Emergency Medical Services, CDC Acute Injury Care Research Agenda	Ma OJ, Atchley RB, Hatley T, et al. Intubation success rates improve for an air medical program after implementing the use of neuromuscular blocking agents. American Journal of Emergency Medicine 1998;16(2):125-127.	**Study Design Type:** Case Control **Sample Size:** 355 **Population Studied:** All patients needing intubation at two air medical programs (nurse/paramedic crews) over a 5-year period.	To determine whether the success rate for endotracheal (ET) intubation improves after implementing use of neuromuscular blocking (NMB) agents in an air medical program	Group A: Control group: use of NMB agents throughout study period Group B1: no use of NMB agents from 1989 to 1992 Group B2: use of NMB agents from 1992 to 1994	**Outcomes Measured:** Intubation success rate **Results:** Group A: the overall successful intubation rate was 93.5%. Group B: the overall successful intubation rate improved from 66.7% before NMB use to 90.5% after NMB use.	Study was based on retrospective chart review and may be subject to reviewer bias. Only patients with complications listed on the transport record were included in the study (other intubation-related complications may have been missed). The study did not include where the intubations were performed or transport conditions. Several patients were excluded from the study die to missing or incomplete records.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=9517684
CDC Acute Injury Care Research Agenda, National Research Agenda Emergency Medical Services	Updike G, Mosesso VN, Jr., Auble TEet al. Comparison of bag-valve-mask, manually triggered ventilator, and automated ventilator devices used while ventilating a nonintubated manikin model. Prehospital Emergency Care 1998;2(1):52-55.	**Study Design Type:** Cross-sectional study **Sample Size:** 19 **Population Studied:** Emergency medical technicians (EMTs)	To determine whether there were differences in tidal volume, minute volume, average mask leak per breath, gastric insufflation, and peak airway pressure when ventilating a nonintubated manikin with a bag-valve-mask (BV), manually triggered ventilator (MTV),	Ventilation of a nonintubated manikin mechanical test lung model with a bag-valve-mask, manually triggered ventilator, and automated ventilator	**Outcomes Measured:** Tidal volume, minute volume, average mask leak per breath, gastric insufflation, and peak airway pressure **Results:** All three devices delivered similar volumes when used by EMTs, but the bag-valve-mask	In vitro study does not consider subjective confounding factors of the prehosptial setting.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=9737408

Clinical Management: Respiratory

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Intervention Examined/ Observations Made	Main Findings	Study Limitations	Link to Abstract
			and automated ventilator (AV).		was associated with higher peak airway pressure, average mask leak per breath, and gastric insufflation.		
National Highway Traffic Safety Administration (NHTSA), Seidel	Harrison TH, Thomas SH, Wedel SK. Success rates of pediatric intubation by a non-physician-staffed critical care transport service. Pediatric Emergency Care. 2004;20(2):101-107.	**Study Design Type:** Case Series **Sample Size:** 143 **Population Studied:** Pediatric patients (younger than 13 years) in whom endotracheal intubation (ETI) was attempted by a nurse/paramedic critical care transport (CCT) crew working under protocols which included neuromuscular blockade -	To assess endotracheal intubation (ETI) success rates achieved by a small cadre of nonphysician critical care transport (CCT) providers. Also to assess the association between ETI success and pediatric age group.	The intervention is attempted endotracheal intubation (ETI) by a nurse/paramedic CCT crew working under protocols which include neuromuscular blockade-facilitated ETI.	**Outcomes Measured:** Successful endotracheal intubation as judged by standard clinical criteria and by follow-up with receiving hospitals. **Results:** Intubation was successful in 136 patients for an overall ETI success rate of 95.1%. Success rates for ETA in the youngest (younger than 3 years), middle (3-8), and older (9-12) pediatric patients were 90.7% (49/54), 98.2% (55/56), and 97.0% (32/33).	There is a confounding relationship between intubator experience and attempts on airways perceived to be difficult.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=14758307
Seidel	Vilke GM, Smith AM, Ray LU, et al. Airway obstruction in children aged less than 5 years: the prehospital experience. Prehospital	**Study Design Type:** Cross-sectional study **Sample Size:** 182	To assess frequency and to stratify etiologies of children less than 5 years of age who had a 911 advanced life support (ALS)	Type of obstruction, age of the child, parents' action, paramedic treatment.	**Outcomes Measured:** incident outcome **Results:** Liquid obstructions were most common in the youngest	The study was limited to records included in an existing database. Some cases potentially could be missing if the chief complaint was not	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15060856

Clinical Management: Respiratory							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	Emergency Care. 2004;8(2):196-199.	**Population Studied:** Pediatrics who had a 911 advanced life support (ALS) ambulance response for airway obstruction	ambulance response for airway obstruction.		children, and solid food and nonfood solid obstructions were most prevalent in children over one year old. One hundred seven (59%) of the initial 182 obstructions resolved before paramedic arrival. Paramedics used ALS skills in only three cases.	among the categories searched. Also, some of the records were incomplete, specifically when identifying the object, although in many cases the object could have been unknown because it was never visualized (i.e., swallowed).	
Seidel, PECARN	Gausche-Hill M, Lewis R, Stratton S, et al. Effect of Out-of-Hospital Pediatric Endotracheal Intubation on Survival and Neurological Outcome. The Journal of the American Medical Association. 2000 Feb: 283(6).	**Study Design Type:** Clinical controlled trial **Sample Size:** 830 patients **Population Studied:** Children under 12 years of age and weighing less than 40 kg	To evaluate the efficacy of endotracheal intubation (ETI) as compared to bag-valve-mask ventilation (BVM) and their effects on hospital discharge and neurological outcomes.	Intervention: ETI group versus BVM group and outcome results in terms of hospital discharge and neurological status	**Outcomes Measured:** Efficacy of two ventilation methods **Results:** No statistically significant findings in differences between hospital discharge and neurological status could be found despite the two methods of ventilation.	Mannequins used to train paramedics. Also, violations of protocols occurred between the two study groups (ETI vs BVM) and occurred more frequently in the ETI group. In addition, inclusion criteria were assessed subjectively and the study was conducted not blinded during chart reviews.	Links: http://www.ncbi.nlm.nih.gov/sites/entrez/10683058

Disaster Preparedness							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
CDC Acute Injury Care Research Agenda, 2006 IOM Report	Zoraster RM, Chidester C, Koenig W. Field triage and patient maldistribution in a mass-casualty incident. Prehospital Disaster Medicine 2007;22(3):224-229.	**Study Design Type:** Cross-sectional study **Sample Size:** 241 **Population Studied:** Patients involved in a train crash in Los Angeles County on 26 January 2005	To assess field triage and patient maldistribution in a mass-casualty incident	Use of START model of mass-casualty incident field triage in response to an event occurred in Los Angeles County. A debriefing to assess and review the response was held with the major fire and EMS responders, Medical Alert Center (MAC) staff, and involved hospitals.	**Outcomes Measured:** Rate of patient maldistribution **Results:** Half of the significantly injured patients were taken to community hospitals while trauma centers were underutilized. Factors contributing to patient maldistribution include: - START system was intended only for field use; - Firescope Field Operations Guide does not address how secondary triage should work; - EMS personnel focus on fast turnaround time instead of patient distribution; - lack of predetermined standards for patient acceptance; - chaos and confusion at the scene make it difficult to track	Data was compromised because patients could not be followed specifically by triage category due to confidentiality concerns, and receiving facilities failed to keep triage tags with their designated patients.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17894217

Disaster Preparedness							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					where patients were going and what resources were utilized.		
National Research Agenda Emergency Medical Services	Berrios-Torres SI, Greenko JA, Phillips M, et al. World Trade Center rescue worker injury and illness surveillance, New York, 2001. American Journal of Preventative Medicine 2003;25(2):79-87.	**Study Design Type:** Cross-sectional study **Sample Size:** 5,222 **Population Studied:** Workers specifically assigned to rescue and recovery operations from September 14 to October 11, 2001 after the World Trade Center attacks in New York City	To quantify and characterize injury and illness among rescue workers, to provide a daily summary report, and to guide timely public health interventions.	Number and type of rescue worker visits, measured based on data from two sources, the temporary DMAT facilities and hospital EDs.	**Outcomes Measured:** Descriptive results based on data collected from the DMAT facilities, hospital EDs. **Results:** Of the 5222 rescue worker visits, 89% were to DMAT facilities and 12% to Emergency Departments. Musculoskeletal conditions were the leading cause of visits (19%), followed by respiratory (16%) and eye disorders (13%).	Because this system focused on DMAT facilities and four ED facilities, not all rescue workers who received treatment were captured. Also data collection forms for 13% of DMAT visits were missing. Accurate counts of the total number of rescue workers at the site were difficult to obtain.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12880873

Education and Training							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
2006 IOM Report	Sohn VY, Miller JP, Koeller CA, et al. From the combat medic to the forward surgical team: the Madigan model for improving trauma readiness of brigade combat teams fighting the Global War on Terror. The Journal of Surgical Research 2007;138(1):25-31.	**Study Design Type:** Cross-sectional study **Sample Size:** 327 **Population Studied:** Soldiers enrolled in the 4-day course, including combat medics, physician assistants, nurses and infantrymen	To test a refresher hybrid training model to provide specific trauma training for the conventional medic deploying in support of the Global War on Terrorism.	Enrollment in a 4-day course that teaches tactical combat casualty care.	**Outcomes Measured:** Improvement in preparedness for casualty care during combat. **Results:** 97% of the course graduates who were combat medics preparing for combat operations in Iraq or Afghanistan stated that their confidence and ability to treat combat casualties were considerably improved. 99% of the medics who took the course and deployed to Iraq for 1 year, stated that the course was beneficial.	No outcomes data from the battlefield. No follow up in American facilities for many of those treated in Iraq. Disparity between course attendees and postcourse survey respondents.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17196987
National Research Agenda Emergency Medical Services	Gordon DL, Issenberg SB, Gordon MS, et al. Stroke training of prehospital providers: an example of simulation-enhanced blended learning and evaluation. Medical Teacher 2005;27(2):114-121.	**Study Design Type:** Clinical trial **Sample Size:** 497 **Population Studied:** Paramedics	To evaluate the effectiveness of a simulation-enhanced stroke course that incorporates different learning strategies.	One-day interactive, emergency stroke course featuring a simulation-enhanced, blended learning approach that includes didactic lectures, tabletop exercises, and focused-examination training and small-group sessions led by	**Outcomes Measured:** Scores associated with two similar 20-question multiple-choice tests administered pre- and post-course, and scores associated with practical application exams based on four case scenarios	Clinician raters were not blinded regarding whether they were observing a pre-test or post-test. Inter-rater reliability for the clinician raters was not calculated. Paramedics were	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16019329

Education and Training							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
				paramedic instructors as standardized patients portraying five key neurological syndromes.	to evaluate 31 specific skills during two pre- and two post-course exams. **Results:** After taking the course, stroke knowledge among paramedics improved significantly both in terms of improved knowledge on written test and improved skills in stroke-related scenarios, including history taking, basis-exam performance (CPSS), expanded-exam performance (MEND exam), and ED reporting.	tested immediately following the course.	
National Highway Traffic Safety Administration, Institute of Medicine Report	Miller D, Guimond G, Hostler D, et al. Feasibility of Sternal Intraosseous Access By Emergency Medical Technician Students. Prehospital Emergency Care. 2005, 9(1); 75-78.	Study Design: Prospective education trial Sample Size: 29 students Population: EMT-B students	To assess the feasibility of teaching (emergency medical technician-basic) EMT-B students to use the commercial sternal intraosseous (IO) infusion device (FAST-1).	Ability of EMT-B students to place the FAST-1 into the sternum of a resuscitation mannequin.	Minimal training yielded limited success for teaching EMT-B students to use a sternal IO infusion device. Research involving more intensive training may produce better results.	This was a pilot study using a simulation mannequin. The results in the lab may differ from the results in the "real world", the sternal notch was marked by an Ace wrap which may have biased the results, study subjects were students and possibly a more	http://www.ncbi.nlm.nih.gov/pubmed/16036832

Education and Training							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
						successful performance would have been observed with higher level rescuers or professional EMT-Bs.	
National Research Agenda Emergency Medical Services	Pratt JC, Hirshberg AJ. Endotracheal tube placement by EMT-Basics in a rural EMS system. Prehospital Emergency Care 2005;9(2):172-175.	**Study Design Type:** Cohort **Sample Size:** 32 **Population Studied:** Patients in cardiopulmonary or respiratory arrest	To evaluate the effectiveness of an intubation-training module and special-waiver project in which Emergency Medical Technician (EMT)-Basics were trained to perform endotracheal intubations in a rural community.	Training module based on the state's paramedic curriculum, including didactic education, practical laboratory / review / evaluation sessions, and practice intubations.	**Outcomes Measured:** Successful intubation **Results:** Of the thirty-two intubations performed by EMT-Basics, thirty were successful and two were unsuccessful.	The small sample size is a limitation of the study. It is also unclear how well the training module would work in an urban or large suburban system, given that this study was conducted in a small, rural setting.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16036842
National Research Agenda Emergency Medical Services, 2006 IOM Report	Soysal S, Karcioglu O, Topacoglu H, et al. Evaluation of prehospital emergency care in the field and during the ambulance drive to the hospital. Advances in Therapy 2005;22(1):44-48.	**Study Design Type:** Case Series **Sample Size:** 81 **Population Studied:** Patients brought into the emergency department (ED) via ambulances	To evaluate the appropriateness of ambulance procedures and interventions in the management of patients dispatched to 2 emergency departments (EDs) of urban hospitals in Izmir, Turkey.	Time from onset of the event until arrival to the ED; medical or trauma status; use of trauma board and cervical collar; appropriate versus inappropriate use of the cervical collar; emergency staff informed or not informed by ambulance staff; emergency problems related to the airway, breathing, and circulation as well as how problems	**Outcomes Measured:** Efficiency of emergency care provided to patients brought to ED in an ambulance **Results:** There was no significant relationship between administration of IV fluids and the presence of circulatory impairment. A trauma board was used in 9 of 30	Multiple variables influencing transport time to ED were not controlled for or analyzed (e.g. traffic, patient demographics, institution of origin). Patient outcome was not used to measure appropriateness of prehospital care. Rather, the prehospital medical procedure was used to determine appropriateness.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15943221

Education and Training							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
				were resolved; Glasgow Coma Scale (GCS) score.	cases and a cervical collar in 6 of 30. It was concluded that basic procedures used in the management of patients brought into the ED via ambulances were inadequate, probably due to a lack o knowledge and experience.		
National Research Agenda Emergency Medical Services	Wojner-Alexandrov AW, Alexandrov AV, Rodriguez Det al. Houston paramedic and emergency stroke treatment and outcomes study (HoPSTO). Stroke 2005;36(7):1512-1518.	**Study Design Type:** Diagnostic Accuracy **Sample Size:** 1,518 **Population Studied:** Suspected stroke patients transported by paramedics to a hospital	To develop citywide stroke centers and improve prehospital paramedic performance to increase the number of patients receiving acute stroke treatment.	Monthly paramedic and hospital education based on the Brain Attack Coalition (BAC) and American Stroke Association (ASA) guidelines.	**Outcomes Measured:** Change in: symptom onset to emergency department arrival; paramedic diagnostic accuracy; paramedic transport times; emergency department arrival to computed tomography (CT) interpretation time; treatment with intravenous tissue plasminogen activator (tPA) **Results:** Accuracy of paramedic diagnosis of stroke increased from 61% in the pre-intervention phase	* Did not control for public awareness of availability and time constraint for thrombolytic treatment. * Results not generalizable to other centers. An overall reduction in the effect of the intervention by a preexisting commitment to the treatment of acute stroke in Houston.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15961712

Education and Training							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					to 79% in the active-intervention phase. Admission within 2 hours of symptom onset increased from 58% in the pre-intervention phase to 62% in the active-intervention phase.		
National Research Agenda Emergency Medical Services, CDC Acute Injury Care Research Agenda	Arreola-Risa C, Mock C, Herrera-Escamilla AJ, et al. Cost-effectiveness and benefit of alternatives to improve training for prehospital trauma care in Mexico. Prehospital Disaster Medicine 2004;19(4):318-325.	**Study Design Type:** Cohort **Sample Size:** 1,880 **Population Studied:** Trauma patients who received treatment from an emergency medical system (EMS) service	To evaluate the cost-effectiveness of several approaches to improving training for personnel in three ambulance services in Mexico.	Demographics, role of endotracheal intubation, and mortality associated trauma patients. Trauma patients treated by an EMS service in Monterrey that received Prehospital Trauma Life Support (PHTLS) training (n=866). Comparison: Trauma patients treated by an EMS service in San Pedro that received Basic Trauma Life Support (BTLS), and Advanced Cardiac Life Support (ACLS) courses as well as an airway management course (n=510). Control: Trauma	**Outcomes Measured:** A causal association between increased training and better health outcomes for patients. **Results:** An Increase from 16% to 39% in basic airway maneuvers for patients in respiratory distress in Monterrey, as well as a 14% to 64% increase for San Pedro. Increases in the role of endotracheal intubation for patients with respiratory distress significantly increased only in San Pedro. Mortality decreased only in Monterrey.	Direct comparisons of later components of the study with the earlier one are inconclusive . Self-reporting by the medics on the ambulance run sheets were used for the data. Death assessments differed between the populations being studied.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15645628

Education and Training							
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				patients treated by an EMS Service in Santa Catarina that received no special training (n=504)			
National Research Agenda Emergency Medical Services	Heegaard W, Plummer D, Dries D, et al. Ultrasound for the air medical clinician. Air Medical Journal 2004;23(2):20-23.	**Study Design Type:** Case Series **Sample Size:** 10 flight nurses and paramedics; 100 patients **Population Studied:** Air medical crews; Air medical patients who had a US performed between July 2001 and July 2002	To develop an ultrasound (US) training program for air medical clinicians using focused US examinations and assess the competencies of each clinician 1 year later	Development of a US training program and assessment of competencies 1 year later through a questionnaire and practical demonstration	**Outcomes Measured:** Percentage of correct answers on the questionnaire, percentage of correct demonstration in the practical exam, US scan results as read by air medical **Results:** Percentage of correct answers on the questionnaire: 82% (2001), 71% (2002); Percentage of correct practical demonstrations: 87% (2001), 94% (2002); In both medical and trauma patients, 99% of US scans were read as negative by the air medical crew and physician who overread US images. Sensitivity and specificity were 100%	Observational study, only 1 reviewer of all US images, total number of US images included in this study is small	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15014392
National Research Agenda Emergency	Markenson D, Foltin G, Tunik M, et al.	**Study Design Type:**	To evaluate the ability to train	A demonstration project developed to	**Outcomes Measured:**	Impossible to determine the	http://www.ncbi.nlm.nih.gov/sites/entre

Education and Training							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
Medical Services	Albuterol sulfate administration by EMT-basics: results of a demonstration project. Prehospital Emergency Care 2004; 8(1):34-40.	Cohort **Sample Size:** 190 **Population Studied:** Patients experiencing bronchospasm that were administered albuterol by an emergency medical technician-basic (EMT-B) in accordance with the treatment protocol approved for the demonstration project	emergency medical technicians-basic (EMT-Bs) to accurately identify bronchospasm and, based on a treatment protocol, administer albuterol sulfate via nebulization as a standing order. To measure the improvement in patient condition after treatment.	train EMT-Bs to appropriately administer albuterol sulfate to patients suffering from bronchospasm.	Patient health outcomes. EMT-B concurrence with emergency department physician in the assessment of bronchospasm. **Results:** A clinical improvement was seen in patients with bronchospasm who were administered albuterol. In 87.4% of the cases the EMT-B and physician concurred in the assessment of bronchospasm.	source of the EMT-Bs assessment ability. Only a small children's sample. 55 patients in the study had no linked hospital data.	z?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=14691785
National Research Agenda Emergency Medical Services, 2006 IOM Report	Riley J, Burgess R, Schwartz B. Evaluating the impact of an educational intervention on documentation of decision-making capacity in an emergency medical services system. Academic Emergency Medicine 2004;11(7):790-793.	**Study Design Type:** Cohort **Sample Size:** 200 **Population Studied:** Emergency medical technicians	To compare the documentation of decision-making capacity by advanced life support (ALS) providers and signature acquisition before, one month after, and one year after an educational intervention.	One-and-a-half hour module on assessment and documentation of decision-making capacity	**Outcomes Measured:** Rate of decision-making capacity, signature acquisition, and number of patients transported **Results:** Documentation rates and rates of signature acquisition immediately after the intervention and one year later did not differ from the period prior to the	The sampling for the study was a convenience sample so sampling bias cannot be ruled out. Also, the frequency of transport refusals initially declined and then rose a year after intervention, but subsequent time periods were not reviewed to determine whether this ultimately reached preintervention levels.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15231474#

Education and Training							
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					intervention. The frequency of call refusals decreased significantly after the intervention.		
CDC Acute Injury Care Research Agenda, National Research Agenda Emergency Medical Services	Sarikaya S, Soysal S, Karcioglu O, et al. Paramedics and triage: effect of one training session on triage in the emergency department. Advances in Therapy 2004;21(5):329-334.	**Study Design Type:** Diagnostic Accuracy **Sample Size:** Phase 1: 250 Phase 2: 250 **Population Studied:** Patients in the emergency department (ED) undergoing triage	To measure the consistency in triage decisions between emergency department (ED) paramedics and emergency physicians (EPs) one week before and one week after a triage training session for ED paramedics	Consistency between ED paramedics and physicians regarding triage decisions one week before and one week after an educational triage training session for ED paramedics	**Outcomes Measured:** Triage of patients to categories of "well," "moderate," and "bad" by physicians and ED paramedics. Triage classification of patients to scores of "emergent," "urgent," "semiurgent," and "nonurgent" by physicians and ED paramedics. Consistency between physician and ED paramedic assessment. **Results:** There was weak consistency between the physicians' and paramedics' evaluation with regard to the patients' general appearance prior to the education session (k=0.327). There was moderate	The triage tasks were assessed for only 8 paramedics over an 8 day period. This interval may be too brief to account for factors that influence paramedic's decision-making. Differences in levels of training between MDs and paramedics lends itself to variation in triage classification.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15727402

Education and Training							
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					consistency between the physicians' and paramedics' evaluation with regard to the patients' general appearance following the education session (k=0.500). There was weak consistency between the physicians' and paramedics' evaluation with regard to the patients' triage score prior to the education session (k=0.317). Consistency between the physicians' and paramedics' evaluation with regard to the patients' triage score remained weak following the education session (k=0.318).		
EMSOP Agenda	Persse DE, Key CB, Baldwin JB. The effect of a quality improvement feedback loop on paramedic-initiated	**Study Design Type:** Cross-sectional study **Sample Size:**	To examine the effect of a paramedic educational program and quality improvement	Feedback of patients' satisfaction with emergency medical services (EMS)	**Outcomes Measured:** Non-transportation rates, percentage of patients seeking further medical	The study is limited by its size as well as potential selection bias that may exist as a result of being able to contact less	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11789647

Education and Training							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	nontransport of elderly patients. Prehospital Emergency Care 2002;6(1):31-35.	254 **Population Studied:** Patients 65 years of age and older who were evaluated but not transported by paramedics	feedback loop on paramedic initiated nontransport of patients 65 years of age and older.		attention within 24 hours, percentage of patients who required hospitalization within 24 hours of the nontransport, and patients' overall satisfaction level **Results:** When paramedics were provided with objective feedback regarding outcome of patients not transported, the paramedic-initiated nontransportation and delayed hospitalization rates decreased, and the patient satisfaction level rose to 100%.	than 60% of patients. Additionally, interpretations of the results of the study are limited by any bias the patient or patients' family members may have introduced. By their inherent nature, telephone interviews have unavoidable intrinsic biases resulting from question sentence structure, the order of the questions, and other factors.	
National Research Agenda Emergency Medical Services	Swanson ER, Fosnocht DE. Effect of an airway education program on prehospital intubation. Air Medical Journal 2002;21(4):28-31.	**Study Design Type:** Cohort **Sample Size:** 372 **Population Studied:** Patients who received rapid sequence intubations (RSI) from an air medical program.	To determine the impact of an airway education program on prehospital intubation.	Airway education program on prehospital intubation. PostAEP group: Patients who received intubations from an air medical program after the medical personnel had gone through the airway education program (n=192).	**Outcomes Measured:** Difference in intubation success rate, use of neuromuscular blockade (NMB), NMB without sedation, cricothyrotomy rate, failed intubation rate in nonarrested patients. **Results:**	Retrospective data collection. The air medical transport chart may have contained inaccuracies.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12087321

Education and Training							
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				PreAEP group: Patients who received intubations from an air medical program before the medical personnel had gone through the airway education program (n=180).	Intubation success rates for the preAEP group and post AEP group were 94% and 97%, respectively. In 63% of preAEP intubations, NMB was used. In 76% of postAEP intubations, NMB was used. NMB without sedation decreased from 55% to 8% between the preAEP and the postAEP groups. Cricothyrotomy rate decreased from 6% to 2% between the preAEP and the postAEP groups. A Failed intubation rate of 6% was seen in nonarrested patients receiving no medications or partial RSI compared with 2% in patients who had full RSI.		
National Research Agenda Emergency Medical Services	Risavi BL, Salen PN, Heller MB, et al. A two-hour intervention using START improves prehospital triage of mass casualty incidents.	**Study Design Type:** Non-randomized-controlled trial **Sample Size:** 109	To evaluate the effectiveness of a brief educational intervention on mass casualty incident (MCI) triage with a written scenario and test.	Intervention: Two-hour educational intervention consisting of a slide and video presentation utilizing the START method (simple triage and	**Outcomes Measured:** Pre-training and post-training test scores **Results:** The mean	Intervention not tested in actual setting. Results can't be applied to MCI with confidence.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11339732

Education and Training							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	Prehospital Emergency Care 2001;5(2):197-199.	**Population Studied:** Prehospital providers		rapid treatment).	immediate post-test score (75% correct) was significantly improved compared with the mean pre-test score (55% correct) for the 109 providers completing both tests.		
National Research Agenda Emergency Medical Services, 2006 IOM Report	Moscati R, Billittier AJ, Marshall B, et al. Blood loss estimation by out-of-hospital emergency care providers. Prehospital Emergency Care 1999;3(3):239-242.	**Study Design Type:** Randomized-controlled trial **Sample Size:** 43 **Population Studied:** Emergency medical technicians (EMTs)	To evaluate emergency medical technicians' (EMTs) ability to estimate spilled blood volume and to determine whether limited training improves estimate accuracy and whether there is a difference in improvement comparing two different training methods.	Receiving "training" on estimating spilled blood at the six original blood spill test sites, versus being "trained" using slides of six similar blood spill sites	**Outcomes Measured:** Emergency medical technicians (EMTs) **Results:** Mean percent error was 74%±41% and 59%±20% for the site group initially and after retesting, respectively. Mean percent error was 56%±17%± and 45%±17% for the slide group initially and after retesting, respectively.	Relatively small numbers of participants prevented the researchers from performing subgroup analysis. Also, the limitless types of surfaces (i.e., with respect to absorbency) found in actual clinical settings could not be included in the study.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10424862
EMSOP Agenda	Ali J, Adam R, Josa D, et al. Effect of basic prehospital trauma life support program on cognitive and trauma management skills. World Journal of Surgery 1998;22(12):1192-	**Study Design Type:** Non-randomized-controlled trial **Sample Size:** 28 **Population Studied:** Paramedical	To assess the impact of the Prehospital Trauma Life Support Program (PHTLS) on cognitive and trauma patient management skills among paramedical personnel completing the	Introduction of a standard PHTLS course. Intervention group: Paramedical personnel who have taken the standard PHTLS course (n=14)	**Outcomes Measured:** Trauma patient resuscitation skills as measured by a simulation test. Cognitive performance as measured by a 50 item multiple choice questionnaire	* Insufficient sample size * Generalizabilty of results.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=9841742

Education and Training							
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	1196.	personnel	program.	Control group: Paramedical personnel who have not taken the standard PHTLS course (n=14)	(MCQ) prepared by experts in prehospital trauma care and administered. Organized approach scores and adherence to priority as determined by study organizer observations. Overall grade for paramedical personnel **Results:** Post-PHLS MCQ scores were statistically significantly higher in the intervention group than in the control group, who did not improve their scores in the MCQ test. After PHLS training, the intervention group improved their mean trauma station scores whereas the control group showed no statistically significant improvement in score. Organized approach, adherence to		

Education and Training							
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					priority, and pass status scores also saw improvement in the intervention group and not the control.		
National Research Agenda Emergency Medical Services	Wynn JS, Black S. Evaluation of retention of safety and survival training content versus industry standard for training. Air Medical Journal 1998;17(4):166-168.	**Study Design Type:** Cohort **Sample Size:** 96 **Population Studied:** Air medical program nurse and paramedics	To determine air medical program crews' ability to understand and retain survival training material	Retention of previous survival and safety training	**Outcomes Measured:** Test scores **Results:** The pretraining test mean score was 60/100; the posttraining test average score was 92/100; and the 6-month mean score was 65/100. Flight crews do not retain a safe level of survival skill knowledge with annual recurrent training.	Air medical program crew knowledge retention was assessed 6 months after a training course, an interval likely to lead to reduced skills retention. The crews members retained for all 3 tests may differ significantly from those who dropped out after test #2.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10185098
Pediatric Emergency Care Applied Research Network (PECARN)	Woollard M, Mannion W, Lighton D, et al. Use of the Airtraq laryngoscope in a model of difficult intubation by prehospital providers not previously trained in	**Study Design Type:** Cohort **Sample Size:** 33 **Population Studied:** Prehospital	To test the ability of the Airtraq to facilitate intubation in the prehospital setting in challenging circumstances.	Training in Airtraq laryngoscopy	**Outcomes Measured:** Proportion of subjects successfully intubating the trachea in one attempt within a breath to breath interval of less than	There was possible sampling bias in this study. Attendees at the conference were arguably more likely to consist of practitioners with a greater commitment to their on-going education.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17845660

Education and Training							
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	laryngoscopy. Anaesthesia. 2007;62(10):1061-1065.	providers without previous training in laryngoscopy who were attending the Australian College of Ambulance Professionals conference in Adelaide, Australia, in November 2006			30 seconds. **Results:** First-time intubation success rate was 26/33; oesophageal intubation rate was 0/33; median time to intubation was 17 seconds; and median subject-rated difficulty of use score was 21 out of 100	Therefore, they may be more knowledgeable about airway anatomy and management than members of the prehospital profession.	
Centers for Disease Control and Prevention (CDC), Pediatric Emergency Care Applied Research Network (PECARN)	Stevens SL, Alexander JL. The impact of training and experience on EMS providers' feelings toward pediatric emergencies in a rural state. Pediatric Emergency Care. 2005;21(1):12-17.	**Study Design Type:** Cross-sectional study **Sample Size:** 792 **Population Studied:** Emergency medical technicians (EMTs)	To determine which factors of training and education influence emergency medical technicians' (EMTs) feelings toward pediatric emergencies in a rural state	Level of comfort with various areas of training and education, types of emergencies encountered, and ages of patients	**Outcomes Measured:** EMTs feelings toward pediatric emergencies **Results:** Advanced level of training was associated with increased comfort levels in all areas queried. Increased call volume was associated with increased comfort levels for: children <4 years old, most skills and chief complains (except Pediatric Assessment by Age, Child Abuse, and Newborn Deliveries), and	The study had a low response rate (18%). However, the distribution of responders (i.e., the percentage of basic, intermediate, and paramedic level providers) is an accurate reflection of the statewide demographics. Another limitation stems from the nature of the survey; the answers to the questions were subjective in nature, and therefore reflect perceptions of the EMS providers rather than objective findings.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15643317

Education and Training							
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					most aspects of training (except Confidence and Resources).		
Seidel, Pediatric Emergency Care Applied Research Network (PECARN)	Sanddal TL, Loyacono T, Sanddal ND. Effect of JumpSTART training on immediate and short-term pediatric triage performance. Pediatric Emergency Care. 2004;20(11):749-753.	**Study Design Type:** Cohort **Sample Size:** 38 **Population Studied:** Emergency medical technicians and registered nurses	To evaluate the effectiveness of JumpSTART training in changing prehospital care personnel and/or school nursing personnel performance in triaging pediatric patients involved in a multiple casualty incident immediately post training and at a 3- to 4-month follow-up interval.	The JumpSTART course administered to emergency medical technicians and registered nurses.	**Outcomes Measured:** Change in triage performance among prehospital and nursing personnel. **Results:** There was a significant improvement in mean score between pre and posttest. Subsequent posttests showed no difference in mean score, indicating retention of material.	A convenience sample was used. Impossible to conclusively determine if the material was retained or was the result of a comprehensive review prior to posttests. The simply measured performance during a staged mass casualty scenario.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15502656
Seidel	Spaite DW, Karriker KJ, Seng M, et al. Increasing paramedics' comfort and knowledge about children with special health care needs. American Journal of Emergency	**Study Design Type:** Cohort **Sample Size:** 72 **Population Studied:** Self-selecting	To evaluate a continuing education program for paramedics about children with special health care needs (CSHCN).	Continuing education program for paramedics about CSHCN	**Outcomes Measured:** Differences in average scores of pre- and post training tests and a follow-up survey **Results:** The self-study	Because of the self-selecting of the paramedics, there may have been selection bias introduced into the study. The response rate on some of the surveys was low.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11103722

Education and Training							
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	Medicine. 2000;18(7):747-752.	nationally registered certified Emergency Medical Technician-Paramedics (EMT-Ps) from a single municipal EMS agency in an urban area in the southwest			program on comfort and knowledge serving CSHCN increased paramedics' comfort and knowledge initially, although it decreased over time.		

EMS Operations							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
2006 IOM Report	Porter A, Snooks H, Youren A, et al. Covering our backs: ambulance crews' attitudes towards clinical documentation when emergency (999) patients are not conveyed to hospital. Emergency Medicine Journal 2008;25(5):292-295.	**Study Design Type:** Cross-sectional study **Sample Size:** 25 **Population Studied:** Paramedics	To explore ambulance crew members' attitudes towards clinical documentation and patients not conveyed to the hospital	Paramedics' attitudes towards clinical documentation for non-conveyed patients as provided by focus group responses	**Outcomes Measured:** Situations in which records were not completed for non-conveyed patients as provided by focus group responses **Results:** Two circumstances in which paramedics did not document non-conveyed patients emerged: when crews were unable to obtain necessary information from patients who were intoxicated or otherwise uncooperative; and when crews may not have recognized the encounter as having a clinical dimension. These circumstances were combined with a lack of monitoring by managers, and a disinclination on the part of some crew members to do seemingly unnecessary work.	The data were gathered in just one ambulance service trust. The 25 paramedics who took part in the study were only a small proportion of the total number employed by the trust.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=18434469

EMS Operations							
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National Research Agenda Emergency Medical Services	Stiell IG, Nesbitt LP, Pickett W. The OPALS Major trauma study: impact of advanced life-support on survival and morbidity. CMAJ. 2008; 178(9) 1141-1152.	**Study Design:** Before-after controlled clinical trial **Sample Size:** 2867 **Population Studied:** adult patients (16 years and older) with a major trauma (severity score >12) in 17 cities	To evaluate changes in survival as result of the system wide introduction of advance life support by prehospital providers. Basic life support had been the program used by EMS services system wide.	Advance life support program for paramedics(endotracheal intubation, placing intravenous line with fluids, medication administration)	**Outcomes Measured:** Primary outcome: survival to hospital discharge (patient leaving the hospital alive or transfer to long term care facility) Secondary measure: Quality of life based on disease. **Results:** Statistically no difference in survival to hospital discharge by either the basic life support phase or the advance life support. Higher mortality was documented for patients that were intubated in the field. Patients with suspected head injuries and a Glasgow coma scale less than 9 had higher mortality rates with the advanced life support group.	The study design was not a randomized trial. Possible selection bias.	http://www.cmaj.ca/cgi/content/full/178/9/1141
2006 IOM Report	Cone DC, Galante N, MacMillan DS, et al. Is there a role for	**Study Design Type:** Non-randomized-	To determine how often first responders (FR)	Implementation of EMD protocol	**Outcomes Measured:** Level of basic life	One facility was study, and therefore the results cannot	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&d

EMS Operations							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	first responders in EMS responses to medical facilities? Prehospital Emergency Care 2007;11(1):14-18.	controlled trial **Sample Size:** 469 **Population Studied:** Patients who required emergency medical system (EMS) dispatches to a facility before and after implementation of the emergency medical dispatch (EMD) protocol	provided patient care at a physician-staffed medical facility and whether the implementation of an emergency medical dispatch (EMD) protocol eliminating FR response could safely conserve FR resources without compromising patient care.	Sample 1: before implementation of EMD protocol (n=242) Sample 2: after implementation of EMD protocol (n=227)	support (BLS) and advanced life support (ALS) FR response. Incidence of patient care among BLS FR and ALS FR. **Results:** In the "before" sample, BLS FR responded to 64% and ALS FR responded to 48%. Patient care was provided by BLS FR in 2 cases, and ALS FR provided care in 17. In the "after" sample, BLS FR and ALS FR each responded to 4%, and all but one were in violation of protocol. BLS FR and ALS FR provided care in 1 and 3 cases, respectively.	safely be generalized. There is no gold standard that identifies "need" for either first responders or ALS. Unvalidated criteria was used in the study.	b=pubmed&dopt=Citation&list_uids=17169870
National Research Agenda Emergency Medical Services	Cooper S, O'Carroll J, Jenkin A, et al. Collaborative practices in unscheduled emergency care: role and impact of the emergency care practitioner--	**Study Design Type:** Cross-sectional study **Sample Size:** 45 **Population**	To develop an overview of the current emergency care practitioner (ECP) role by identifying instances and hindrances to collaboration in unscheduled care.	Interviews of and collection of observational data on the population studied.	**Outcomes Measured:** Influences on collaboration. **Results:** The ECP role: "restricted transport codes" of	Study does not include a cost-benefit analysis. Also not addressed are the culture of learning or the dangers of rapid changes in roles	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17711937

EMS Operations							
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	qualitative and summative findings. Emergency Medicine Journal 2007;24(9):625-629.	**Studied:** Emergency care practitioners, stakeholder participants (e.g., senior health authority and trust managers, A&E consultants and senior nurses, paramedics, general practitioners and practice managers, care home managers, social services and Falls group leads)			communication, focus on reducing admissions, frustrations about patient tasking and conflicting views about leadership and team work. Education and training: drivers for multi-professional clinically focused graduate level education, requirements for skill development in minor injury units and general practice, and the need for clinical supervision/member ship. Cultural white collar views, power and communication conflicts, and a lack of understanding of ECP's role.		
2006 IOM Report	Machen I, Dickinson A, Williams J, et al. Nurses and paramedics in partnership: perceptions of a new response to low-priority ambulance calls. Accident and Emergency Nursing	**Study Design Type:** Cross-sectional study **Sample Size:** 256 patients 5 nurses 6 paramedics **Population**	To explore patients' and staffs' perceptions of a pilot service which dispatches a nurse and paramedic to low-priority ambulance calls.	Patient and staff perceptions of an ambulance service including a nurse and paramedic dispatched to low-priority ambulance calls as ascertained by a questionnaire and individual interviews.	**Outcomes Measured:** Results of patient questionnaire: Patient group 1 (patients in the pilot group) and patient group 2 (patients in another geographical area) received a	Calls were not randomized to the pilot or standard service groups and there was a small sample size due to a low response rate to the questionnaire. The lag-time between the	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17993276

EMS Operations							
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	2007; 15(4):185-192.	**Studied:** Patients, nurses, and paramedics			questionnaire of two open ended questions regarding patients' views of the service Results of semi-structured interviews with willing patients Results from 2 focus groups with staff **Results:** Most patients responded positively to the service. The staff felt confident managing the calls, their combined skills enabled them to address a broad range of health needs, and the experience was rewarding. Areas for improvement identified by nurses and paramedics included the need for extended prescribing skills and more extensive training in basic skills (e.g., paramedic can open chest but not stitch a wound).	emergency call and patients' interviews may have interfered with recall of events. Pilot service group patients were note followed-up to assess whether their treatment was appropriate.	

EMS Operations							
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Cone Prehospital Care Research Agenda, National Research Agenda Emergency Medical Services	Mason S, Knowles E, Colwell B, et al. Effectiveness of paramedic practitioners in attending 999 calls from elderly people in the community: cluster randomised controlled trial. British Medical Journal 2007;335(7626):919.	**Study Design Type:** Randomized-controlled trial **Sample Size:** 3,018 **Population Studied:** Patients aged 60 and above who received aid from a paramedic and whose presenting complaint fell within the scope of practice of the paramedic practitioners	To evaluate the benefits of paramedic practitioners and, when possible, treating older people in the community after minor injury or illness.	Intervention: Provided services by a paramedic practitioner (n=1549) Control: Provided services by a traditional paramedic (n=1469)	**Outcomes Measured:** Patient satisfaction with care, attendance at emergency department, hospital admission and total episode time. **Results:** Patients in the intervention group were not as likely to attend an emergency department. Required hospital admissions among this group was lower also. The intervention group more regularly reported being "very satisfied." The intervention group experienced shorter total episode time by an average of about 42 minutes.	Differences in both recruitment time and response times between the two groups. Cannot generalize the results. Clustering may have occurred.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17916813
CDC Acute Injury Care Research Agenda	Mason S, O'Keeffe C, Coleman P, et al. Effectiveness of emergency care practitioners working within existing emergency service models of care. Emergency	**Study Design Type:** Cross-sectional study **Sample Size:** 524 **Population**	To evaluate appropriateness, satisfaction and cost of emergency care practitioners (ECP) compared with the usual service available in the same healthcare	Care provided to patients as provided by a survey to patients; the impact of ECP working on ECPs themselves, other healthcare professionals and stakeholders as	**Outcomes Measured:** Patients' perceptions of care as provided by surveys; healthcare professionals' perceptions of the impact of ECPs as	The method of recruitment of patients for the interviews may have resulted in selectivity. The economic findings presented in the study are	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17384374

EMS Operations							
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	Medicine Journal 2007;24(4):239-243.	**Studied:** Patients eligible to be seen by an emergency care practitioner (ECP), healthcare providers and managers	setting, to increase understanding of what effect, if any, ECPs are having on delivery of health services locally, and to evaluate whether ECP working yields cost savings	provided by telephone interviews.	provided by telephone interviews; and cost savings. **Results:** ECPs carried out fewer investigations, provided more treatments and were more likely to discharge patients home than the usual providers. Patients were satisfied with the care received from ECPs. Costs information indicated that ECP care may be cost effective in working in different settings across tradition professional boundaries.	based on limited data in one operational setting, and may not be generalizable.	
National Research Agenda Emergency Medical Services, Cone Prehospital Care Research Agenda	Mengual RP, Feldman MJ, Jones GR. Implementation of a novel prehospital advance directive protocol in southeastern Ontario. Canadian Journal of Emergency Medicine 2007;9(4):250-259.	**Study Design Type:** Cohort **Sample Size:** 86 **Population Studied:** Patients who experienced cardiac arrest	To assess satisfaction and comfort with implementation of a prehospital advance directive protocol	Implementation of a prehospital do- not-resuscitate (DNR) protocol that allows paramedics to honor verbal and non-standard written requests.	**Outcomes Measured:** Following a verbal or non-standard written DNR request, paramedics completed a questionnaire and follow-up structured telephone interview with surrogate decision makers (SDM).	Conclusions are limited by small sample size, lack of a comparison group, and limited follow-up.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17626689

EMS Operations							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					Comfort with the protocol was assessed using a 5 point Likert scale (5 being very comfortable). **Results:** Satisfaction with prehospital DNR protocol was uniformly high. Both the mean paramedic comfort and mean SDM comfort level with the protocol was rated 4.9/5.0. SDMs felt comfortable in withholding CPR in 98% of cases and with paramedic care in all cases. One SDM stated discomfort in making the DNR request although it was the patient's wishes.		
National Research Agenda Emergency Medical Services	Roudsari BS, Nathens AB, Cameron P, et al. International comparison of prehospital trauma care systems. Injury 2007;38(9):993-1000.	**Study Design Type:** Cohort **Sample Size:** **Population Studied:** Patients requiring	To compare trauma patients' outcome within and between countries with technician-operated advanced life support (ALS) and physician-operated (Doc-ALS) emergency medical	Review of patient-level data from regions in five countries with ALS EMS systems and four countries with DOC-ALS EMS systems.	**Outcomes Measured:** Emergency department shock rate (proportion of patients with systolic blood pressure <90mmHg in the ED) and early trauma fatality rate	Only few regions used. Only used high income countries. Missing data led to wider standard deviations.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17640641

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Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
		emergency medical system (EMS) services	service (EMS) systems.		(i.e. death during the first 24h after hospital arrival) **Results:** No difference in emergency department shock rate. ALS EMS systems more commonly saw early trauma fatality than did Doc-ALS EMS systems.		
2006 IOM Report, , National Research Agenda Emergency Medical Services	Studnek JR, Crawfird JM. Factors associated with back problems among emergency medical technicians. American Journal of Industrial Medicine 2007; 50 (6): 464-469.	**Study Design Type:** Case control **Sample Size:** 579 **Population Studied:** Emergency medical services technicians (EMT)	To determine the likelihood of an EMT reporting a back problem based on individual and work-related characteristics of a national sample of EMTs.	Current certification level involvement in patient transport and job satisfaction and age, race, marital status, and physical fitness (individuals variables)	**Outcomes Measured:** Self reported back problems **Results:** EMT's dissatisfied with their current assignment were significantly more likely to report back problems as were EMTs reporting food or fair fitness. Satisfaction with current assignment and self reported physical fitness seem to be two modifiable factors associated with self-reported back problems among EMTs	It is impossible to know if the results are generalizable to all EMTs. The resoinse rate of 32% is low and raised concerns about non-response bais. Misclassification can result in information bias when variables are measured with error, an occurrence that is more probable with self reported data.	http://www.ncbi.nlm.nih.gov/pubmed/17471509

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2006 IOM Report, National Research Agenda Emergency Medical Services	Studnek JR, Ferketich A, Crawford JM. On the job illness and injury resulting in lost work time among a national cohort of emergency medical services professionals. American Journal of Industrial Medicine 2007;50(12):921-931.	**Study Design Type:** Cross-sectional study **Sample Size:** 5,096 **Population Studied:** Emergency medical services (EMS) professionals	To evaluate the prevalence and incidence of job-related illness or injury resulting in lost work time among a national cohort of Emergency Medical Services (EMS) professionals.	Individual characteristics, work-related characteristics, and participant's health information as provided by survey	**Outcomes Measured:** Self-reported absence from an EMS job due to an EMS work related illness or injury as provided by survey **Results:** In a year, 8.1 of 100 EMS providers missed work due to job-related illness or injury. The overall prevalence was 9.4%. Increasing call volume, an urban work environment, and a history of back problems were associated with reporting job-related illness or injury.	The year-to-year response rate on the survey was low and may decrease the generalizability of the findings to the entire EMS workforce. The low response rate may also be due to participants being injured and leaving the workforce, which may also have biased the data. The study is also limited by the self-reported nature of the outcome variable. The analysis was limited by the variables available on the questionnaire.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17918231#
National Research Agenda Emergency Medical Services	Wiitavaara B, Lundman B, Barnekow-Bergkvist M, et al. Striking a balance--health experiences of male ambulance personnel with musculoskeletal symptoms: a grounded theory. International Journal of Nursing Studies 2007; 44(5):770-	**Study Design Type:** Cross-sectional study **Sample Size:** 10 **Population Studied:** Men with musculoskeletal symptoms who work as ambulance	To explore the experience of illness and wellness in ambulance personnel with musculoskeletal symptoms.	Experiences with musculoskeletal symptoms as provided by interviews	**Outcomes Measured:** Wellness and illness balance as provided by interviews **Results:** The study resulted in a model describing the experience of illness and wellness as characterized by an effort to strike a	Females were excluded from the informant group. * Small sample size.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16600239

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	779.	personnel			balance. Wellness through nurturing seemed similar to thinking of illness as an experience and a threat. Accepting and handling illness was important in maintaining wellness, and wellness through nurturing was the motivation for accepting and handling illness.		
National Research Agenda Emergency Medical Services, 2006 IOM Report	Aasa U, Kalezic N, Lyskov E, et al. Stress monitoring of ambulance personnel during work and leisure time. International Archives of Occupational and Environmental Health 2006; 80(1):51-59.	**Study Design Type:** Cross-sectional study **Sample Size:** 24 **Population Studied:** Ambulance personnel working a 24-h work shift followed by 2 work-free days	To assess physiological and subjective stress markers during a 24-h ambulance work shift and during the next two work-free days, and relate these parameters to self-reported health complaints.	Workers were followed with electrocardiogram, cortisol assessments, and diary notes. The ambulance personnel also performed tests of autonomic reactivity before and at the end of the work shift. Data collected is compared to data from work-free days.	**Outcomes Measured:** Comparison between data collected during a 24-h work day and two consecutive work-free days. **Results:** Subjective and physiological characteristics of ambulance personnel did not indicate distinctive stress during the 24-h work shift.	Lack of randomization. Insufficient sample size. Study design did not include an age and gender matched comparison group.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16680487
Cone Prehospital Care Research Agenda	Benner JP, Brauning G, Green M, et al. Disagreement between transport team and ED staff	***Study Design Type:*** Cohort **Sample Size:** 84	To determine the rate of disagreement in assessment of significant illness or injury between air	Assessment of significant illness or injury by air medical transport teams compared to assessment at the	**Outcomes Measured:** Concurrence between air medical team assessment and ED assessment	Retrospective study design.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16818166

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	regarding the prehospital assessment of air medically evacuated scene patients. Air Medical Journal 2006; 25(4):165-169.	**Population Studied:** Patients transported by medical flight teams from an accident scene to an emergency department (ED)	medical transport team assessment and emergency department (ED) diagnosis in patients transferred from the scene of an incident to the ED.	ED	for injuries to the head, spine, chest/airway, abdomen, musculoskeletal system, and cardiovascular system **Results:** Head: 98.5% agreement' spinal cord: 96.4% agreement; chest/airway 96.7% agreement; abdomen: 92.9% agreement; musculoskeletal: 94.4% agreement; cardiovascular: 98.2% agreement.		
2006 IOM Report	Burton JH, Dunn MG, Harmon NR, et al. A statewide prehospital emergency medical service selective patient spine immobilization protocol. The Journal of Trauma 2006; 61 (1): 161-167.	**Study Design Type:** Case series **Sample Size:** 31, 885 **Population Studied:** All prehospital patients treated with selective spine immobilization.	To evaluate the practices and outcomes associated with a state-wide emergency medical service (EMS) protocol for trauma patient spine assessment and selective patient immobilization.	The implementation of a selective spine immobilization protocol for all prehospital patients.	**Outcomes Measured:** Incidence of spine fracture among EMS-assessed trauma patients and the correlation between EMS and correlation between EMS spine immobilization decisions and the presence of spine fractures-stable and unstable. **Results:**	Limitations of the current study include chart review, identification, and dataset linkage methodology. Fracture descriptors were limited by the implementation ICD-9 of injuries.	http://www.ncbi.nlm.nih.gov/pubmed/16832265

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					The use of this state-wide EMS spine assessment protocol resulted in one nonimmoblized, unstable spine fracture patient in approximately 32,000 trauma encounters. Presence of the protocol affected a decision not to immobilized greater than half of all EMS-assessed trauma patients.		
Cone Prehospital Research Agenda, 2006 IOM Report	Casado A, De LN, Lopez-Fernandez E, et al. Lipid peroxidation, occupational stress and aging in workers of a prehospital emergency service. European Journal of Emergency Medicine 2006;13(3):165-171.	**Study Design Type:** Non-randomized-controlled trial **Sample Size:** 191 **Population Studied:** Workers form a prehospital emergency service.	To determine the levels of malondialdehyde, an end product of lipid peroxidation, according to demographic and occupational variables in workers of a prehospital emergency service and to analyze the relationship between malondialdehyde (MDA) levels and burnout.	Sociodemographic parameters, lifestyle and occupational factors as measured by a survey. Blood sampling. Group of interest: Prehospital emergency service workers (n=111) Control group: Age-matched healthy individuals (n=80)	**Outcomes Measured:** Levels of MDA and its correlation to stressful conditions in the prehospital emergency service workers. **Results:** Occupational stress increased MDA levels as a response to free radical generation and can lead to aging. Professional category is associated with lipid peroxidation and burnout levels.	* Insufficient sample size for each group * Selection bias	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16679882

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					Working night and evening shifts was causally associated with MDA levels and burnout levels		
2006 IOM Report, CDC Acute Injury Care Research Agenda	Ferreira J, Hignett S. Reviewing ambulance design for clinical efficiency and paramedic safety. Applied Ergonomics 2005;36(1):97-105.	**Study Design Type:** Cohort **Sample Size:** 14 **Population Studied:** Paramedics in ambulances	To review the layout of the patient compartment in ambulances for paramedic efficiency and safety	Link analysis of clinical efficiency and the effect of the design of the ambulance on the musculoskeletal wellbeing or the paramedics using postural analysis	**Outcomes Measured:** Links (i.e., movements of position, communication, and attention) between the paramedics and equipment categorized by the type of call received (e.g., cardiac arrest, collapsed patient); Postural analysis to describe the body posture, force application, and the activity of the worker resulting in a relative risk score on a four point scale. **Results:** Link analysis: The passenger seat was used the majority of the time (71%), but paramedics also treated patients by sitting on the stretcher (14%), rear passenger seat (11%), the attendant	Link analysis can only evaluate the patient compartment layout based upon the frequency of interactions between the patient, equipment, and paramedic. Full analysis should include task sequences. No major traumatic incidences were included in the study. There was limited data on the use of equipment and consumables in life-threatening emergencies. Limitations of using postural analysis include wide variation in measurement with different observation types	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15627427

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					seat (2%) and the paramedic box (2%). Postural analysis: Paramedic postures were found to have significantly higher action category (AC) when treating an emergency patient. Only 26% of time-sampled postures within the patient compartment required some corrective measures.		
National Research Agenda Emergency Medical Services, 2006 IOM Report	Mason S, Coleman P, O'Keeffe C, et al. The evolution of the emergency care practitioner role in England: experiences and impact. Emergency Medicine Journal 2006; 23(6):435-439.	**Study Design Type:** Cross-sectional study **Sample Size:** 17 **Population Studied:** Leaders at sites with varying emergency care practitioner (ECP) schemes	To describe the development of emergency care practitioner (ECP) schemes in 17 sites, identify criteria contributing to a successful operational framework, analyze routinely collected data and provide a preliminary estimate of costs.	The development of ECP Schemes as provided by a survey	**Outcomes Measured:** Identification of criteria contributing to a successful operational framework **Results:** Most ECPs had trained as paramedics. Fifty-four percent of patient contacts with the ECP service did not require a referral to another health professional or use of emergency transport. Factors contributing to a successful	The studies took place within tight deadlines, which restricted more detailed data collection and analysis. Only 50% of the sites surveyed were operational. Data submission by each ECP scheme was voluntary so it is unclear how representative the quantitative findings are.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16714501

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					operational framework were strategic visions crossing traditional organizational boundaries and appropriately skilled workforce integrating flexibly with existing services. The mean cost per ECP patient contact is £24.00, compared to £55.00 for emergency department contact.		
CDC Acute Injury Care Research Agenda, 2006 IOM Report	Aasa U, Barnekow-Bergkvist M, Angquist KA, et al. Relationships between work-related factors and disorders in the neck-shoulder and low-back region among female and male ambulance personnel. Journal of Occupational Health 2005; 47(6):481-489.	**Study Design Type:** Cross-sectional study **Sample Size:** 1,187 **Population Studied:** Male and female Swedish ambulance personnel	To investigate the relationships between work-related physical and psychosocial factors and disorders in the neck-shoulder and low-back region among female and male ambulance personnel. Also to investigate the influence of worry about work conditions on these relationships.	Work related factors, as measured by a survey. Complaints and activity limitation in the neck-shoulder and low-back as measured by a survey.	**Outcomes Measured:** Associations between physical and psychosocial factors and disorders in the neck-shoulder and low-back region. **Results:** Associations within Female population: - Physical demands w/ activity limitation in the neck-shoulder and low-back region. -Psychological demands w/ neck-shoulder and low-	The associations here cannot be considered causal. Subjects with musculoskeletal disorders may influence the results.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16369110

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					back complaints. -Independent association between worry about work conditions and activity limitation due to low-back complaints.		
National Research Agenda Emergency Medical Services, 2006 IOM Report	Frakes MA, Kelly JG. Shift length and on-duty rest patterns in rotor-wing air medical programs. Air Medical Journal 2004; 23(6):34-39.	**Study Design Type:** Cross-sectional study **Sample Size:** 129 **Population Studied:** Association of Air Medical Services-member rotor-wing air medical programs	To analyze relationships between shift length and on-duty rest practices of air medical teams and program model (hospital-operated, vendor-operated, independent, or public safety), base location, flight volume, and job requirements.	Shift length, on-duty rest practices, program model, base location, flight volume and job requirements as measured by a survey.	**Outcomes Measured:** Associations between shift length/on-duty rest practice and program model, base location, flight volume and job requirements. **Results:** Independent associations between shift length greater than 12 hours and: flight volume per-aircraft under 731 flights/year, program model (not hospital-operated), and nonhospital base. Any on-duty crew rest is associated with nonhospital base, program model (not hospital-operated), and shift length exceeding 12	Personal follow up could not be completed because of anonymity of respondents. Other means of general reminders should have been used but were not done in this study to increase survey return rates.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15520734

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					hours. Nonflight clinical assignment while on flight duty is associated with a prohibition against on-duty rest.		
National Research Agenda Emergency Medical Services	Hobgood C, Xie J, Weiner B, et al. Error identification, disclosure, and reporting: practice patterns of three emergency medicine provider types. Academic Emergency Medicine 2004; 11(2):196-199.	**Study Design Type:** Cross-sectional study **Sample Size:** 116 **Population Studied:** Emergency department (ED) providers	To gather preliminary data on how the three major types of emergency medicine (EM) providers, physicians, nurses (RNs), and out-of-hospital personnel (EMTs), differ in error identification, disclosure, and reporting.	Error frequency, disclosure, reporting practices, error based discussion and educational activities as evaluated by a survey. Sample 1: EMTs (n=41) Sample 2: RNs (n=33) Sample 3: Physicians (n=42)	**Outcomes Measured:** Differences between the three sample in error identification, disclosure and reporting. **Results:** 45% of EMTs, 56% of RNs, and 21% of physicians identified no clinical errors during the preceding year. For known errors, all providers were equally unlikely to inform the team caring for the patient. Disclosure to patients was limited and varied by provider type (19% EMTs, 23% RNs, and 74% physicians). 59% of physicians had observed another provider disclose and error to a patient. Error discussions are	The study was performed in only one ED on a small convenience sample of providers. The survey method asked providers to recall the number of errors in the preceding year and provided only the Institute of Medicine's definition of error with no illustrating examples. The survey instrument required that providers recall error events.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=14759966

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					widespread, with all providers indicating they discussed their own errors as well as the errors of others.		
2006 IOM Report	Kilner T. Desirable attributes of the ambulance technician, paramedic, and clinical supervisor: findings from a Delphi study. Emergency Medicine Journal 2004;21(3):374-378.	**Study Design Type:** Cross-sectional study **Sample Size:** 93 **Population Studied:** Ambulance technicians, paramedics, clinical supervisors	To identify desirable attributes of the ambulance technician, paramedic, and clinical supervisor.	Identification of desirable qualities for each occupational group in four areas: attitudes and values, knowledge, intellectual skills, and psychomotor skills as ascertained through questionnaires provided to a panel of experts.	**Outcomes Measured:** Desirable attributes for ambulatory technicians, paramedics, and clinical supervisors as identified by experts **Results:** Using Kendall coefficient on concordance, the top ranked attributes (mean score) for each occupational group were: Technician: honest (93.86); patient centered (91.29); caring, empathic, and values life (90.63); professionalism (89.52); non-judgmental, non-discriminatory (88.45); self aware, recognizing personal responsibilities and	Small sample size. Cross-sectional study. There is an element of inherent subjectivity in the expert panel. Members, for example, were drawn only from the executive, management and faculty arms of Ambulance Service and not the practitioner level. Desirable attributes selected by panel members may reflect their personal bias. The roles of paramedic and clinical supervisor are still evolving while the role of technician is better defined. Less agreement among panel members as to the desired attributes of the former is likely.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15107388

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					limitations (87.93). Paramedic: honest (94.17); professionalism (92.80); range of clinical skills to manage range of emergency conditions (92.40); familiarity with medical equipment operation (92.31); caring, empathic, and values life (91.74); patient centered (91.55).		
National Research Agenda Emergency Medical Services	Jonsson A, Segesten K. Guilt, shame and need for a container: a study of post-traumatic stress among ambulance personnel. Accident and Emergency Nursing 2004;12(4):215-223.	**Study Design Type:** Cross-sectional study **Sample Size:** 10 **Population Studied:** Ambulance nurses and ambulance technicians	To review post-traumatic stress among ambulance personnel	The way in which ambulance staff experience and handle traumatic events as ascertained through one-on-one interviews	**Outcomes Measured:** The structure of traumatic experiences as reported by the ambulance personnel, from pre- to mid- to post-trauma phases and how traumatic experiences were handled. **Results:** Post-traumatic stress symptoms including guilt, shame and self-reproach are common after duty-	Selection bias: the small number of study participants were selected using a non-randomized method to intentionally ensure representation of demographic variables. The secondary analysis of the data was an interpretive approach (subjective) based on philosophy.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15474346

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					related traumatic events in ambulance personnel. Personnel in ambulance organizations who perform defusing, debriefing and counseling have to be informed of the importance that the roll of guilt and shame may play in developing post-traumatic stress symptoms		
National Research Agenda Emergency Medical Services	Nor AM, McAllister C, Louw SJ, et al. Agreement between ambulance paramedic- and physician-recorded neurological signs with Face Arm Speech Test (FAST) in acute stroke patients. Stroke 2004;35(6):1355-1359.	**Study Design Type:** Diagnostic Accuracy **Sample Size:** 287 **Population Studied:** Suspected stroke/transient ischemic attack (TIA) patients referred to the acute stroke unit by paramedics through the Rapid Ambulance Protocol	To determine paramedic's accuracy in detecting acute stroke signs by comparing agreement between neurological signs recorded in the Face Arm Speech Test (FAST), a stroke recognition instrument, by paramedics on the scene and by stroke physicians after admission.	The Face Arm Speech Test (FAST) stroke recognition instrument performed by paramedics pre-hospital Reference Standard: FAST recognition instrument performed by stroke physicians at hospital	**Outcomes Measured:** Accuracy in determining whether a patient is suffering from acute stroke/transient ischemic attack **Results:** Of the 278 suspected stroke patients, 217 had confirmed stroke or TIA. Recorded signs and agreement between paramedics and stroke physicians in confirmed stroke group were: facial weakness, 68%	The study is limited by its design in that it is unrepresentative of routine clinical practice. Additionally, prehospital personnel were instructed to score the findings on examinations undertaken by a neurologist without having to elicit the signs themselves, which, again, is not reflective of their prehospital personnel. These differences in study design might be	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15118173

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					versus 70%; arm weakness, 96% versus 95%; and speech disturbance, 79% versus 77%.	expected to lead to greater agreement between paramedics and physicians than in a clinical practice comparison like this one.	
National Research Agenda Emergency Medical Services, 2006 IOM report	Shah MN, Brooke LE, Chiumento S, et al. An evaluation of paramedics' ability to screen older adults during emergency responses. Prehospital Emergency Care 2004; 8(3):298-303.	**Study Design Type:** Cohort **Sample Size:** 288 **Population Studied:** Patients 65 years of age or older who requested assistance via a 911 call, and were treated by a paramedic using a directed medical record	To evaluate the feasibility of using the emergency medical services (EMS) system as a public health provider by having paramedics screen older adults (equal to or greater than 65 years of age) for influenza immunization status during emergency responses	Paramedic treatment of patients who are 65 years of age or older.	**Outcomes Measured:** The proportion of patients who reported being nonimmunized. Comparison of patients screened and not screened by EMS providers and patients who reported being immunized and reported being nonimmunized. **Results:** Of the older-adult patients, paramedics successfully screened 61%. Of that 61%, 37% had not received the influenza vaccine for the most recent season. Patients who were able to communicate effectively, such as	Must generalize with caution. Impossible to gauge the accuracy of the screening performed. Categorizations of race may not be exact. Patients were considered not screened simply if they didn't know their immunization status.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15295732

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					those with a Glasgow Coma Scale (GCS) score of greater than 13, were more likely to be screened by paramedics. Vaccinated patients tended to be older, male and white.		
National Research Agenda Emergency Medical Services	Persse DE, Jarvis JL, Corpening J, et al. Customer satisfaction in a large urban fire department emergency medical services system. Academic Emergency Medicine 2004;11(1):106-110.	**Study Design Type:** Cohort **Sample Size:** 10,957 **Population Studied:** Ten percent of all patients transported during the period of October 15, 2001 through March 15, 2002. Also all emergency medical services (EMS) incidents in which a patient was not transported were included	To determine if emergency medical services (EMS) customer satisfaction could be assessed using telephone-survey methods.	Patients' perceptions of customer service of emergency medical services as measured by a telephoned survey.	**Outcomes Measured:** Assessment of patient perceptions of customer satisfaction of emergency medical services. **Results:** Found that 2,498 of the 10% of patients transported (5,098) were successfully contacted. Of those, 94.8% reported overall satisfaction with the service provided. 2,975 of the patients not transported (5,859) were contacted, with 96.3% reporting overall satisfaction. It was determined that phone surveys are an appropriate way to measure consumer	A potential bias exists in which patients contacted by phone may be hesitant to report negative experiences, thus artificially elevating satisfaction.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=14709439

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					satisfaction of patients.		
National Research Agenda Emergency Medical Services, CDC Acute Injury Care Research Agenda, 2006 IOM report	Snooks H, Foster T, Nicholl J. Results of an evaluation of the effectiveness of triage and direct transportation to minor injuries units by ambulance crews. Emergency Medicine Journal 2004; 21(1):105-111.	**Study Design Type:** Randomized-controlled trial **Sample Size:** 834 **Population Studied:** Patients who were attended by participating ambulance crews, who fell within an agreed list of dispatch criteria that were judged to cover all cases of minor injury, and who were assessed as matching protocols for transportation to a minor injury unit (MIU) by the study paramedic	To evaluate the effectiveness of triage and direct transportation of patients to minor injury units (MIUs) by ambulance crews.	Intervention: Patients who were attended by ambulance crews that had undergone training and were asked to use protocols to transport patients who met specific criteria to an MIU (n=409) Control: Patients who were attended by ambulance crews that were performing according to normal practice (n=425).	**Outcomes Measured:** Differences in ambulance performance, patient satisfaction, and clinical safety. **Results:** There was a very similar proportion of patients taken to MIU during control and intervention weeks. Distance from the incident to where the patient was taken was the biggest influence on choice of patient destination was. For patients taken to MIU, Ambulance service job cycle time, time to treatment, and total time in unit were shorter than for patients taken to the accident & emergency department (A&E). A&E patients were 7.2 times less likely to rate their care as excellent as MIU patients.	Randomization schedule not followed. Low response rate	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=14734396

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Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
National Research Agenda Emergency Medical Services	Verbeek PR, McClelland IW, Silverman AC, et al. Loss of paramedic availability in an urban emergency medical services system during a severe acute respiratory syndrome outbreak. Academic Emergency Medicine 2004;11(9):973-978.	**Study Design Type:** Cohort **Sample Size:** 920 **Population Studied:** Paramedics	To describe the loss of paramedic availability to Toronto Emergency Medical Services during a biphasic (SARS-1 and SARS-2) outbreak of severe acute respiratory syndrome (SARS).	Paramedic surveillance and quarantine program implemented between SARS-1 and SARS-2	**Outcomes Measured:** The number of paramedics on quarantine each day, the type of quarantine (either home quarantine [HQ] or work quarantine [WQ]), and the development of SARS-like symptoms **Results:** During SARS-1, 234 paramedics were placed on home quarantine (HQ) for a total of 1,615 HQ days. During SARS-2, 292 paramedics were on HQ or work quarantine (WQ) for a combined total of 1,637 quarantined days. Paramedics were available for duty on 708 days, or 78% of the time, due to the WQ program.	The researchers cannot be certain they identified all paramedics who actually required quarantine. The experiences with SARS as reported in this study may not reflect the experience of other EMS systems in the event of a future SARS outbreak.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15347550
Seidel, 2006 IOM Report	Kober A, Schubert B, Bertalanffy P, et al. Capnography in non-tracheally intubated emergency patients	Study Design: Prospective Sample Size: 70	To test a capnometer for measuring respirations, ease of use, and to determine if	OxyArm device which provides noninvasive $ETco_2$ monitoring.	Patients could be monitored by a capnometer. There was no significant difference in patient satisfaction between	Relatively small sample size	http://www.ncbi.nlm.nih.gov/sites/entrez/14693620

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	as an additional tool in pulse oximetry for prehospital monitoring of respiration. Anesthesia and Analgesia. 2004;98;206-10	Population: Adults (over 19 years of age) with American Society of Anesthesiologists (ASA) physical status of I-III and transported by the Hungarian Ambulatory Service	monitoring capnography reduces emergency monitoring interruptions.		the capnometer and Spo_z fingerclip. There was no difference between the capnometer and fingerclip for ease of use by paramedics.		
2006 IOM Report	Fosnocht DE, Swanson ER, Middleton E. EMS provider level does not impact use of air medical transport. Air Medical Journal 2003;22(2):30-32.	**Study Design Type:** Cohort **Sample Size:** 107 **Population Studied:** Patients transported by an emergency medical system (EMS) air ambulance.	To investigate the effect of an increased local emergency medical services (EMS) provider level on air ambulance utilization.	The number of air ambulance transports before and after the change in EMS provider level. Hemodynamic instability, heart rate, systolic blood pressure, respiratory rate, and injury severity markers of Glasgow Coma Score and revised trauma score. Patients transported by an air ambulance after change in EMS provider level (n=53). Control: Patients transported by an air ambulance before change in EMS provider level (n=54).	**Outcomes Measured:** Causal association between increase in local EMS level of care and decreased utilization of air ambulance transport services and an increased acuity of patients transported by air ambulance. **Results:** The number of air medical transports was not impacted by the change in EMS provider level. After the change in EMS provider level, the acuity of patients flown remained similar.	The retrospective method of data collection. This study took place in a semirural area and therefore is not generalizable.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12621376

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CDC Acute Injury Care Research Agenda, Cone Prehospital Care Research Agenda	Garza AG, Gratton MC, Chen JJ, et al. The accuracy of predicting cardiac arrest by emergency medical services dispatchers: the calling party effect. Academic Emergency Medicine 2003; 10(9):955-960.	**Study Design Type:** Retrospective **Sample Size:** 506 **Population Studied:** Patients for whom a 911 call was placed and a dispatcher-assigned presumptive patient condition (PPC) or field diagnosis of cardiac arrest.	To analyze the accuracy of paramedic EMS dispatchers in predicting cardiac arrest and to assess the effect of the caller party on dispatcher accuracy in an advanced life support, public utility model EMS system, with greater than 90,000 calls and greater than 60,000 transports per year.	Number of actual cardiac arrests. Type of caller.	**Outcomes Measured:** Sensitivity and positive predictive value (PPV) of the PPC code for cardiac arrest by calling parties. Homogeneity of sensitivity and PPV of the PPC code for cardiac arrest by calling parties. Quality assurance scores between calling parties. **Results:** Sensitivity was 68.3% with a PPV of 65.0%. PPV fpr the EMS dispatcher diagnosis of cardiac arrest varied significantly depending on the caller.	Study was limited to paramedic diagnosis. The retrospective design.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12957979
2006 IOM Report, National Research Agenda Emergency Medical Services	Key CB, Pepe PE, Persse DE, et al. Can first responders be sent to selected 9-1-1 emergency medical services calls without an ambulance? Academic Emergency Medicine 2003; 10(4):339-346.	**Study Design Type:** Cohort **Sample Size:** 11,488 **Population Studied:** Patients classified as low-risk 911 requests, which	To evaluate the feasibility and safety of initially dispatching only first responders (FRs) to selected low-risk 9-1-1 requests for emergency medical services.	Lone fire apparatus first responders (FAFRs) without ambulances dispatched to low-risk 911 requests for EMS (n=4,735). Historical Control: Basic life support ambulances (n=6,753).	**Outcomes Measured:** Comparison of transport rate and follow-up use of advanced life support (ALS) **Results:** In the 6 months following FAFR deployment, there	Current study is affected by certain biases specific to type of crew responding. A BLS crew will be more apt to transport since they are operating a transport vehicle, for example.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12670847

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		includes automatic medical alerts (ALERTs), motor vehicle incidents (MVIs) in which the caller could not give enough information to prioritize the call, and 911 call disconnects (D/Cs)			was a significant increase in some type of ALS care compared to the control and no significant difference in transport rates for ALERTs; a decrease in transport rate and no change in ALS use in the MVIs; and among the 911 D/Cs, only 15% were transported and 4% received follow-up ALS. Based on these findings, use of FAFRs may allow the system to operate more efficiently since most of these calls do not result in patient transportation and ambulances are spared from responding to these calls.	Use of historical controls. Lack of follow-up data on patients who were not transported.	
CDC Acute Injury Care Research Agenda, National Research Agenda Emergency Medical Services	Robinson KJ, Murphy DM, Jacobs LM. Presumption of death by air medical transport teams. Air Medical Journal 2003; 22(3):30-34.	**Study Design Type:** Cross-sectional study **Sample Size:** 190	To investigate nationwide trends and factors influencing the determination of death practice by rotor-wing air medical transport	All of the following determined by a survey: EMS program's practice of determination of death in the field. Medical criteria used to determine	**Outcomes Measured:** **Results:** No response to advanced cardiac life support, no	Limited by the nature of the survey. Patient advanced directives and changes to protocols were not considered.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12748529

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		Population Studied: Association of Air Medical Service (AAMS) members	programs.	and what issues would prevent determination of death of a patient on scene. Demographics, area of operation, crew configuration, medical team leadership, medical control, response and transport times, billing practice, and responsibility for patient body disposition once death was determined on scene.	signs of life on scene, and asystole in 2 EKG monitor leads were the most common field presumption criteria. "Political issues and "signs of life on scene" were the most frequent reasons cited not to presume a patient dead. Ground personnel input and program policy/medical control were criteria other than medical condition that were considered in the decision to presume death . The presumption rate was not affected by crew configuration, team leader, transport time, billing, or type of medical control.		
National Research Agenda: Emergency Medical Services (NHTSA), 2006 IOM Report	Eckstein M, Suyehara D. Ability of paramedics to treat patients with congestive heart failure via standing field treatment protocols. American Journal of Emergency	**Study Design Type:** Case Series **Sample Size:** 104 **Population Studied:** All patients treated	To determine if paramedics can accurately select the appropriate standing field treatment protocol (SFTP) in lieu of online medical direction (OLMD) for patients with congestive	Accuracy of diagnosis of CHF was measured based on treatment under the "rales" protocol or any other standing field treatment plan (SFTP).	**Outcomes Measured:** Diagnosis of CHG or other respiratory diagnosis. **Results:** Of the 104 patients included, 102 met all required	This study did not compare treatment or outcomes for patients treated for CHF under OLMD versus SFTPs. Additionally, because the study did not attempt to examine patient	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11781907

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	Medicine 2002;20(1):23-25.	under the rales protocol between January 1998 and June 1999 by paramedics assigned to the LA County/University of Southern California Medical Center base station and transported to its emergency department (ED). Patients were also included if they had a discharge diagnosis of congestive heart failure (CHF) and were treated under any standing field treatment protocol (SFTP)	heart failure.		inclusions Of the 58 patients treated under the rales protocol, 50 (86%) had an ED diagnosis of CHF and 8 (13%) had a primary respiratory diagnosis. The remaining 44 (43%) of patients studied were treated under an SFTP other than rales but had a discharge diagnosis of CHF.	outcome, the effect of correct field treatment of CHF or potential adverse impact of improper use of the rales protocol was not determined.	
National Research Agenda Emergency Medical Services	Frakes MA. Flight team management of in-place endotracheal tubes. Air Medical Journal 2002; 21(6):29-31.	**Study Design Type:** Cross-sectional study **Sample Size:** 184 **Population Studied:** Association of Air Medical Services (AAMS) members	To evaluate the current industry practices regarding Flight nurse emergency medical services (FN EMS) credentialing and to determine whether that requirement was affected by flight team composition or program location.	Flight team composition, program location and FN EMS certification requirements as determined by a telephone survey.	**Outcomes Measured:** Affect of flight team composition and/or program location on FN EMS certification requirements. **Results:** FN EMS certification was significantly related to team configuration. FN partnered with a paramedic (FN/EMTP) tended	The operational definitions for endobronchial and esophageal intubation were imperfect in the absence of the gold standard for confirmation, chest radiography. Study power was limited by the small number of tube repositionings available for study. Results in the	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12585074

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					not to require certification and FN partnered with a respiratory therapist (FN/RRT) tended to require certification. There were regional patterns to configuration and FN EMS certification requirements.	studied prehospital setting are not directly comparable to hospital results.	
Cone Prehospital Care Research Agenda, National Research Agenda Emergency Medical Services	Kelly AM, Currell A. Do ambulance crews with one advanced paramedic skills officer have longer scene times than crews with two? Emergency Medicine Journal 2002; 19(2):152-154.	**Study Design Type:** Cohort **Sample Size:** 3 mixed crews and 3 all-APS crews **Population Studied:** Advanced paramedic skills (APS) paramedics and non-APS paramedics	To compare scene times at critical cases for mixed crews and all advanced paramedic skills (APS) crews.	Mixed crews (i.e., one APS officer and one non-APS officer) (n=3 crews). Comparison: All-APS units (n=3 crews).	**Outcomes Measured:** Scene time defined as point of ambulance arrival at the scene to departure from the scene. Rates of APS procedures attempted and rate of APS procedures that failed. **Results:** Mixed crews demonstrated statistically significantly lower in scene time and APS procedure failure rates than all-APS crews. However, all-APS crews attempted higher rates of APS procedures which	Times are drawn from patient care record forms completed by paramedics. Valid scene times were not available for a proportion of critical cases. A higher proportion of missing data is associated with APS procedure and failure rates.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11904270

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					may have contributed to the scene time. The difference in scene time is not likely to be clinically significant.		
Cone Prehospital Care Research Agenda, 2006 IOM Report	Kurola J, Wangel M, Uusaro A, et al. Paramedic helicopter emergency service in rural Finland - do benefits justify the cost? Acta Anaesthesiologica Scandinavica 2002;46(7):779-784.	**Study Design Type:** Cohort **Sample Size:** 558 missions **Population Studied:** Helicopter missions	To investigate the potential health benefits of the Helicopter Emergency Medical Service (HEMS), and their relation to cost of the service in a rural area. The study also evaluated whether the patient benefit is due to early advanced life support (ALS) procedures performed on-scene, or due to rapid transport of patients to definitive care.	Retrospective review of all helicopter missions with regards to events after dispatch and level of care needed on-scene (e.g., mission aborted, patient death on-scene, BLS care, ALS care). Review of hospital patient records to determine the benefit of HEMS.	**Outcomes Measured:** Missions canceled, care received, patient outcome, cost per successful mission **Results:** In 40% of HEMS, the missions were canceled; 35.3% of HEMS missions provided ALS care. Ten percent of HEMS missions resulted in patient death on-scene. A minority of all patients did benefit from HEMS. Benefit was related to early ALS care and the cost per beneficial mission was 28,444 Euro.	Retrospective study. Results may not be applicable to different settings. Possibly misclassified patients who did and did not benefit from HEMS.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12139530
National Highway Traffic Safety Administration	Grange JT, Corbett SW. Violence against emergency medical services personnel. Prehospital	Study Design: Prospective analysis Sample Size: 4,102 cases	To determine the prevalence of and factors for violence towards emergency medical services (EMS) personnel.	Verbal and/or physical violence directed at EMS personnel on a call	Violence (physical and verbal) was recorded in 184 out of 4,102 cases (4.5%) towards EMS personnel.		http://www.ncbi.nlm.nih.gov/pubmed/11962565

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	Emergency Care. 2002 Apr-June; 6(2):186-90.	Population: Violent encounters involving EMS providers in southern California from July 1-31, 1995.			Multiple logistic regression showed that police presence, suspected psychiatric disorder, gang member presence, and supposed drug/alcohol presence were predictors for violence. Suggestions to avert violent encounters include having police clear the scene, use pharmaceutical restraint, and more training for dealing with violent situations		
National Research Agenda Emergency Medical Services	Regehr C, Goldberg G, Hughes J. Exposure to human tragedy, empathy, and trauma in ambulance paramedics. American Journal of Orthopsychiatry 2002;72(4):505-513.	**Study Design Type:** Cross-sectional study **Sample Size:** 86 (questionnaire) 18 (interview) **Population Studied:** Paramedics within an emergency service organization that provides emergency medical	To determine and better understand factors that lead to higher levels of distress among paramedics within the theoretical framework of emotional and cognitive empathy	Paramedic perception of exposure to traumatic events, levels of social support, and levels of distress as measured through a survey; Exploration of paramedic experiences as evaluated through an interview	**Outcomes Measured:** Level of exposure to traumatic events; Level of social support; Level of distress. **Results:** 100% had been exposed to at least 1 of the listed critical incidents; 82% indicated they had been overwhelmed or deeply disturbed	Sampling for the quantitative component; study is not generally applicable to a larger population	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15792036

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		services in a large urban area			by an incident; 25.5% of the respondents fell into the severe or high range of posttraumatic stress syndromes; 79.1% indicated their lover/spouses were supportive or very supportive		
National Research Agenda Emergency Medical Services	Schaefer RA, Rea TD, Plorde M, et al. An emergency medical services program of alternate destination of patient care. Prehospital Emergency Care 2002;6(3):309-314.	**Study Design Type:** Case Control **Sample Size:** 3,633 **Population Studied:** Patients with specific low-acuity diagnosis codes being transported for emergency care	To determine whether emergency medical technicians (EMTs) could decrease emergency department (ED) use by patients with nonurgent concerns who use 911 by appropriately identifying and triaging them to alternate care destinations.	Alternate care destination program	**Outcomes Measured:** Frequency of the dissemination of care **Results:** The intervention appeared to be both safe and satisfactory for patients, based on physician review of the group who received care in a medical clinic and follow-up with these patients. Compared with the preintervention group, a smaller portion of patients in the intervention group received care in the ED, while a greater proportion of patients in the intervention group	The intervention was not instituted in a randomized fashion so there may be a causal relationship between decreased ED use and the intervention. The data did not allow the researchers to determine the intervention's impact on the quality of care or costs for care. The results may also not be generalizable to other EMS agencies or patient groups.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12109574

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					received clinic care or home care.		
2006 IOM Report, National Research Agenda Emergency Medical Services	Wirtz MH, Cayten CG, Kohrs DA, et al. Paramedic versus nurse crews in the helicopter transport of trauma patients. Air Medical Journal 2002;21(1):17-21.	**Study Design Type:** Cohort **Sample Size:** 1,193 **Population Studied:** Blunt and penetrating trauma patients with an Injury Severity Score (ISS) greater than or equal to 9 who were transported to the hospital via helicopter	To explore the outcomes of patients transported by helicopter crews that consisted of either two nurses or a nurse and a paramedic.	Transportation to the hospital via helicopter	**Outcomes Measured:** Mortality rates and discharge disposition **Results:** The percentages of patients who lived, died, or were discharged home or to rehabilitation were similar for a nurse-practitioner team and a team of two nurses. No statistically significant difference was found in observed versus predicted mortality for both groups.	The sample was not randomized and small sample size with regards to patient outcomes. The inclusion of interfacility transfers may also have skewed the results. The mean age of patients in the paramedic group was statistically significantly higher than the nurse group, so age may have been a limitation. Also, some of the nurses were dually trained as paramedics, which may have skewed the data.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11805762
Cone Prehospital Care Research Agenda	Cone DC, Wydro GC. Can basic life support personnel safely determine that advanced life support is not needed? Prehospital Emergency Care 2001;5(4):360-365.	**Study Design Type:** Cohort **Sample Size:** 69 **Population Studied:** Patients taken to the emergency department by fire department ambulances	To determine whether firefighter/emergency medical technicians-basic (FF/EMT-Bs) staffing basic life support (BLS) ambulances in a two-tiered emergency medical services (EMS) system can safely determine when	EMS response based on prospectively established criteria for potential need for ALS.	**Outcomes Measured:** Safety of the decision to cancel ALS; interventions performed in the emergency department soon after the patient's arrival; admission rates; length of stay; mortality. **Results:**	There are no concrete definitions for need for ALS. The patient sample for this study was small. Field vital signs taken by the FF/EMT-Bs were poorly documented, which limited the value of using vital signs to help determine the need for ALS. Most of the	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11642585

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			advanced life support (ALS) is not needed.		Inappropriate cancelation of ALS, as determined by the study criteria, occurred in a total of 77%. 87% of patients were provided care at the emergency department that could have been administered by an ALS unit in the field. 63% of patients were discharged from the emergency department once treated.	FF/EMT-Bs in this study were not full-time ambulance personnel.	
National Research Agenda Emergency Medical Services	Eckstein M. Implementation of standing field treatment protocols in an urban EMS system. American Journal of Emergency Medicine 2001;19(4):280-283.	**Study Design Type:** Case Series **Sample Size:** 13,586 incidents **Population Studied:** All emergency medical services (EMS) incidents	To examine the first 21 days of implementation of standing field treatment protocols (SFTP) for 7 medical chief complaints and all major trauma patients in a large, urban EMS system compared to on-line medical control (OLMC) for patients treated by paramedics	Evaluation of 14 protocols that were to be implemented (altered level of consciousness, chest pain, respiratory disease, respiratory distress, seizure [adult], seizure [pediatric], abdominal trauma, burns, chest trauma, extremity trauma, head and neck trauma, multisystem trauma, traumatic arrest)	**Outcomes Measured:** Number of patients treated for a particular SFTP; Percent of the total number of patients treated for a particular SFTP; Number of incidents reviewed for a particular SFTP; Percent of the total number of incidents reviewed for a particular SFTP. Quality control review using hospital records. **Results:**	Poor documentation, no comparison group using OLMC, need for a longer study period.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11447512

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					Thirty percent of all EMS incidents received ALS treatment. Altered level of consciousness (29%) and chest pain (25%) were the two SFTPs most commonly used. Out of 1,450 incidents with outcome data provided by the receiving hospitals, only 3 cases involved incorrect treatment, with an additional 2 involving the unnecessary use of lidocaine. None of these instances resulted in adverse effects or complications.		
National Research Agenda Emergency Medical Services, 2006 IOM Report	Hawkins SC, Morgan S, Waller A, et al. Effects of ground EMS and ED personnel on air medical trauma on-site times. Air Medical Journal 2001;20(3):32-36.	**Study Design Type:** Case Series **Sample Size:** 118 **Population Studied:** Ground emergency medical system (EMS) and emergency	To evaluate whether the activities of ground EMS (GEMS) and ED providers affect the scene and transport times of helicopter EMS (HEMS)	HEMS evaluation of prehospital procedures including: full spinal stabilization, airway procedures, ventilation/respiration procedures, circulation procedures, and environmental procedures.	**Outcomes Measured:** HEMS report of GEMS/ED completion or omission of indicated and nonindicated prehospital procedures according to the standard of care	Unblinded HEMS teams evaluation of GEMS/ED performance has potential bias, analysis of data from one provider, lack of inter- and intrarater reliability analysis, and inability to measure activities delaying transport in	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11331825

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		department (ED) personnel			Scene missions: scene to hospital transport times Interfacility missions: between hospital transport times **Results:** GEMS and ED providers frequently did not complete indicated basic and advanced procedures. With no omitted procedures, average HEMS on-site time was 13 minutes. Omitting one procedure increased average on-site time to 17 minutes and omitting two or more procedures increased average on-site time to 20 minutes. No relationship was found between ED provider omissions and HEMS on-site times.	interfacility missions.	
CDC Acute Injury Care Research Agenda, Cone	Hickman BJ, Mehrer R. Stress and the effects of air	**Study Design Type:** Cross-sectional	To examine the psychologic and physiologic effects	Air ambulance crews members' and their family or	**Outcomes Measured:** Perceived stress	Survey was an informal assessment and	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&d

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Prehospital Care Research Agenda	transport on flight crews. Air Medical Journal 2001;20(6):6-9.	study **Sample Size:** 54 **Population Studied:** Air ambulance crew members and close friends/family members	of critical air transport on air ambulance crews	friends' perceptions of stress levels, coping mechanisms, and job satisfaction.	levels and sources of stress, coping mechanisms, job satisfaction as indicated by an ambulance crew members and their family or friends. **Results:** There were notable differences in stress perception between crew members self-identified as Generation X (Xs) and those self-identified as Baby Boomers (BBs). For example, both groups agreed air medical work was more stressful than hospital work, but and BBs thought It was less stressful than ground EMS. Both groups agreed humor and conversation with peers were coping mechanisms to relieve job stress. Of family or friends surveyed, 60% agreed the flight job was an added stress in their lives.	was too small to have sufficient validity or reliability.	b=pubmed&dopt=Citation&list_uids=11692125

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CDC Acute Injury Care Research Agenda, National Research Agenda Emergency Medical Services	Jones AE, Summers RL, Deschamp C, et al. A national survey of the air medical transport of high-risk obstetric patients. Air Medical Journal 2001;20(2):17-20.	**Study Design Type:** Cross-sectional study **Sample Size:** 203 **Population Studied:** US helicopter air medical program personnel	To determine the frequency and current practices of air medical transport of high-risk obstetric (HROB) patients	Survey administered to determine the frequency and current practices of air medical transport of HROB patients	**Outcomes Measured:** Frequency and current practices of air medical transport of HROB patients **Results:** While HROBs account for 5% of air medical flights, many programs appear to be poorly prepared for these patients.	One individual completing the survey for an entire organization may not accurately represent the views of the entire organization. The survey did not inquire about the number of programs that had specific policies prohibiting HROB transports. The questionnaire could have been more comprehensive.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11250614
CDC Acute Injury Care Research Agenda	Schmidt T, Atcheson R, Federiuk C, et al. Evaluation of protocols allowing emergency medical technicians to determine need for treatment and transport. Academic Emergency Medicine 2000;7(6):663-669.	**Study Design Type:** Diagnostic Accuracy **Sample Size:** 1,300 **Population Studied***:* Patients for whom a 911-initiated ambulance arrived at the scene, excluding patients transferred from an acute hospital	To determine whether emergency medical technicians (EMTs) can safely apply protocols to assign transport options to assess agreement between groups of providers on application of the protocols.	EMT categorization of patients as needing an ambulance, able to go to the emergency department (ED) by alternative means, needing to contact a primary care provider (PCP), or treat and release according to a new standard protocol. Reference standard: Ambulance reports.	**Outcomes Measured:** Demographic information, transporting EMTs triage categorization, agreement between transporting EMTs and first responders, comparison of transporting EMT triage categorizations and the occurrence of critical events. **Results:** EMTs categorized 79% of patients as needing ambulance	Convenience sample used. Communication among participants may have influenced responses. Patients who had the potential to have a critical event but did not weren't included. The critical events used were debatable. No hospital outcomes data was used and no financial analysis was completed.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10905645

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Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					transport; 15% as able to get to the ED by alternative means; 5% could contact a PCP; and 1% could be treated and released. There was general agreement between the transporting EMT and first responder. 11% of patients appeared to experience a critical event when they were determined not to need an ambulance. Sensitivity for identifying patients needing ambulance transport was 94.5% and specificity was 32.8%		
National Research Agenda Emergency Medical Services	Guru V, Verbeek PR, Morrison LJ. Response of paramedics to terminally ill patients with cardiac arrest: an ethical dilemma. Canadian Medical Association Journal 1999; 161(10):1251-1254.	**Study Design Type:** Cross-sectional study **Sample Size:** 144 **Population Studied:** Terminally ill patients	To determine the care received by terminally ill patients when paramedics were summoned by a 911 call and to document whether do-not-resuscitate (DNR) requests influenced the care given.	Patient's do-not-resuscitate status	**Outcomes Measured:** Paramedic care, including cardiopulmonary resuscitation and advanced cardiac life support **Results:** Paramedics encountered a DNR request in 90 (62.5%) of the 144 terminally ill	Retrospective design using chart review. * Small sample size.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10584085

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					patients. There was no difference in the likelihood that CPR would be initiated between patients with and without a DNR request.. When CPR was initiated, paramedics were more likely to withhold full advanced cardiac life support if there was a DNR request than if there was not.		
PECARN Research Agenda, National Research Agenda Emergency Medical Services,	Macnab AJ, Richards J, Green G. Family-oriented care during pediatric inter-hospital transport. Patient Education and Counseling 1999;36(3):247-257.	**Study Design Type:** Case Series **Sample Size:** 100 families 10 paramedics **Population Studied:** Parents of children receiving inter-hospital air transport	To assess provision of family-centered care by paramedics during pediatric inter-hospital air transport	Paramedics participating in the study underwent a 2-year training program and continuing education following graduation to develop skills in counseling and sharing information with parents.	**Outcomes Measured:** Parents completed a 10-question survey that asked (1) to rate how they felt the transport personnel should interact with families under ideal circumstances; and (2) rate their actual experience. A Likert scale ranging from 1 (very low) to 5 very high) was used. Paramedics also completed a questionnaire to assess completion of 10-family-oriented	There was no formal control group. Asking parents to compare their preferences with what actually occurred has an inherent element of bias.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=14528560

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					practices for informing and counseling parents. **Results:** There were significant differences in 4 of 9 behavioral areas between patients' recollections and their preferences for how pre-transport communication should occur: - 86% of parents sought to obtain all information they wanted, only 35% did. - 76% indicated a need for an opportunity to say everything that they wanted to say, but only 24% had an opportunity to do so. - 76% did not want the dialogue controlled by the paramedic, but 40% reported this occurred. - 56% of parents wanted paramedics to show their feelings while counseling them but felt that this did not		

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					happen.		
Cone Prehospital Care Research Agenda	Mock EF, Wrenn KD, Wright SW, et al. Anxiety levels in EMS providers: effects of violence and shifts schedules. American Journal of Emergency Medicine 1999;17(6):509-511.	**Study Design Type:** Cohort **Sample Size:** 63 (23 EMTs and 40 EMT-Ps) **Population Studied:** Emergency medical technicians (EMTs) and emergency medical technicians-paramedics (EMT-Ps)	To measure anxiety levels in emergency medical service (EMS) providers to determine the effects of 1) having had a violent encounter during a shift, and 2) different shift schedules.	Anxiety levels of providers as measured using the Spielberger State-Trait Anxiety Inventory before and after 1) having had a violent encounter during a shift and 2) experiencing different shift schedules.	**Outcomes Measured:** The primary endpoint of this study is no change in anxiety level of providers as a result of having had a violent encounter or different shift schedules. **Results:** There was no significant difference in state scores between those EMS providers who had encountered violence during the preceding 12 hours and those providers who had not. Comparisons of state scores of providers assessed at hour 12 of a 12 hour shift, hour 12 of a 24 hour shift, and hour 24 of a 24 hour shift failed to show any significant differences. There was no difference in anxiety levels in providers who worked 12 and 24	Potential limitation is the selection of the Spielberger anxiety scale to measure providers' responses to violent episodes. While this scale has been used in research to identify levels of anxiety induced by unavoidable life stressors, perhaps other scales would have yielded different results.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10530524

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					hour shifts.		
National Research Agenda Emergency Medical Services, 2006 IOM Report	O'Brien DJ, Price TG, Adams P. The effectiveness of lights and siren use during ambulance transport by paramedics. Prehospital Emergency Care 1999;3(2):127-130.	**Study Design Type:** Case Series **Sample Size:** 75 **Population Studied:** Ambulances	To determine whether lights and siren (L&S) use during transport in the authors' emergency medical service (EMS) system results in reduced transport time to the hospital, and to determine whether L&S use results in any emergency department critical interventions in the time saved.	Ambulance with L&S traveling to the hospital versus a personal observer vehicle traveling to the hospital without L&S	**Outcomes Measured:** Transport times, and medical interventions accomplished at the hospital prior to the non-EMA vehicle's arrival **Results:** Use of L&S significantly shortens transport time. There was a statistically significant correlation between transit time difference and number of stoplights encountered, traffic intensity, and distance traveled. In this series of patients transported under the care of a paramedic, the time saved by the use of L&S was not usually associated with immediately apparent clinical significance.	The study is limited by the small number of trauma patients enrolled. Therefore, conclusions from the data can be applied only to the transportation of "medical" patients.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10225645
Seidel Article, Growing Pains IOM Report, 2006 IOM	Pace SA, Fuller FP, Dahlgren TJ. Paramedic	Study Design: Prospective observational study	IV placement in the field was prospectively	Out of hospital IV placement.	Of the 165 patients with an IV placed in the field, 29% were	Defining appropriate IV placement, sampling bias	http://www.ncbi.nlm.nih.gov/sites/entrez/10530531

EMS Operations							
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Report	decisions with placement of out-of-hospital intravenous lines. American Journal of Emergency Medicine. 1999 Oct; 17(6):544-7.	Sample Size: 290 patients Population: EMS patients that had an IV placed in the field.	studied to determine the "appropriateness" of incidence of unused out-of-hospital IV lines.		not used and were considered over-triaged. The under-triage rate was found to be 2.4% as 7 patients required an IV in the ED. Limitations of the study include an unclear definition for "appropriate IV placement," patient selection, and exclusion of other trauma centers.	related to low number of pediatric and major trauma patients, and the inability to show a difference between groups looking at transport times and paramedic experience.	
National Research Agenda Emergency Medical Services	Billittier AJ, Lerner EB, Moscati RM, et al. Triage, transportation, and destination decisions by out-of-hospital emergency care providers. Prehospital Disaster Medicine 1998;13(2-4):22-27.	**Study Design Type:** Cross-sectional study **Sample Size:** 311 **Population Studied:** Certified and non-certified out-of-hospital emergency care providers	To determine if out-of-hospital emergency care providers consistently make appropriate triage, transportation and destination decisions; and to determine if experience and training have an effect on these decisions.	Out-of-hospital emergency care providers' (who are part of a BLS ambulance) selected method of transport and of destination facility for patients in varying need of emergency care as determined by a survey. Non-certified providers (n=108) Certified providers (n=203)	**Outcomes Measured:** Correct/Incorrect responses to the scenarios identified in the survey indicating appropriate/inappropriate BLS ambulance response. **Results:** Mean score of 32.6% correct answers for non-certified providers. Mean score of 41.1% correct answers for certified providers.	Individual participants were selected out of a group that had voluntarily attended presentations (potential bias). A subjective "gold standard" of correct answers was used. The scenarios presented to the providers probably weren't reflective of normal practice settings.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10346404
NHTSA Agenda	Mock EF, Wrenn KD, Wright SW, et al. Prospective field	**Study Design Type:** Case Series	To investigate the nature and frequency of	EMS runs observed for violence and measured using the	**Outcomes Measured:** Comparison of	Study represents a convenience sample of runs. Other	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&d

EMS Operations							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	study of violence in emergency medical services calls. Annals of Emergency Medicine 1998;32(1):33-36.	**Sample Size:** 297 **Population Studied:** Patient encounters with emergency medical system (EMS) personnel	violence encountered by EMS personnel.	Overt Aggression Scale.	violent encounters and non-violent encounters among EMS personnel. **Results:** There were 239 (81%) nonviolent runs, 16 (5%) violent runs, and 42 (14%) violent runs that occurred after a violent episode had taken place. This was a frequency of one violent episode for every four 12-hour shifts, or for every 19 runs. The violent behaviors included verbal aggression solely in 50% (n=8), physical aggression solely in 13% (n=2), and both verbal and physical aggression in 38% (n=6). One episode involved an unsecured weapon.	limitations are the small number of violent events and a bias toward urban experience.	b=pubmed&dopt=Citation&list_uids=9656946
Cone Prehospital Care Research Agenda, NHTSA Agenda	Moss ST, Chan TC, Buchanan J, et al. Outcome study of prehospital patients signed out against medical advice by field paramedics. Annals of Emergency	**Study Design Type:** Case Series **Sample Size:** 6,512 **Population Studied:**	To describe the incidence and demographic data of prehospital patients who contact paramedics by way of the 911 system, refuse transport against medical	Patients who signed out AMA and called 911 again within 48 hours	**Outcomes Measured:** Characteristics of patients who signed out AMA and then called 911 again within 48 hours **Results:**	The study was limited by the database. The information recovered was only as complete as the data entered by the field paramedics and base-hospital	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=9472189

EMS Operations							
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	Medicine 1998; 31(2):247-250.	Patients who called 911 for a medical emergency	advice (AMA), then call 911 and are subsequently reevaluated by paramedics in the following 48 hours		Of the 431 AMA patients for whom a name was available, 10 called 911 again within 48 hours. Four of these patients were admitted to the hospital, one died en route, and one was transferred to another facility. Seven of the ten patients were older than 65 years, compared with 17% of all AMA patients older than 65 years.	nurses.	
National Research Agenda Emergency Medical Services	Partridge RA, Virk A, Sayah A, et al. Field experience with prehospital advance directives. Annals of Emergency Medicine 1998; 32(5):589-593.	**Study Design Type:** Cross-sectional study **Sample Size:** 142 **Population Studied:** Emergency medical system (EMS) providers employed by a local, private ambulance service in the northeastern US	To assess EMS providers' knowledge of and experience with prehospital advance directives (AD).	Providers' perceptions and experience with prehospital advance directives as measured by a questionnaire.	**Outcomes Measured:** Assessment of provider's perceptions and experience with prehospital advance directives. **Results:** Of 142 participating providers, 106 (74.6%) completed questionnaires. 93.4% of respondents were familiar with advance directives, and most providers (78.3%) consider advance directives	Nonresponse rate of this study was 24.5% - selection bias may have been introduced. Also, as participants were questioned about past events, recall bias may exist. The external validity of this study may also be limited.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=9795323

EMS Operations							
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					before implementing extraordinary life support measures in terminally ill patients. Few (28%) have implemented prehospital advance directives without medical control.		
NHTSA Agenda	Prezant DJ, Kelly KJ, Mineo FP, et al. Tuberculin skin test conversion rates in New York City Emergency Medical Service health care workers. Annals of Emergency Medicine 1998;32(2):208-213.	**Study Design Type:** Cohort **Sample Size:** 7,290 **Population Studied:** Emergency medical technicians and paramedics with negative baseline tuberculin purified protein derivative (PPD) skin tests	To determine annual tuberculin skin test conversion (infection) rates for prehospital health care workers (emergency medical technicians (EMTs) and paramedics) in an urban environment with a high prevalence of Mycobacterium tuberculosis	Tuberculin skin testing	**Outcomes Measured:** Conversion rates from negative to positive **Results:** Annual tuberculin skin test conversion rates were 1.3% in 1993, 0.7% in 1994, 0.1% in 1995, and 0.2% in 1996 (average 0.5%0. In a static subgroup with at least 15 years' seniority, conversion rates were 0.5% in 1993, 0 in 1994, 0.5% in 1995, and 1.5% in 1996 (average 0.6%). The findings suggest EMS prehospital health care workers have an annual tuberculin conversion rate that is relatively low compared with	A potential weakness of the study is that the emergency medical service workforce is a dynamic population, with health care workers entering and leaving the workforce throughout the study. Another potential weakness is that 2-step PPD baseline testing was not performed, but the lack of this test would only have lead to an overestimation of conversion rates when the rate was already surprisingly low.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=9701304

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					hospital-based health care workers.		
National Research Agenda: Emergency Medical Services	Weinmann S, Siscovick DS, Raghunathan TE, et al. Human immunodeficiency virus seroprevalence among adults treated for out-of-hospital cardiac arrest in Seattle, Washington, 1989-1993. Annals of Emergency Medicine 1998;32(2):148-150.	**Study Design Type:** Cross-sectional study **Sample Size:** 1,474 **Population Studied:** Patients with HIV who were treated for out-of-hospital cardiac arrest by paramedics	To estimate the potential risk of HIV exposure for those providing emergency care for out-of-hospital cardiac arrest in Seattle, Washington, by surveying the seroprevalence of HIV in the patient population.	Seroprevalence of HIV	**Outcomes Measured:** Risk of HIV transmission during paramedic treatment **Results:** Eight of the 1,011 men were seropositive for HIV-1 during t he five-year period studied. All were younger than 55. No women studied were found to be seropositive.	The findings of this study may not be generalizable to pediatrics. Also, applicability of these findings to other communities may be limited, since HIV seroprevalence varies geographically.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=9701296
Seidel, National Highway Traffic Safety Administration (NHTSA)	Johnson TD, Lindholm D, Dowd MD. Child and provider restraints in ambulances: knowledge, opinions, and behaviors of emergency medical services providers. Academic Emergency Medicine. 2006;13(8):886-892.	**Study Design Type:** Cross-sectional study **Sample Size:** 302 **Population Studied:** Emergency medical service (EMS) providers	To measure the knowledge, opinions, and behaviors of emergency medical service (EMS) personnel regarding child and provider restraint use in ambulances.	Provider characteristics and experience, educational background, child-passenger safety knowledge, opinions on child-passenger safety in ambulances, and behaviors regarding securing child occupants and self, both in ambulances in private vehicles as measure by a survey.	**Outcomes Measured:** Overall knowledge, opinions, and behaviors of EMS personnel regarding child and provider restraint use in ambulances. **Results:** 91% reported some training in child-restraint use in ambulances, and half reported that they know a lot or very much about securing a critically ill child for transport.	The data were collected from a single region with large well-organized ambulance services, and results may not be generalizable. There were four questions in the self-reported knowledge section that examined knowledge of "child" and "infant" restraint requirements. Definitions of each category were not provided, leading to possible ambiguity. Respondents may	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16825667

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					30% did not identify the correct method of transport for a stable 2-year-old, and 40% did not choose the correct method of securing a child seat to the ambulance cot. Specialized pediatric-transport providers were more likely to report safe pediatric and occupant restraint practices than were community EMS providers. Pediatric restraint behaviors were not associated with years of service or history of a crash. Two thirds of respondents reported not wearing their seatbelt on the squad bench while treating patients, and half believe that wearing a seatbelt interferes with patient care. A total of 95% report wearing seatbelts in the front seat of the ambulance.	have given answers that they perceived to be more acceptable to themselves, their peers, or their employer. Comparisons between responders and non-responders were not possible because demographic data were only collected on the survey. Agency occupant-protection policies were not examined in this study, and reported behaviors of respondents could not be compared with existing agency policy.	
Seidel, Pediatric Emergency Care	Butterfoss FD, Major DA, Clarke	**Study Design Type:**	To assess institutional climate	Providers perceptions on	**Outcomes Measured:**	Due to staff turnover and requirements	http://www.ncbi.nlm.nih.gov/sites/entre

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Applied Research Network (PECARN)	SM, et al. What providers from general emergency departments say about implementing a pediatric asthma pathway. Clinical Pediatrics (Philadelphia). 2006;45(4):325-333.	Cross-sectional study **Sample Size:** 61 (24 physicians/PAs, 20 nurses, 17 EMTs) **Population Studied:** Physicians, physician assistants, nurses, and emergency medical technicians (EMTs) from emergency departments in 4 general hospitals from July to October 2002	and providers' readiness to adopt pediatric pathways for asthma treatment and management.	pathway adoption as measured by focus groups and a survey related to experience with previous pathways, open communication, and buy-in from clinicians and administrators, comprehensive training on pathways, and adopting standards to fit specific emergency department environments.	Analysis of providers' perceptions on pathway adoptions. **Results:** Providers were optimistic about successfully implementing an asthma pathway (95%) and supportive of pathway implementation (87%).	imposed by the Health Insurance Portability and Accountability Act, baseline data collection and our intervention to improve pathway development and adherence were delayed. Also, even with skilled facilitators, some voices in the focus group discussions may have dominated and not all participants may have been forthcoming.	z?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16703155
Pediatric Emergency Care Applied Research Network (PECARN)	Roberts K, Jewkes F, Whalley H, et al. A review of emergency equipment carried and procedures performed by UK front line paramedics on paediatric patients. Emergency Medicine Journal. 2005;22(8):572-576.	**Study Design Type:** Cross-sectional study **Sample Size:** 32 **Population Studied:** Chief executives of the National Health Service (NHS) Ambulance Trusts in England and Wales	To identify current standards of care in pediatric paramedic practice and areas of potential skill in the United Kingdom.	Resource and skill availability for pediatric care by UK paramedics	**Outcomes Measured:** Compliance with national guidelines **Results:** Despite the issuance of national guidelines, the trend of expanding and standardizing practice among adult patients has not extended to pediatric practice. Many Trusts have not adopted guidelines for the	Cross-sectional study. Small sample size limited to subjective population with unique interest in findings.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16046763

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					management of life threatening pediatric emergencies such as asthma, meningitis, and fluid replacement in hypovolaemia.		

Injury and Trauma							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
2006 IOM Report	Burton JH, Dunn MG, Harmon NR, et al. A statewide prehospital emergency medical service selective patient spine immobilization protocol. The Journal of Trauma 2006; 61 (1): 161-167.	**Study Design Type:** Case series **Sample Size:** 31, 885 **Population Studied:** All prehospital patients who used a selective spine immobilization.	To evaluate the practices and outcomes associated with a state-wide emergency medical service (EMS) protocol for trauma patient spine assessment and selective patient immobilization.	The implementation of a selective spine immobilization protocol for all prehospital patients.	**Outcomes Measured:** Incidence of spine fracture among EMS-assessed trauma patients and the correlation between EMS and correlation between EMS spine immobilization decisions and the presence of spine fractures-stable and unstable. **Results:** The use of this state-wide EMS spine assessment protocol resulted in one nonimmoblized, unstable spine fracture patient in approximately 32,000 trauma encounters. Presence of the protocol affected a decision not to immobilized greater than half of all EMS-assessed trauma patients.	Limitations of the current study include chart review, identification, and dataset linkage methodology. Fracture descriptors were limited by the implementation ICD-9 of injuries.	http://www.ncbi.nlm.nih.gov/pubmed/16832265
National Research Agenda Emergency Medical Services	Davis DP, Serrano JA, Vilke GM, et al. The predictive value of field versus arrival Glasgow Coma	**Study Design Type:** Retrospective **Sample Size:**	To explore the predictive value of the field Glasgow Coma Scale (fGCS) and arrival GCS	fGCS scores and aGCS scores used to calculate fTRISS and aTRISS scores.	**Outcomes Measured:** Predictive value of fGCS scores in relation to aGCS	Impossible to determine the accuracy of paramedic GCS assessments.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids

Injury and Trauma							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	Scale score and TRISS calculations in moderate-to-severe traumatic brain injury. The Journal of Trauma 2006; 60(5):985-990.	12,882 **Population Studied:** Major trauma victims with head Abbreviated Injury Scores (AIS) of 3 or greater	(aGCS) as well as Trauma Score and Injury Severity Score (TRISS) calculations using field (fTRISS) and arrival (aTRISS) data in patients with moderate-to-severe traumatic brain injury (TBI).		scores. Predictive value of fGCS and aGCS scores with regard to mortality neurosurgical intervention and other patient outcomes **Results:** fGCS values were predictive of aGCS values. Both fGCS and aGCS values were associated with outcome from TBI. pGCS was predictive of both mortality and neurosurgical intervention.	Because only one fGCS value is entered into the trauma registry. The ability of fGCS to predict fTRISS scores may have been influenced by the fact that the population of patients with TBI was selected by head AIS.	=16688059
CDC Acute Injury Care Research Agenda, National Research Agenda Emergency Medical Services	Davis DP, Vadeboncoeur TF, Ochs M, et al. The association between field Glasgow Coma Scale score and outcome in patients undergoing paramedic rapid sequence intubation. Journal of Emergency Medicine 2005; 29(4):391-397.	**Study Design Type:** Cohort **Sample Size:** 412 **Population Studied:** Patients who have sustained traumatic head injury	To explore the predictive value of the Glasgow Coma Scale (GCS) with regard to head injury severity and the need for emergent intubation.	Review of paramedic GCS score calculations. Reference standard: descriptive data of all study subjects.	**Outcomes Measured:** Relationship between GCS score calculation and head-injury severity; the presence of factors related to the need for intubation such as hypoxia and aspiration; eventual outcome. **Results:** There was an association between paramedic GCS	Data was adopted from another study with an entirely different aim. The use of self-reported data. Higher GCS scores were excluded from the study. The main outcomes measures what events should prompt intubation are poorly defined.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16243194

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					score and Head Abbreviated Injury Score (AIS), mortality, and pre-intubation aspiration, or desaturation. There was a relationship between GCS and Head/Neck AIS, Injury Severity Score (ISS), and overall mortality. The predictive value of GCS score to with regards to various clinical variables based on receiver-operator curve was low.		
National Research Agenda Emergency Medical Services	Davis DP, Dunford JV, Poste JC, et al. The impact of hypoxia and hyperventilation on outcome after paramedic rapid sequence intubation of severely head-injured patients. The Journal of Trauma 2004; 57(1):1-8.	**Study Design Type:** Cohort **Sample Size:** 603 **Population Studied:** Adult major trauma victims with severe traumatic brain injury undergoing rapid sequence intubation (RSI)	To explore the impact of hypoxia and hypocapnia on outcome in patients undergoing rapid sequence intubation (RSI) for sever traumatic brain injury.	Intervention group: Patients with severe traumatic brain injury undergoing RSI (n=426). Control group: Historical nonintubated patients from the same prehospital system (n=177)	**Outcomes Measured:** Mortality associated with hypoxia and hyperventilation. **Results:** There existed a relationship between hyperventilation and severe hypoxia during paramedic RSI and increased mortality. RSI patients had a mortality rate of 40.7%, while the control group had a mortality rate of	This group of patients is a relatively small subset of the total population of trial patients. No randomization. No control group data for prehospital oxygenation and ventilation.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15284540

Injury and Trauma							
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					21.5%.		
Centers for Disease Control and Prevention, National Highway Traffic Safety Administration	Bochicchio GV, Ilahi O, Joshi M, et al. Endotracheal intubation in the field does not improve outcome in trauma patients who present without an acutely lethal traumatic brain injury. Journal of Trauma 2003 Feb; 54(2):307-11.	Study Design: Prospective Sample Size: 191 Population: Adults with Glasgow Comma Scale score ≤ 8 and a head Abbreviated Injury Scale scores ≥ 3 and survival over 48 hours.	To determine if prehospital intubation improved outcomes in adult trauma patients with traumatic brain injury. Patients were grouped based on when they were intubated; prehospital versus upon arrival to the ED.	Endotracheal Intubation in the prehospital setting	Patients intubated in the field had significantly longer transport times and time to surgery than those intubated at the hospital. The number of immediate neurosurgical procedures was significantly different for those intubated in the hospital than in the field. A larger, randomized, prospective trial is needed to determine parameters for patients that should be intubated in the field.	Limits include subjective intubation by flight personnel based on transport time, lack of long term data, and difference in training between flight and ground paramedics.	http://www.ncbi.nlm.nih.gov/pubmed/12579056
CDC Acute Injury Care Research Agenda, National Research Agenda Emergency Medical Services, Seidel: Priorities in EMSC Research,	Liberman M, Mulder D, Lavoie A, et al. Multicenter Canadian study of prehospital trauma care. Annals of Surgery 2003;237(2):153-160.	**Study Design Type:** Cohort **Sample Size:** 9,405 **Population Studied:** Trauma patients	To evaluate outcomes based on type of on-site care a trauma patient receives.	Type of on-site crew managing the patient (EMTs, MPDs, or MDs) and Prehospital care (Advanced Life Support (ALS) versus Basic Life Support (BLS))	**Outcomes Measured:** Death as a result of injury **Results:** The overall mortality rate of patients receiving only BLS was 18% compared to 29% for patients receiving ALS. For patients with major but survivable	Results are not generalizable beyond the urban prehospital setting. Findings may not apply to rural trauma patients.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12560770

Injury and Trauma							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					injuries, the mortality rates were 30% for ALS and 26% for BLS. The adjusted increased risk for mortality in patients receiving ALS at the scene was 21%.		
National Research Agenda Emergency Medical Services	Osterwalder JJ. Mortality of blunt polytrauma: a comparison between emergency physicians and emergency medical technicians--prospective cohort study at a level I hospital in eastern Switzerland. The Journal of Trauma 2003; 55(2):355-361.	**Study Design Type:** Cohort **Sample Size:** 267 **Population Studied:** Blunt polytrauma patients	To establish whether the prehospital deployment of emergency physicians (EPs) rather than emergency medical technicians (EMTs) decreased mortality in blunt polytrauma patients.	Prehospital deployment of EPs (n-196) Comparison: Prehospital deployment of EMTs (n=71)	**Outcomes Measured:** Mortality; Predicted mortality compared to actual mortality **Results:** The mortality of patients treated by EPs was not statistically lower than for the patients treated without EP involvement. Multivariate logistic regression showed a significant mortality odds ratio of 37 for the EMT group as compared with the EP group.	The study had a relatively small sample size and 11.6% of the data were missing in the multiple regression.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12913649
2006 IOM Report, National Research Agenda Emergency Medical Services	Hale D, Sipprell K. Ability of EMT-Bs to determine which wounds can be repaired in the field. Prehospital Emergency Care 2000;4(3):245-249.	**Study Design Type:** Diagnostic Accuracy **Sample Size:** 180 **Population Studied:** Any patient with a	To evaluate the ability of emergency medical technicians-basic (EMT-Bs) to identify wounds repairable in the field or requiring tetanus prophylaxis.	Wounds were inspected by the EMT-B to determine if it is repairable in the field and whether or not the patient required tetanus prophylaxis. The gold standard in this study was	**Outcomes Measured:** The outcome in this study is the comparison between wound inspection by an EMT-B and the gold standard.	Wounds seen in the ED are preselected to have a high likelihood of requiring repair. Another limitation is that EMT-Bs might be more willing to consider a wound as potentially being	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10895920

Injury and Trauma							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
		wound, potentially requiring suturing, and seen in the emergency department (ED) while the emergency medical technician-basic (EMT-B) was present		inspection of the wound for the same characteristics by a physician.	**Results:** The EMT-Bs were 100% sensitive and 100% specific in determining which wounds could be repaired in the field. There was also 100% (108/108) agreement on which patients required tetanus immunization.1	sutured in the field because they did not have any direct responsibility for the patient.	
National Research Agenda Emergency Medical Services	Garner A, Rashford S, Lee A, et al. Addition of physicians to paramedic helicopter services decreases blunt trauma mortality. Australia New Zealand Journal of Surgery 1999; 69(10):697-701.	**Study Design Type:** Cohort **Sample Size:** 207 **Population Studied:** Patients who were transported by helicopter emergency medical services (HEMS) that had suffered blunt trauma and an Injury Severity Score (TRISS) of greater than or equal to 10	To test the hypothesis that the addition of a critical care physician to the flight crew of a paramedic-staffed helicopter emergency medical services (HEMS) crew would decrease mortality due to blunt trauma.	Demographic information, mechanism of injury, distance transported, response, scene, transport times, intubation, fluids administered, thoracic decompressions, mortality. Patients transported by HEMS staff with a physician (n=67) Control: Patients transported by HEMS staff with only paramedics (n=140)	**Outcomes Measured:** Causal association between the presence of a physician on a HEMS staff and better health outcomes for blunt trauma patients. **Results:** A greater proportion of patients were intubated by a physician aided HEMS staff. Physicians gave higher volumes of fluids to hypotensive patients and performed thoracic decompressions on a more of the patients they saw. The Z statistics for	Limitations in TRISS methodology. Data collected on emergency department arrival was used. Potential selection bias. Different dispatch practices.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10527344

Injury and Trauma							
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					the physician treatment group and the paramedic group were 2.72 and - 1.16, respectively. The physician group would yield between 8 and 19 extra survivors per 100 patients treated as compared with the paramedic group.		
National Highway Traffic Safety Administration, Institute of Medicine Report, Centers for Disease Control and Prevention	Bickell WH, Wall MJ Jr, Pepe PE, et al. Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries. New England Journal of Medicine 1994; 331:1105-9.	**Study Design:** Randomized Control Trial **Sample Size:** 598 **Population Studied:** Adults (16 years or older) with abdominal trauma and seen by paramedics from the City of Houston EMS system	To determine the effects of delayed fluid resuscitation until operation for patients with penetrating torso injuries.	Delay of fluid resuscitation.	Delaying fluid resuscitation in hypotensive patients with penetrating torso injuries have improved outcomes following surgery.	Limitations include a limited study population with extremely low blood pressure (less than 40mm HG), and limited translation of results to other injuries such as traumatic brain injuries.	http://www.ncbi.nlm.nih.gov/pubmed/7935634?ordinalpos=6&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum
National Highway Traffic Safety Administration, Institute of Medicine Report, Centers for Disease Control and Prevention	Bickell WH, Pepe PE, Bailey ML, et al. Randomized trial of pneumatic antishock garments in the prehospital management of penetrating abdominal injuries. Ann Emergency Medicine 1987; 16(6):653-8.	Study Design: Randomized Control Trial. Sample Size: 201 Population: Over 12 years of age with gunshot or stab wound to anterior abdomen with systolic blood	To determine if outcomes for patients with abdominal trauma are affected by the use of pneumatic antishock garments (PASG).	Use of PASG	The use of PASG did not significantly affect number of transfusions, length of hospital stay, costs, or time to death.	Estimation of blood loss was done subjectively and not measured.	http://www.ncbi.nlm.nih.gov/pubmed/3578970?ordinalpos=3&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum

Injury and Trauma							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
		pressure of 90 mm Hg or less transported by ground to the Ben Taub General Hospital Emergency Trauma Center.					
Seidel	Qazi K, Kempf JA, Christopher NC, et al. Paramedic judgment of the need for trauma team activation for pediatric patients. Academic Emergency Medicine. 1998;5(10):1002-1007.	**Study Design Type:** Cohort **Sample Size:** 192 **Population Studied:** Pediatric blunt trauma patients	To determine the value of paramedic judgment in determining the need for trauma team activation (TTA) for pediatric blunt trauma patients	Paramedic judgment in determining the need for TTA	**Outcomes Measured:** Sensitivity and specificity of paramedic judgment **Results:** The sensitivity and specificity of paramedic judgment of the need for TTA for pediatric blunt trauma patients were 50% and 87.7%, respectively. The positive and negative values were 16.7% and 97.3%.	The study had a relatively low number of TTAs. There were reservations about generalizing the results of the study due to the small size of the city in which the study took place, as well as there being, a stable population that influences the out-of-hospital triage system.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=9862593

Pain Management							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
CDC Acute Injury Care Research Agenda	Lang T, Barker R, Steinlechner B, et al. TENS relieves acute posttraumatic hip pain during emergency transport. The Journal of Trauma 2007;62(1):184-188.	**Study Design Type:** Randomized-controlled trial **Sample Size:** 63 **Population Studied:** Adults >19 years suffering from hip fracture for the first time, who had not consumed analgesics within previous 48 hours	To assess the effectiveness to transcutaneous electrical nerve stimulation (TENS) in ambulance patients suffering pain from hip fracture	Intervention: Received TENS (n=30) Control: Received "sham" TENS (n=33)	**Outcomes Measured:** Heart rate Blood pressure Patient self assessment of pain and anxiety **Results:** Pain scores, anxiety level, and heart rate were significantly lower in patients that received TENS and remained unchanged in patients that did not receive TENS.	Small sample size. There may be crossover effects because the same observer made baseline and post treatment measurements. Variability in transport distance may affect outcomes.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=17215752
CDC Acute Injury Care Research Agenda	Barker R, Kober A, Hoerauf K, et al. Out-of-hosptial auricular acupressure in elder patients with hip fracture: a randomized double-blinded trial. Academy Emergency Medicine 2006 Jan; 13(1):19-23.	**Study Design:** Randomized Control Trial **Sample Size:** 38 **Population Studied:** Elder adults (80 – 95 years old) with hip fracture	To determine if auricular acupressure is effective compared to a sham acupressure in reducing anxiety and pain in elder patients with an acute hip fracture.	Auricular acupressure and sham acupressure point.	Those treated with auricular acupressure had significantly lower anxiety and pain scores than those treated with sham acupressure.	Auricular acupressure was not compared to analgesic drugs. Data collection was done at the hospital and not during transport.	http://www.ncbi.nlm.nih.gov/pubmed/16365322?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum

Pain Management							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
Seidel	Watkins N. Paediatric prehospital analgesia in Auckland. Emergency Medicine Australasia: EMA. 2006;18(1):51-56.	**Study Design Type:** Case Series **Sample Size:** 45 **Population Studied:** Children with a diagnosis of limb fracture or burn arriving by ambulance at Starship Children's Emergency Department	To determine whether the age of a child influences the likelihood of their receiving prehospital analgesia from the Auckland ambulance service and to investigate the effect of age on ambulance officers' decision-making and use of analgesia.	Prehospital analgesia.	**Outcomes Measured:** Prehospital administration of analgesia to child **Results:** Fifty-one percent of children ages 5-15 (n=35) received prehospital analgesia compared to no children under the age of five (n=10). On arrival in the hospital, 70% of children less than five years required IV opiate analgesia, compared to 54% of children older than 5. Ambulance officers did not perceive that a child's age would significantly alter their decision to use analgesia.	Levels of pain during transport were not documented and it is possible some children were comfortable during this phase, only becoming symptomatic during transfer from ambulance to hospital bed. In the secondary part of the study, no attempt was made to prevent officers discussing the questionnaire while completing it.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16454775
Cone Prehospital Care Research	Hennes H, Kim MK, Pirrallo RG.	**Study Design Type:**	To assess the knowledge of	Providers perceptions as	**Outcomes Measured:**	The retrospective nature of the	http://www.ncbi.nlm.nih.gov/sites/entrez

Pain Management							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
Agenda	Prehospital pain management: a comparison of providers' perceptions and practices. Prehospital Emergency Care 2005;9(1):32-39.	Cross-sectional study **Sample Size:** 202 **Population Studied:** Emergency medical technicians-paramedics (EMT-Ps) in the Milwaukee County system	emergency medical technicians-paramedics (EMT-Ps) and compare their practice perceptions with actual pain management interventions in adults and pediatric patients with chest pain (CP) extremity injuries, or burns.	measured by a 15 question anonymous survey asking about their knowledge of the indications for analgesia listed in the medical protocols for CP, suspected extremity fracture, and burn for both adults and children. Responders were also asked to record their comfort level in providing morphine to hemodynamically stable adults, adolescents, and children with CP, extremity injuries, and burns. Survey results were compared to information found in the EMS patient care database for all patient encounters by EMT-Ps between January and December 2001.	The outcome of this study is the comparison between provider perceptions by EMTs and data found in the EMS database. **Results:** Significant disparity exists between EMT-Ps' perceptions of acute pain assessment and the frequency of providing analgesia and their actual practice. Children and adolescents had less documentation of pain assessment and received less analgesic interventions compared with adults.	database review limited the ability to evaluate contraindications for providing morphine in the field. The survey instrument was not externally validated and the providers' responses may have included recall bias for some items. In addition, the anonymous nature of the survey did not allow researchers to obtain information for nonresponders.	?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16036825
National Research Agenda Emergency Medical Services	Jones GE, Machen I. Pre-hospital pain management: the paramedics' perspective. Accident and Emergency Nursing	**Study Design Type:** Cross-sectional study **Sample Size:** 6	To explore paramedics' perceptions of patients in pain and the paramedics' perspective of pre-hospital pain	In-depth data from paramedics working in an urban ambulance service, as ascertained via semi-structured	**Outcomes Measured:** Paramedics'' perceptions of patients experiencing pain, as well as their	Potential differences in what was reported by the participants and their actual behavior and activity in practice.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12804613

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Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
	2003; 11(3):166-172.	**Population Studied:** Paramedics	management.	interviews	perceptions of pre-hospital pain management **Results:** Four main themes emerged from the interviews: (1) the patient's experience of pain, (2) The evaluation of pain, (3) decision making and (4)Alternative methods. Patients were not always perceived by the participants to be honest when describing their pain. This study has revealed small deficits in knowledge, highlighted where additional training would be of benefit.		
2006 IOM Report, Seidel Priorities in EMSC Research	Lord BA, Parsell B. Measurement of pain in the prehospital setting using a visual analogue scale. Prehospital Disaster Medicine 2003;18(4):353-358.	**Study Design Type:** Cohort **Sample Size:** 262 **Population Studied:** Patients 10 years or older with severe pain requiring ambulance	To measure the adequacy of prehospital pain management using the visual analogue scale (VAS)	Patients rated their pain using a VAS at two points: (1) during initial assessment by a paramedic (T0); and (2) on arrival at the hospital (Tend). Survey of each paramedic to identify attitudes, values, and beliefs	**Outcomes Measured:** Mean value of time differences between T0 and Tend Mean value for pain severity at T0 and Tend Comparison of values for pain reduction to a	Study did not address the carryover effect of pain measurement at T_0 on pain measurement at T_{end} The variables should not be treated as independent. The VAS is not commonly used in	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15310048

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		transport		that may influence their measurement of pain.	benchmark greater or equal to 20mm **Results:** Mean value of time differences between T0 and Tend was 16 minutes Mean value for pain severity at T0 was 66mm and at Tend was 47.8mm; with a mean value for the change T0-Tend of 18.2mm 42.7% of patients recorded pain reduction greater or equal to 20mm at the second evaluation For patients that did not receive analgesia, the mean value for pain severity at T0 was 54.5mm, with mean value for change T0-Tend of 10.6mm 17.6% of patients recorded some deterioration in their pain score at Tend. The attitude survey	the prehospital setting so its influence on patient and paramedic perception of pain is unknown. The validity of its use in this setting was based on evidence from its use in the ED.	

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					indicated that certain beliefs may have a significant influence on assessment and management of pain by paramedics (e.g., patients tend to overrate the severity of their pain, paramedics are able to judge the severity of a patient's pain).		
National Research Agenda Emergency Medical Services	Luger TJ, Lederer W, Gassner M, et al. Acute pain is underassessed in out-of-hospital emergencies. Academic Emergency Medicine 2003;10(6):627-632.	**Study Design Type:** Cohort **Sample Size:** 51 (36 nontrauma and 15 trauma patients) **Population Studied:** Sample of patients transported by ambulance	To evaluate the quality of pain assessment by EMS personnel in out-of-hospital emergencies	Assessment by emergency patients of pain ratings documented at three different intervals and compared with concomitant assessments by EMS providers. The three intervals were: (1) at the beginning of emergency care before administration of analgesics; (2) immediately after loading the patient into the ambulance; (3) when arriving at the hospital.	**Outcomes Measured:** Visual analog scale (VAS) and verbal pain scale (VPS) were used for pain assessment by both patients and EMS personnel. **Results:** The severity of a patient's pain at the scene was underestimated 67 to 69% of the time by many members of the EMS team. Similar results were found with VPS scores whereby EMS providers underestimated the severity of patients' pain 60% of the	Number of patient studies in small, therefore disparity of pain assessment is difficult to evaluate in the moderate and mild pain group. The cohort is rather heterogeneous with regard to age and category of emergency. The large number of excluded patients may have impacted study results and important information may have been lost.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=12782523

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					time.		

Patient Safety							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
National Research Agenda Emergency Medical Services	Hobgood C, Weiner B, Tamayo-Sarver JH. Medical error identification, disclosure, and reporting: do emergency medicine provider groups differ? Academic Emergency Medicine 2006;13(4):443-451.	**Study Design Type:** Cross-sectional study **Sample Size:** 103 (40 physicians, 26 nurses, and 35 emergency medical technicians [EMTs]) **Population Studied:** Physicians or nurses scheduled to provide direct care to emergency department patients or out-of-hospital personnel primarily responsible for the care of patients being transported.	To determine if the three types of emergency medicine providers - physicians, nurses, and out-of-hospital providers (EMTs) - differ in their identification, disclosure, and reporting of medical error.	Provider perceptions as measured by a survey containing the following questions: Did anyone ever teach you how to tell patient about a medical error?, Have you ever observed another health care provider while he or she told a patient about a medical error?, and Have you ever hear colleagues discuss a medical error they committed?	**Outcomes Measured:** Survey data was analyzed and cross-tabulated. **Results:** Physicians were more likely to classify an event as an error (78%) than nurses (71%) or EMTs (68%). Physicians were the least likely to report the error (54%) compared with nurses (68%) or EMTs (785). For all provider and error types, identification, disclosure, and reporting increased with increasing severity.	The study was performed at only one institution, and the results may differ at other institutions. Also, the study had a modest sample size, and the enrollment targets, while approached, were not met for all categories.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16531598
National Research Agenda Emergency Medical Services	Wang HE, Lave JR, Sirio CA, et al. Paramedic intubation errors: isolated events or symptoms of larger problems? Health Affairs (Millwood) 2006;25(2):501-509.	**Study Design Type:** Cohort **Sample Size:** 1,941 **Population Studied:** Patients receiving out-of-hospital endotracheal intubation (ETI)	To characterize the relationship between the number of out-of-hospital endotracheal intubation (ETI) attempts and ETI success	ETI attempts	**Outcomes Measured:** ETI success, defined as correct intratracheal placement of the endotracheal tube as reported by the rescuer on each ETI attempt. **Results:** More than 30% of	The study did not link ETI attempts to morbidity or mortality. Thus, the analysis offers insights regarding the process of ETI but contains no information regarding the process of ETI but contains no information	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16522604

Patient Safety							
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		attempts by one of 42 independent advanced life support emergency medical system (EMS) agencies from the Commonwealth of Pennsylvania			patients received more than one ETI attempt. Cumulative success for the first three attempts was 69.9%, 84.9% and 89.9%; cumulative success approached overall success (91.8%) after three attempts.	regarding patient outcomes or procedural effectiveness.	
National Research Agenda Emergency Medical Services	Wang HE, Yealy DM. How many attempts are required to accomplish out-of-hospital endotracheal intubation? Academic Emergency Medicine 2006;13(4):372-377.	**Study Design Type:** Case Series **Sample Size:** 1,953 **Population Studied:** Patients receiving endotracheal intubation (ETI)	To identify the prevalence of endotracheal intubation (ETI) errors and their associations with patient and EMS system characteristics.	Data collection forms administered to rescuers from forty-two advanced-life-support EMS services in Pennsylvania	**Outcomes Measured:** Prevalence of adverse medical events during intubation attempts. **Results:** In 22% of intubation attempts, errors occurred. EMS services that performed more intubations annually had generally lower error rates were, but error rates were higher for services with greater numbers of patient contacts.	Limited data pool could have influenced patient outcomes. The data was self-reported.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16531595
2006 IOM Report, National Research Agenda Emergency Medical Services	Bair AE, Smith D, Lichty L. Intubation confirmation techniques associated with unrecognized non-tracheal intubations	**Study Design Type:** Cohort **Sample Size:** 35	To characterize the various confirmation techniques used among unrecognized non-tracheal intubation	Tube verification methods employed by intubating paramedics among patients with misplaced endotracheal tubes.	**Outcomes Measured:** Characterization of tube verification methods. **Results:**	Self-reporting of the providers. There could have been more cases of unrecognized, non-tracheal intubation that had not been	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15837020

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	by pre-hospital providers. Journal of Emergency Medicine 2005;28(4):403-407.	**Population Studied:** Patients identified with an unrecognized, non-tracheal intubation arriving in an emergency department (ED)			60% of misplaced endotracheal intubations had more than one confirmatory technique employed by paramedics. The most regularly used techniques in this group were "equal lung sounds" (91%) and "visualized cords" (52%). 49% of the non-tracheal intubations could have been recognized.	entered into the quality assurance database.	
Cone Prehospital Research Agenda, EMSOP agenda	Barton ED, Colwell CB, Wolfe T, et al. Efficacy of intranasal naloxone as a needleless alternative for treatment of opioid overdose in the prehospital setting. Journal of Emergency Medicine 2005;29(3):265-271.	**Study Design Type:** Cohort **Sample Size:** 95 **Population Studied:** Patients over 14 years of age encountered in the field with a prehospital encounter diagnosis of "altered mental status" (AMS), "found down" (FD), or "suspected opioid overdose" (OD)	To investigate the use of intranasal (IN) naloxone by paramedics to assess its efficacy and safety as an alternative (needleless) medication delivery route.	Paramedic use of IN naloxone to treat patients encountered in the field with a prehospital encounter diagnosis of AMS, FD, or OD.	**Outcomes Measured:** Number of patients responding to IN naloxone before IV administration of a second dose of naloxone. The time of response to naloxone. **Results:** 83% of naloxone responders awoke with IN naloxone prior to administration of IV naloxone. 84% of the IN naloxone response group did not need additional naloxone therapy.	Due to unknown efficacy of IN naloxone to treat OD patients, the researchers had to perform standard procedures on all the patients that included rescue breathing and administration of IV naloxone. Subjectivity of paramedic reports for use in the study. No blinding or randomization. The researchers did not confirm the presence of opiate metabolites in the bloodstream of	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=16183444

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						patients who responded to IN or IV naloxone upon hospital arrival.	
National Research Agenda Emergency Medical Services	Frakes MA, Lord WR. EMS certification requirements for flight nurses. Air Medical Journal 2004;23(5):38-40.	**Study Design Type:** Case Series **Sample Size:** 926 **Population Studied:** Patients transported to the hospital by a flight team	To determine the incidence of unplanned endotracheal tube (ETT) removal at any time during transport and of endobronchial or nontracheal ETT placement on arrival at the receiving hospital.	Cases of consecutive patients transported to the hospital during a 9-month period.	**Outcomes Measured:** Incidence of ETT and incidence of complications associated with ETT. **Results:** 36.7% of patients studied were intubated while with the flight team. Of the ETTs that were placed before flight team arrival, 7.9% had to be repositioned. EMS and critical care literature had reported significantly higher rates of misplacement on arrival at the hospital and of unplanned extubation than were found in this study.	Imperfect operational definitions for endobronchial and esophageal intubations were used. Patients with repositioned ETTs comprised a small sample. Can't make direct comparisons between study results and inpatient units, anesthesia reports, and emergency medicine settings.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15337955
National Research Agenda Emergency Medical Services, 2006 IOM Report	Keane MF, Brinsfield KH, Dyer KS, et al. A laboratory comparison of	**Study Design Type:** Non-randomized-controlled trial	To compare the speeds and success rates of placement for percutaneous cricothyrotomy	Intervention: Placement of percutaneous cricothyrotomy (n=22)	**Outcomes Measured:** Correct placement of percutaneous cricothyrotomy;	Use of dead pig trachea rather than live animal or human subjects.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15

Patient Safety							
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	emergency percutaneous and surgical cricothyrotomy by prehospital personnel. Prehospital Emergency Care 2004; 8(4):424-426.	**Sample Size:** 22 **Population Studied:** Paramedics	versus surgical or open cricothyrotomy	Comparison: Placement of surgical or open cricothyrotomy (n=22)	correct placement of surgical cricothyrotomy; timing of placement for both percutaneous and surgical cricothyrotomy. **Results:** Placement of surgical cricothyrotomy was significantly faster than the percutaneous method. Mean difference between the 20 matched percutaneous versus surgical pairs was 93.75 seconds. The surgical route had a 100% success rate at obtaining airway control, whereas the percutaneous method had a 90.9% success rate.		626006
National Research Agenda Emergency Medical Services, CDC Acute Injury Care Research Agenda	Wills VL, Eno L, Walker C, et al. Use of an ambulance-based helicopter retrieval service. Australia New Zealand Journal of Surgery 2000;70(7):506-510.	**Study Design Type:** Case Series **Sample Size:** 3,087 **Population Studied:**	To assess the over-triage rate created by the protocols in place for a helicopter primary retrieval service for trauma at a major trauma center, and to assess the	Helicopter retrieval	**Outcomes Measured:** Estimates of time delay or saving and likelihood of benefit from being transported to the hospital via helicopter	There was an overall low incidence of serious injury cases (ISS > 16) in the region studied biasing the result in favor of over-triage. The remote geography	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=10901579#

Patient Safety							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
		Trauma patients	benefit to patient outcomes that may be attributable to the service.		**Results:** Overall, 1.7% of patients were potentially harmed, 17.3% benefited, and 81.0% had no attributable benefit related to the helicopter use.	of the studied area requires helicopter retrievals even for less serious cases.	
IOM Report	Vilke GM, Marino A, Fisher R, et al. Estimation of pediatric patient weight by EMT-PS. Journal of Emergency Medicine. 2001;21(2):125-128.	**Study Design Type:** Diagnostic Accuracy **Sample Size:** 20 **Population Studied:** Urban paramedics	To determine paramedics' experience, comfort, and accuracy in the estimation of pediatric weights	Experience, comfort, and method of determining pediatric weights Reference Standard: The child's actual weight	**Outcomes Measured:** Accuracy of estimating pediatric weights **Results:** Of the 20 participating paramedics, 15 (75%) stated they were uncomfortable estimating pediatric weights. During a process where the 20 paramedics estimated the weight of four children, the majority of estimations were within 50% of the children's' actual weights. Overall, paramedics were accurate in estimating pediatric weights, and use of the Broselow tape	Limitations in this study include small numbers of participants. We feel the study group did offer a good cross-sectional representation of the paramedics in the region. It is also unknown which children were lifted by the paramedics as a way to determine the child's weight, and thus it cannot be determined if lifting played any role in increasing the estimation accuracy. Additionally, most paramedics, when lifting the children, did so by lifting upward after placing both hands under the child's axillae, which in actual	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=11489399

Patient Safety							
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Intervention Examined/ Observations Made**	**Main Findings**	**Study Limitations**	**Link to Abstract**
					(a method of estimating pediatric weight) improved the precision of these estimations.	practice would be unlikely to be the method used. The number of estimations were small (four children), but given the tight correlation of the estimations, it is unlikely that increasing the number of children and estimations would significantly alter these results.	

Appendix B: Literature Review: Non-clinical Studies

Airway/Respiratory Management				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
2006 IOM Report, NHTSA Agenda	Freeman K, Shalit M, et al. Use of the Gamow Bag by EMT-Basic Park Rangers for Treatment of High-Altitude Pulmonary Edema and High Altitude Cerebral Edema. Wilderness and Environmental Medicine.2004, 15; 198-201.	**Study Design:** Case study **Sample Size:** N/A **Population:** National park service rangers	The purpose of this article was to inform the population of uses of the Gamow bag and to encourage training amongst park rangers.	Gamow Bag – produces an environment equivalent to descending 5000 feet High altitude pulmonary edema responsible for most high altitude illness deaths EMT-Bs/Park Rangers should be trained to use this equipment	http://www.ncbi.nlm.nih.gov/sites/entrez/15473460
EMS Research Strategic Plan, 2006 IOM Report, EMSOP	Bulger E, Copass M. An analysis of advanced prehospital airway management. The Journal of Emergency Medicine. 2002, 23(2); 183-89.	**Study Design:** Retrospective review **Sample Size:** 2700 patients **Population:** Prehospital airway procedures from Jan. 1997 to Nov. 1999.	This article's purpose is to describe the use of intubation and airway management factors.	The overall intubation success rate was about 88% with a oral endotracheal intubation success rate of 98.4%. The addition of paralytic agents to facilitate endotracheal intubation results in decrease need for surgical airway access Discussion of ongoing training/medical supervision for maintaining standards for airway management Data support use of paralytic agents in prehospital setting for oral endotracheal intubation	http://www.ncbi.nlm.nih.gov/pubmed/12359289
2006 IOM Report, NHTSA Agenda	Weitzel N, Kendall J, et al. Blind Nasotracheal Intubation for patients with penetrating neck trauma. The Journal of Trauma. 2004, 56(5); 1097-1101.	**Study Design:** Retrospective review of charts **Sample Size:** 240 patients **Population:** Patients with penetrating neck injuries	The purpose of this study was to determine if BNTI had any adverse consequences over endotracheal intubation.	Discusses advantages of blind nasotracheal intubation (BNTI) over endotracheal intubation BNTI can be performed when patient is awake and in field – can cause swelling of existing hematomas. 45% of patients received BNTI – no documentation showing BNTI caused further airway damage BNTI had a 90% success rate Choice of airway management does not directly relate to	http://www.ncbi.nlm.nih.gov/pubmed /15179252

Airway/Respiratory Management				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
				complications	
NHTSA Agenda, EMS Research Strategic Plan	Rocca B, Crosby E. Maloney J, et al. An assessment of paramedic performance during invasive airway management. Prehospital Emergency Care. 2000, 4(2).	**Study Design:** Retrospective chart review **Sample Size:** 453 **Population:** Attempted intubation in patients residing in the Ottawa-Carleton region in of Ontario, Canada.	Assess the performance of paramedics in a newly-initiated invasive airway management process	Paramedics were successful 90% of the time in intubating . Intubation success was slightly higher for medical patients versus trauma patients. Nasal intubations had a significantly lower success rate than oral intubation.	http://www.ncbi.nlm.nih.gov/pubmed/10782606

Cardiovascular Care and Stroke				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
National EMS Strategic Plan, EMSOP	Rittenberger J, Hostler D, Tobin T, et al. Predictors of ROSC in Witnessed Aeromedical Cardiac Arrests. Resuscitation. 2008,76(1);43-6.	**Study Design:** Retrospective analysis **Sample Size:** 12,140 air transport patients **Population:** 134 cardiac arrests	Documentation of cardiac arrest frequencies/factors during aeromedical transport.	The authors concluded that cardiac arrest is an infrequent occurrence during aeromedical transport. ROSC (return of spontaneous circulation) is less common in patients who have poor i.v. access. Finally, those patients with hypotension and traumatic injury are less likely to survive cardiac arrest in transport.	http://www.ncbi.nlm.nih.gov/sites/entrez/17688998
2006 IOM Report, NHTSA Agenda	Garvey J, MacLeod B. Pre-Hospital 12-Lead Electrocardiography Programs. Journal of the American College of Cardiology. 2006, 47(3)	**Study Design:** Pooled results of 6 randomized trials **Sample Size:** 6434 patients **Population:** Patients in whom intubation was attempted in the Ottawa-Carleton region in of Ontario, Canada.	Assess the impact of pre-hospital fibrinolytic therapy through the use of pre-hospital 12 lead electrocardiography.	P12ECG allows for quicker notification of hospitals that STEMI (segment elevation myocardial infarction) patient is arriving. Therefore, mean time to fibrinolytic therapy is reduced (from 62-32 minutes). Prehospital fibrinolysis is associated with a decreased chance of mortality.	http://www.ncbi.nlm.nih.gov/pubmed/16458125
2006 IOM Report	Le May MR, Dionne R, Maloney J, et al. Diagnostic performance and potential clinical impact of advanced care paramedic interpretation of ST-segment elevation myocardial infarction in the field. Canadian Journal of Emergency Medicine 2006; 8(6):401-407.	**Study Design:** Retrospective **Sample Size:** 967 **Population:** Patients with chest pain consistent with myocardial ischemia	To determine if advanced care paramedics (ACP) can accurately identify STEMI on the pre-hospital ECG and contribute strategies that shorten time to reperfusion.	**Outcomes Measured:** Identification of STEMI on ECG: sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) hypothetical decision to use thrombolytic therapy by ACP: sensitivity, specificity, PPV, NPV Median time arrivals in patients with STEMI on pre-hospital ECG **Results:** Correct diagnosis of STEMI on ECG by ACP was confirmed in	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd+Retrieve&db=pubmed&dopt&Citationlist_uids=1720999489

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Main Findings	Link to Abstract
				63 patients. Identification of STEMI on ECG resulted in sensitivity (96%), specificity (96%), PPV (82%), NPV (99%). Decision to use thrombolytic therapy by ACP resulted in sensitivity (92%), specificity (97%), PPV (73%), NPV (99%). Time saved with ACP administration of thrombolytic therapy would have been 44 minutes.	
Cone Agenda	Rittenberger J, Beck P, Paris P. Errors of Omission in the Treatment of Prehospital Chest Pain Patients. Prehospital Emergency Care. 2005, 9(1); 2-5.	**Study Design:** Retrospective review of ambulance records. **Sample Size:** N/A **Population:** 300 calls to 4 ambulance services (75 each)	(1)Standardized treatment protocol by emergency medical services for chest pain was assessed to identify deviations. (2) Quantify delay in time for treatment of presumed ischemic cardiac related chest pain.	No variation in response time was noted; however, suburban ambulance services had longer transport times. Documentation of patient history, physical examination, treatment, and following orders varied substantially.	http://www.ncbi.nlm.nih.gov/pubmed/16036820
EMSOP	McVaney KE, Macht M, Colwell CB; et al. Treatment of suspected cardiac ischemia with aspirin by paramedics in an urban emergency medical services system. Prehospital Emergency Care. 2005; 9:282-284.	**Study Design:** Retrospective chart review **Sample Size:** 2045 charts reviewed (encounters) **Population:** Urban EMS system (paramedics)	To determine how often paramedics used aspirin with patients with chest pains that was suspicious of cardiac ischemia.	Based on 2045 chart reviews, 54% of patients with no contraindications to aspirin with suspected cardiac ischemia received aspirin. Of the patients that received nitroglycerin because of the high concern of cardiac ischemia, 79% were treated with aspirin. It was concluded that aspirin was underutilized by paramedics in the prehospital setting for suspected cardiac ischemia.	http://www.ncbi.nlm.nih.gov/sites/entrez /16147476
2006 IOM Report, National Research Agenda Emergency Medical Services	Humphrey J, Walker A, Hassan TB. What are the beliefs and attitudes of paramedics to prehospital thrombolysis? A questionnaire study.	**Study Design**: Cross-sectional study **Sample Size**: 250 **Population:**	To ascertain the knowledge of risks and benefits of acute myocardial infarction (AMI) treatments in paramedics	**Outcomes Measured:** Paramedic knowledge of the risks and benefits of AMI treatments and their views on prehospital thrombolysis treatment delivered by paramedics	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15911960

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Main Findings	Link to Abstract
	Emergency Medicine Journal 2005;22(6):450-451.	Paramedics who have been trained to perform and interpret a 12 lead electrocardiogram (ECG)		**Results:** Of the included paramedics, 77% responded. 83% felt that paramedics could deliver prehospital thrombolysis (PHT); 67% felt PHT was safe; and 12% felt that paramedics should not carry out PHT.	
EMS Research Strategic Plan	Rajajee V, Saver J. Prehospital Care of the Acute Stroke Patient. Techniques in Vascular and Interventional Radiology. 2005, 8;74-80.	**Study Design:** Discussion **Sample Size:** N/A **Population:** EMS personnel	An investigation into poor EMS responses to stroke warning signs.	Time is a crucial factor in stroke intervention 7 D's: early detection, dispatch through activation/prompt EMS response, delivery of victim, door (ED triage), data, decision about therapy, drug therapy Stroke needs to be viewed in a manner similar to myocardial infarction	http://www.ncbi.nlm.nih.gov/pubmed/16194754
NHTSA Agenda, 2006 IOM Report, EMSOP	Goebel PJ, Daya MR, Gunnels MD. Accuracy of arrhythmia recognition in paramedic treatment of paroxysmal supraventricular tachycardia: a ten-year review. Prehospital Emergency Care 2004;8(2):166-170.	**Study Design:** Retrospective **Sample Size**: 224 **Population**: All patients with presumed paroxysmal supraventricular tachycardia (PSVT) who were treated with adenosine by paramedics from 1993 to 2002	To examine trends in paramedic rhythm misidentification rates in the use of adenosine for presumed paroxysmal supraventricular tachycardia (PSVT) over a 10-year period.	**Outcomes Measured:** Accuracy of arrhythmia recognition by paramedics **Results:** Inappropriate use of adenosine occurred in 20% of cases over the 10-year period. Misidentification rates for arrhythmia per year ranged from 9% to 31% with the lowest rate occurring after implementation of a targeted education program on tachydyrsrhythmias in 1998. An initial heart rate of <160 beats/minute and an absence of a medical history of either fast heart rate or palpitations were associated with inappropriate use of adenosine.	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=15060851

Cardiovascular Care and Stroke				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
2006 IOM Report, CDC Agenda	Waalewijn R, Vos R, Tijssen J, et al. Survival Models for Out-of-hospital Cardiopulmonary Resuscitation from the Perspectives of the Bystander, the First Responder, and the Paramedic. Resuscitation. 2001, 51(2)113-22.	**Study Design:** Retrospective Review **Sample Size:** Not specified **Population:** Amsterdam	The purpose of this study was to observe the "chain of survival" and determine possible predictors.	"Early defibrillation can restore circulation without the need for advanced CPR. When advanced CPR is needed, its delay leads to a markedly reduced survival."	http://www.ncbi.nlm.nih.gov/sites/entrez/11718965
NHTSA Agenda	Banerjee A, Rhoden W. Fast-tracking of myocardial infarction by paramedics. Journal of the Royal College of Physicians in London. 1998, 32(1); 36-38.	**Study Design:** Review **Sample Size:** 30 groups **Population:** Ambulance staff	This study assessed the efficacy of a fast-track method for patients with myocardial infarctions to be admitted directly into the CCU (coronary care unit).	A&E (Accident & Emergency Departments) do not have facilities for coronary thrombolysis Ambulance staff should be trained to identify patients with myocardial infarctions so they can be admitted directly to the CCU (coronary care unit) Best results of thrombolysis occurs when treatment given in first hour Admittance directly to CCU saved 24 minutes – no significant problem of inappropriate admissions	http://www.ncbi.nlm.nih.gov/sites/entrez/9507439

Cardiovascular Care and Stroke				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
NHTSA Agenda, 2006 IOM Report	Shimauchi A, Toki Y, Ito T, et al. Characteristics of prehospital cardiac arrest patients in Japan and determinant factors for survival. American Journal of Emergency Medicine 1998; 16(2):209-213.	**Study Design:** Case Series **Sample Size:** 130 **Population:** Cardiac arrest patients brought to an emergency department	To study the characteristics of prehospital cardiac arrest patients to elucidate which factors might increase the survival rate of these patients.	**Outcomes Measured:** Factors that increase the survival rate of prehospital cardiac arrest patients. **Results:** Being witnessed on collapse, receiving prompt ALS, and ventricular fibrillation on arrival at hospital all resulted in a better prognosis after prehospital cardiac arrest	http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=pubmed&dopt=Citation&list_uids=9517706
EMS Research Strategic Plan	White R, Hankins D, Bugliosi T. Seven Years' Experience with Early Defibrillation by Police and Paramedics in an Emergency Medical Services System. Resuscitation. 1998, 39(3); 145-51.	**Study Design:** Retrospective observational outcome study **Sample Size:** 131 patients **Population:** Patients with ventricular fibrillation	This study measured the outcomes of out of hospital patients in cardiac arrest with ventricular fibrillation.	The study found that short time differences (i.e. 1 minute) are determinants of response to shocks and discharge survival. However, outcome is strongly correlated to the speed at which defibrillation is performed.	http://www.ncbi.nlm.nih.gov/sites/entrez/10078803

Education and Training				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
NHTSA Agenda, 2006 IOM Report, CDC Agenda, EMS Research Strategic Plan	Lineback W. Responding to the educational needs of our emergency medical services responders. NC Medical Journal. 2007, 68(4); 253-54.	**Study Design:** Case study **Sample Size:** N/A **Population:** EMS providers in North Carolina	Discussion of continuing education needs of EMS providers.	Consolidates North Carolina state and county resources to provide additional EMS educational equipment. Train EMS personnel continually with continuing education. Attracting more students into EMS and health care programs. Better funding for community colleges and EMS programs. Target underrepresented populations in EMS	http://www.ncbi.nlm.nih.gov/sites/entrez /17694843
Cone Agenda, EMSOP Agenda, National EMS Research Strategic Plan, Seidel Article	Margolis, G. Emergency Medical Services Education: Past, Present & Future. North Carolina Medical Journal. 2007, 68(4); 249-52.	**Study Design:** Case study of EMS **Sample Size:** N/A **Population:** EMS	This study aims to suggest ways of improving EMS.	Recommendations to improve EMS included (1)adopt nationally consistent levels of practice/nomenclature;(2) require national certification for state licensure; (3) link national certification eligibility to graduation from an accredited institution and increase the role of higher education in EMS.	http://www.ncbi.nlm.nih.gov/pubmed /17694842
2006 IOM Report	Martin-Gill C, Baer A. Poison Centers as information resources for volunteer EMS in a suspected chemical exposure. The Journal of Emergency Medicine. 2007, 32(4); 397-403.	**Study Design:** Survey **Sample Size:** 116 Population: Rural EMS providers	To identify the most trusted information sources for EMS personnel during chemical exposures.	Poison Centers & CHEMTREC (Chemical Transportation Emergency Center) are the most trusted sources by EMS responders for information during chemical incidents.	http://www.ncbi.nlm.nih.gov/sites/entrez/17499694
2006 IOM Report, Cone Agenda	Melby V, Ryan A. Caring for older people in prehospital emergency care: can nurses make a difference? Journal of Clinical Nursing. 2005, 14, 1140-50	**Study Design:** N/A **Sample Size:** 24 EMS personnel **Population:** Ambulance personnel, elderly patients, paramedics, nursing students in Sweden and Norway	This article discusses whether elderly patients need specialized nurses.	Crucial that ambulance staff have special education/training to deal with elderly population One possible solution would be to diversify the roles of nurses and in effect have ambulance nurses.	http://www.ncbi.nlm.nih.gov/sites/entrez/16164532

Education and Training				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
NHTSA Agenda, 2006 IOM Report	Miller D, Guimond G, Hostler D, et al. Feasibility of Sternal Intaosseous Access By Emergency Medical Technician Students. Prehospital Emergency Care. 2005, 9(1); 75-78.	**Study Design:** Prospective education trial **Sample Size:** 29 students **Population:** EMT-B students	To assess the feasibility of teaching (emergency medical technician-basic) EMT-B students to use the commercial sternal IO infusion device (FAST-1).	Minimal training yielded limited success for teaching EMT-B students to use a sternal IO infusion device. Research involving more intensive training may produce better results.	http://www.ncbi.nlm.nih.gov/pubmed/16036832
Emergency Medical Services Outcomes Project	Sanddal T, Loyacono T. Effect of JumpSTART training on immediate and short term pediatric triage performance. Pediatric Emergency Care. 2005; 21(7): 486.	**Study Design:** Pre/post/follow-up surveys **Sample Size:** N/A **Population:** EMS personnel in North Kingstown, RI; Mt. Pleasant, Iowa; Grahm, Washington.	The objective of the study was to evaluate the effectiveness of JumpSTART training in "changing prehospital care personnel and/or school nursing personnel performance in triaging pediatric patients involved in a multiple casualty incident."	Changes were significant 1 hour post lecture. These changes were maintained over the next 3 months prior to the follow up survey. Prehospital personnel and school nurses both benefited from the JumpSTART training.	http://www.ncbi.nlm.nih.gov/sites/entrez /15502656
NHTSA Agenda	Stevens S, Alexander J. The impact of training and experience on EMS providers' feelings towards pediatric emergencies in a rural state. Pediatric Emergency Care. 2005 Jan; 21(1);12-7.	**Study Design:** Survey **Sample Size:** N/A **Population:** All registered EMTs in Maine	The purpose of the study was to determine what factors influence EMTs' feelings towards pediatric emergencies in rural states.	The study concludes that hours of continuing education and level of EMT are the main factors that influence comfort of EMTs when facing pediatric emergencies. Increased exposure to emergencies (especially pediatric) also increases confidence.	http://www.ncbi.nlm.nih.gov/sites/entrez /15643317
NHTSA Agenda, 2006 IOM Report	Ellison S, Gratton M, et al. Prehospital Dispatch Assessment of Stroke. Missouri Medicine. 2004, 101(1); 64-66.	**Study Design:** Retrospective review **Sample Size:** 191 patients **Population:** Stroke patients	To determine the accuracy of stroke diagnosis by paramedics/EMS dispatchers versus emergency physicians.	Study wanted to determine assessment accuracy for stroke diagnosis between EMS dispatchers & emergency physicians (EPs). Early recognition of stroke symptoms is important for maintaining neurological function. EMS dispatchers recognize less than 50% of stroke cases however on-scene paramedics	http://www.ncbi.nlm.nih.gov/pubmed/15017757

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Main Findings	Link to Abstract
				are better able to diagnose a stroke patient. Article suggests improving paramedic education/training.	
CDC Agenda, NHTSA Agenda, EMS Research Strategic Agenda	Jaslow D, Ufberg J. Primary injury prevention in an urban EMS system. The Journal of Emergency Medicine.2003, 25(2); 167-70.	**Study Design:** Cross sectional survey/interviews **Sample Size:** 162 respondents **Population:** Paramedics	The survey was administered to assess attitudes towards, education/ training and frequency of PIP (primary injury prevention).	The survey was administered to sample of paramedics assessing attitudes, how often they practice PIP (primary injury prevention) & education/training on PIP. 70% think that PIP should be a core mission of the EMS, while 82% agree it should be implemented at local and regional levels. 60% of the respondents were never given any PIP prevention. In addition, it has been recognized as a serious issue in the last 5-7 years. Finally, EMS providers want to be able to identify/modify illness/injury risks.	http://www.ncbi.nlm.nih.gov/sites/entrez/12902003
National EMS Research Strategic Plan (Sayer), Seidel Article, EMSOP Agenda	Schreiber M, Holcomb J. et al. Military trauma training performed in a civilian trauma center. Journal of Surgical Research. 2002, 104; 8-14.	**Study Design:** questionnaire **Sample size:** one army team of 24 persons **Population:** surgeons, nurses, EMTs, OR Techs (operating room technicians)	This study examined the best location for trauma training.	The study finds that 1 month of trauma training at a civilian hospital is better than 1 year training at home station – because EMS personnel can perform more surgeries/deal with more trauma cases. During Gulf War it was discovered that medical personnel had little/no training in taking care of seriously injured people. Lack of peacetime trauma training identified as a problem by US Government.	http://www.ncbi.nlm.nih.gov/pubmed /11971671
2006 IOM Report, NHTSA Agenda, EMS Research Strategic Plan, Seidel Agenda, PECARN Agenda	Babl F, Vinci R, Bauchner H, et al. Pediatric Pre-Hospital Advanced Life Support Care in an Urban Setting. Pediatric Emergency Care.	**Study Design:** Retrospective Observational Review **Sample Size:** 555 people	To describe pediatric advanced life support activities (PALS) and characterize educational priorities.	Continuing education for EMS personnel requires balancing the training for uncommon procedures that may provide necessary medical support with more common and routine procedures.	http://www.ncbi.nlm.nih.gov/pubmed/11265910

Education and Training				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
	2001, 17(1); 5-9.	**Population:** 590,000			
National EMS Research Strategic Plan, Seidel Article, PECARN Research Agenda (PECARN)	Spaite DW, Karriker KJ, Conroy C. Emergency Medical Services assessment and treatment of children with special health care needs before and after specialized paramedic training. Prehospital and Disaster Medicine. 2001; 16(2):96-101	**Study Design:** Cross sectional study **Sample size:** 147 people **Population:** Paramedics	To determine whether a pediatric special needs education program designed specifically for paramedics improves clinical assessment and management based on documentation.	Paramedic documentation was deemed to be appropriate for the majority of encounters with children with special health care needs. There were however areas that the researchers felt paramedics could benefit from additional training, for example pulse oximetry, and indications for intravenous line placement. This article suggests that specialized training on children with special health care needs would benefit the paramedic's clinical assessment and management of this patient population.	http://www.ncbi.nlm.nih.gov/pubmed /11513288
NHTSA Agenda	Funk D, Groat C, Verdile V. Education of paramedics regarding aspirin use. Prehospital Emergency Care. 2000, 4(1).	**Study Design:** Post test survey including 2 month follow up. **Sample Size:** 22 people **Population:** EMT-Ps from a suburban EMS system	To determine EMT-Ps (Emergency medical technician – paramedics) information retention after a didactic session on aspirin use in acute myocardial infarction (AMI).	The average overall post test score was 94% on a 12 item instrument. The questions missed on the post-test were regarding: 1) the length of the effects of aspirin, 2) the bronchospastic effects of aspirin, and 3) the recently instituted indications for its out-of-hospital use. All paramedics correctly identified the contraindications to aspirin use.	http://www.ncbi.nlm.nih.gov/pubmed/10634286
Seidel Agenda, Pediatric Emergency Care Applied Research Network, Institute of Medicine Report (Growing Pains)	Spaite D, Karriker K, Seng M, et al. Training paramedics: Emergency care for children with special health care needs. Prehospital Emergency Care.	**Study Design:** Pre and post training surveys for a self study program **Sample Size:** 41 pre and 49 post training surveys	Enhance knowledge and comfort related to the emergency care of children with special health care needs (CSHCN)	The most significant improvements were in changing tracheostomy, using G-tubes to relieve gastric distention, managing a dislodged G-tube using a partially implanted central venous catheter, totally implanted central venous	http://www.ncbi.nlm.nih.gov/pubmed /10782609

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Main Findings	Link to Abstract
	2000, 4(2).	completed **Population:** Full-time, nationally registered paramedics employed by a municipal fire department		catheter, recognizing ventriculoperitoneal shunt occlusion.	
NHTSA Agenda, EMS Strategic Research Agenda, Cone Agenda, CDC Agenda	Crocco T, Kothari R, Sayre M, et al. A Nationwide Prehospital Stroke Survey. Prehospital Emergency Care. 1999, 3(3).	**Study Design:** Cross sectional survey **Sample Size:** 355 people **Population:** 256 EMT-Ps (emergency Medical Technicians-paramedics), and 99 advanced EMT-I (emergency medical technicians-intermediate) from a random selection of the NREMT (National Registry of Emergency Medical Technicians) database.	Identify deficiencies in stroke knowledge among prehospital providers	983 surveys were mailed with a 36% response rate. Survey responders were similar to non-responders in terms of age and years of experience. 68% EMT-Ps and 60% EMT-Is, reported 1-5 hours of stroke instruction during initial training. 9% of the EMT-Ps and 24% of EMT-Is reported having < 1hr of instruction on stroke during their initial training. 47% EMT-Ps and 57% EMT-Is stated they had never had a subsequent review session on stroke. 98% identified that a stroke injures the brain, but only 78% of the EMT-Ps and 47% of the EMT-Is correctly defined a transient ischemic attack (TIA). The EMT-Ps were more likely to recognize that dextrose is potentially harmful to stroke patients [EMT-P = 85%, EMT-I = 72%). Only 36% of the EMT-Ps and 22% of the EMT-Is knew that tissue plasminogen activator must be given within 3 hours of symptom onset.	http://www.ncbi.nlm.nih.gov/pubmed/10424856

Education and Training				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
Cone Agenda, 2006 IOM Report	Jezierski M. Family Violence Screening: Opportunities in prehospital settings. Journal of Emergency Nursing.1999, 25; 201-05.	**Study Design:** Observational Case study **Sample Size:** N/A **Population:** EMS providers	The study was performed to assess how EMS providers should be utilized against domestic violence (DV).	DV education/screening should be included as a part of the training/education for EMS providers. The article outlines the steps necessary to create a DV education program, including a discussion of potential red flags.	http://www.ncbi.nlm.nih.gov/sites/entrez/10346843
NHTSA Agenda, EMS Strategic Research Agenda, Cone Agenda	Liberman M, Lavoie A, Mulder D, et al. Cardiopulmonary Resuscitation: Errors Made by Pre-hospital Emergency Medical Personnel. Resuscitation. 1999, 42(1); 47-55.	**Study Design:** Observational **Sample Size:** 66 people **Population:** Emergency Healthcare Professionals	This study aimed to evaluate CPR techniques of emergency health professionals (EMTs, firemen, emergency first responders, CPR instructors).	Additional teaching/certification is necessary amongst the CPR performing population. Participants of the study were not able to complete their exhalations with enough strength to fill the patients' lungs. In addition, emergency health professionals struggled to find a carotid pulse after a minute, with only 45.4% finding the pulse.	http://www.ncbi.nlm.nih.gov/sites/entrez/10524730
NHTSA Agenda, 2006 IOM Report, EMS Research Strategic Plan	Walz BJ, Smith TL. The Cadre of Death Education Instructors in Paramedic Programs. Prehospital and Disaster Medicine. 1998; 13(1): 63-66.	**Study Design:** Self-administered survey **Sample Size:** 537 paramedic programs in the USA **Population:** Death education instructors	Examination of death education instructors in paramedic training programs and how well EMS personnel are prepared in situations that involve persons dealing with death.	78% of the programs said that a paramedic is the primary instructor in teaching death related material. 66% said a nurse is the primary instructor in teaching death related material. 32% of programs said a physician is the primary instructor of death related material. 68% of faculty members have had no formal training in death and dying 1/3 of death education programs have multidisciplinary staff However, <40% teach death related material with trained instructors Lack of proper opportunities for	http://www.ncbi.nlm.nih.gov/pubmed/10187028

Education and Training				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
				instructor training is due to a lack of funding as well as lack of importance given to formal training as most programs do not have formally trained instructors.	

EMS Operations				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
NHTSA Agenda	Berger W, Figueira I, et al. Partial and Full PTSD in Brazilian Ambulance workers: Prevalence and Impact on Health and on Quality of Life. The Journal of Traumatic Stress. 2007, 20(4); 637-42.	**Study Design:** Cross sectional survey with questionnaire **Sample Size:** 234 ambulance workers **Population:** 180 male Brazilian ambulance workers 54 female Brazilian ambulance workers	This article investigates the prevalence and frequency of post-traumatic stress disorder in ambulance personnel.	Many previous studies show post-traumatic stress disorder (PTSD) in about 20% of ambulance personnel Full PTSD found in 6.7% of males Duration of exposure/type of trauma can affect vulnerability of women to traumatic events.	http://www.ncbi.nlm.nih.gov/sites/entrez/17721969
NHTSA Agenda	Gerhardt R. Impact of Emergency Medicine Specialists in Tactical Pre-Hospital and En Route Care: What does the available data say? The Journal of Trauma. 2007, 62(6); S11-S12.	**Study Design:** Review **Sample Size:** 17 people **Population:** EMS personnel	A discussion of feasibility of EMS providers in dangerous areas of combat.	Emergency medicine skilled providers & EMS system model in combat zone are feasible and will improve outcome ALS-skilled care en route helps combat casualty survival	http://www.ncbi.nlm.nih.gov/sites/entrez /17556936
EMS Research Strategic Plan, CDC Agenda, 2006 IOM Report	Hoek M, Bracebridge S, Oliver I. Health Impact of the Buncefield oil depot fire, December 2005. Study of accident and emergency case records. Journal of Public Health. 2007, 29(3); 298-302.	**Study Design:** Case study **Sample Size:** N/A **Population:** Buncefield Oil Depot	This article proposes an emergency plan during a major incident.	During a major incident – triage posts should be at the scene to deal with pressing concerns – cuts/sprains, respiratory symptoms, general health/occupational health advice Surveillance systems should be developed by DOH & HPA to collect complaints, common diagnoses etc. which allows for better understanding of incident	http://www.ncbi.nlm.nih.gov/sies/entrez/1758686
NHTSA Agenda, EMS Research Strategic Plan	Oglesby R. Recruitment and Retention Benefits of EMT-Paramedic Utilization During ED Nursing Shortages. Journal of Emergency Nursing. 2007; 33; 21-5.	**Study Design:** Observational case studies **Sample Size:** N/A **Population:**	A study exploring the use of emergency medical technicians-paramedics (EMT-Ps) in recruitment and retention of experienced registered nurses (RNs).	**Purpose:** clarify where/how EMS personnel can practice & to define written plan/protocols for them to follow ED nurse:patient ratio expected to increase Specific cases cited: RNs appreciate EMT-Ps and have	http://www.ncbi.nlm.nih.gov/sites/entrez/17258048

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Main Findings	Link to Abstract
		Emergency medical technician-paramedics and RNs (registered nurses)		requested additional support Make RNs equal partners in redesigning workplace Must start to address staff morale, patient satisfaction & patient outcome issues	
2006 IOM Report	Sandman L, Nordmark A. Ethical conflicts in prehospital emergency care. Nursing Ethics. 2006, 13(6); 592-607.	**Study Design:** focus groups/interviews **Sample Size:** N/A **Population:** N/A	This study aimed to understand the fundamentals of ethical conflicts in medicine.	Analyze/describe ethical conflicts faced by prehospital emergency care-givers (PECs) in prehospital settings Ethical conflicts arise when it comes to: patient's best interest, patient's self-determination, professional ideals, organizational structure/resource management, societal ideals, significant others/bystanders, care professionals, other professionals	http://www.ncbi.nlm.nih.gov/pubmed /17193801
2006 IOM Report	Brugger H, Elsensohn F, et al. A survey of emergency medical Services in North America. Official Recommendations of the International Commission for Mountain Emergency Medicine (ICAR Medcom). High Altitude Medicine & Biology. 2005, 6(3); 226-37.	**Study Design:** Cross Sectional Questionnaire **Sample Size:** N/A **Population:** 21 countries	This study examines high altitude training of medical personnel.	Comparison of 21 countries with high altitude areas On site treatment of patients is occurring more in countries where physicians are present in mountain rescue operations Lack of education/training in areas of mountain rescue operations Suggest physicians, paramedics and mountain rescuers become part of the mountain rescue team	http://www.ncbi.nlm.nih.gov/sitesentrez/16185140
NHTSA Agenda	Maguire B, Hunting K, Guidotti T et al. Occupational Injuries Among Emergency Medical Services Personnel. Prehospital Emergency Care. 2005, 9(4); 405-411.	**Study Design:** Review of injury records by two urban agencies. **Sample Size:** 489 **Population:** EMTs	To describe the nature of EMS worker's occupational injuries and compare these injury rates with other professional groups.	The study concluded that the injury rate of EMS workers was 34.6 per 100 FT employees; back injuries were reported most often. Department of Labor statistics indicate that injuries of EMS workers were higher than any other industry in 2000.	http://www.ncbi.nlm.nih.gov/pubmed/16263673

EMS Operations				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
2006 IOM Report	Miller N, Gudmestad T, Eisenberg M. Development of Model Infectious Disease Protocols for Fire and EMS Personnel. Prehospital Emergency Care. 2005, 9(3); 326-331.	**Study Design:** Survey **Sample Size:** 24 Fire Departments **Population:** 35 Fire Departments in King County, Washington	To compare infectious disease protocols in King County, Washington to assess variation and develop a model plan.	Fire department infectious disease protocol plans were diverse. Additionally, it was noted that prophylaxis treatment was not considered timely for some departments.	http://www.ncbi.nlm.nih.gov/pubmed/16147484
NHTSA Agenda	Custalow CB, Gravitz CS. Emergency medical vehicle collisions and potential for preventive intervention. Prehospital Emergency Care. 2004 Apr-Jun;8(2):175-84.	**Study Design:** Retrospective **Sample Size:** 206 **Population:** Emergency medical vehicle collisions in the Paramedic Division of the Denver Health and Hospital Authority from 1989-1997.	Determine factors that can be changed through intervention to prevent emergency medical vehicle (EMV) collisions.	Factors for injury from an EMV collision include perpendicular contact, collision at intersection, and intoxication of the other party involved. Interventions include ensuring the intersection is cleared prior to entering, retraining, and public education on the dangers of drunk driving. Limitations of this study include incomplete records of crashes and unknown baseline experience of EMV drivers and environmental factors.	http://www.ncbi.nlm.nih.gov/sites/entrez /15060853
NHTSA Agenda, 2006 IOM Report, CDC agenda , EMS Research Strategic Plan	Lukins J, Feldman M, Summers J et al. A Paramedic-Staffed Medical Rehydration Unit at a Mass Gathering. Prehospital Emergency Care. 2004, 8(4); 411-416.	**Study Design:** Prospective observational study **Sample Size:** 143 people **Population:** Greater than 450,000	To evaluate the medical effectiveness of providing a rehydration unit to reduce heat-related illnesses at mass gatherings.	The medical rehydration unit resulted in a 21% reduction in patients requiring services at the main field hospital. This research suggests offering a rehydration unit at mass gatherings may create a new role for paramedics in treating heat related illnesses.	http://www.ncbi.nlm.nih.gov/pubmed/15626003
NHTSA Agenda	Smith E, Boyle M, MacPherson J. The development of a quality assessment tool for ambulance patient care records. Health Information Management. 2004, 33(4); 112-20.	**Study Design:** Retrospective cohort study **Sample Size:** N/A **Population:** 2002 Victorian	The purpose of this study was to conduct an investigation to improve patient care records (PCR).	Develop an assessment tool for Patient Care Records (PCR) because many prehospital studies are based on this information Quality assessment tool has been developed and must be implemented – identified 3 main areas where PCR needs	http://www.ncbi.nlm.nih.gov/sites/entrez/18239230

EMS Operations				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
		prehospital emergency care documentation completed by ambulance paramedics.		improvement	
NHTSA Agenda, EMS Research Strategic Plan	Colwell C, Pons P. Complaints against an EMS system. Journal of Emergency Medicine. 2003, 25(4); 403-408	**Study Design:** Retrospective Review **Sample Size:** 286 complaints **Population:** Patients, medical personnel, family members	A study done to investigate the source of complaints in hospitals.	Average of 48 complaints/year Originators of complaints: patients, medical personnel, family members Complaints filed for: rude behavior, technical skills, transport problems, loss of belongings	http://www.ncbi.nlm.nih.gov/sites/entrez/14654181
2006 IOM Report, EMS Research Strategic Plan	Hall W, Myers J, Pepe P, et al. The Perspective of Paramedics about On-scene Termination of Resuscitation Efforts for Pediatric Patients. Resuscitation. 2003, 60(2); 175-87.	**Study Design:** Cross Sectional Survey **Sample Size:** 201 paramedics **Population:** Paramedics	Study performed to measure paramedics' attitudes towards on-scene termination of pediatric cardiopulmonary resuscitation.	Policies should be developed to guide paramedics in determining when to end resuscitation efforts in pediatric patients. Increasing paramedic familiarity/skills should be a goal for pediatric resuscitation.	http://www.ncbi.nlm.nih.gov/sites/entrez/15036737
NHTSA Agenda	Lerner E, Billittier A. The time first-response fire fighters have to initiate care in a midsize city. The Journal of Emergency Medicine. 2003, 25(2); 171-74	**Study Design:** Retrospective Review **Sample Size:** 4752 EMS requests **Population:** Fire fighters and EMS ambulance providers	This study determined whether first response fire fighters arrived at the scene before EMS ambulance providers.	Fire was found to be on scene 1.3 (+/- 3.2min) mins before and arrives before the ambulance 69% of time. Conclusion: Utilize staged first response fire team.	http://www.ncbi.nlm.nih.gov/sites/entrez/12902004
NHTSA Agenda, Cone Agenda	Hauswald, M. Can paramedics safely decide which patients do not need ambulance transport or emergency department care? Prehospital Emergency Care. 2002 Oct-Dec;6(4):383-6.	**Study Design:** Prospective survey. Retrospective outcome chart review **Sample Size:** 236 people **Population:**	To survey paramedics if a patient does not need transport by ambulance or emergency department (ED) care.	There was low agreement (kappa=0.47) between paramedics and actual need from chart reviews for patients. There was no significant difference between paramedics opinion for transport or need for ED care when compared to the chart review.	http://www.ncbi.nlm.nih.gov/sites/entrez /12385602

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Main Findings	Link to Abstract
		Paramedics that transferred patients to single ED in November 1997 in New Mexico.		Further training is needed for paramedics to properly determine which patients require transport or ED care.	
NHTSA Agenda	Mechem CC, Dickinson ET, Shofer FS, et al. Injuries from assaults on paramedics and firefighters in an urban emergency medical services system. Prehospital Emergency Care 2002 Oct-Dec;6(4):396-401.	**Study Design:** Retrospective **Sample Size:** 1,100 injury reports **Population:** Paramedics and firefighters with injury reports from Jan. 1, 1996 to Dec. 31, 1998 in Philadelphia.	Evaluate the frequency and nature of injuries from assaults on paramedics and firefighters.	Of the 1,100 injury reports, 44 (4%) were assaults; 26 of the 44 assaults (59.1%) were intentional while 17 (38.6%) were unintentional. Suggestions to reduce on the job violence include training and dispatching police to potentially violent calls. Limitations include incomplete data, not all incidents are reported, and not having a universal definition for assault.	http://www.ncbi.nlm.nih.gov/sites/entrez /12385605
Cone Agenda, EMS Research Strategic Plan	Silvestri S, Rothrock SG, Kennedy D, et al. Can paramedics accurately identify patients who do not require emergency department care? Prehospital Emergency Care. 2002 Oct-Dec; 6(4):387-90.	**Study Design:** Cross-sectional/Prospective **Sample Size:** 313 people **Population:** Paramedics that transported patients during a 14 day period.	Survey paramedics following patient transport for proper assessment of their need for treatment in the emergency department (ED).	Assessment by paramedics was found to be 81% sensitive with positive and negative predictive values of 50% and 68% respectively. Overall, the paramedics could not predict the need for ED care. Limitations include no blinding of paramedic to pre-ED care and generalizabilty to other sites.	http://www.ncbi.nlm.nih.gov/pubmed /12385603
NHTSA Agenda, EMSOP, 2006 IOM Report, EMS Research Strategic Plan	Van Emmerik AAP, Kamphuis JH, Hulsbosch AM, et al. Single session debriefing after psychological trauma: a meta-analysis. Lancet. 2002 Sept. 7; 360(9335):766-71.	**Study Design:** Meta-analysis **Sample Size:** 29 outcome studies **Population:** N/A	This review of published studies for single-session debriefing following trauma was done to determine the efficacy of this practice. Intervention types included critical incident stress debriefing (CISD), non-CISD models (such as the	Post-traumatic stress disorder symptoms were improved for those treated with non-CISD models and no intervention. CISD models were found to have a negative affect on recovery from a traumatic event. Limitations for this study include the exclusion criteria and a lack	http://www.ncbi.nlm.nih.gov/pubmed/12241834

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Main Findings	Link to Abstract
			comprehensive critical incident stress management (CISM)) and no intervention.	of pre-intervention data.	
Seidel Agenda, 2006 IOM Report, Pediatric Emergency Care Applied Research Network, Emergency Medical Services Outcomes Project	Vilke G, Steen P. Out of Hospital pediatric intubation by paramedics: the San Diego experience. The Journal of Emergency Medicine. 2002; 22(1); 71-74.	**Study Design:** Retrospective review **Sample Size:** 324 pediatric patients **Population:** Patients with intubation attempts	The purpose of this study was to evaluate pediatric endotracheal intubations.	Assess frequency of unrecognized esophageal intubations by field paramedics Conclusion: low occurrence of unrecognized esophageal placements by out of hospital paramedics in established EMS system	http://www.ncbi.nlm.nih.gov/pubmed/11809559
IOM Report (Growing Pains), Sayer Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report), National Research Agenda Emergency Medical Services (NHTSA)	Clawson J, Sinclair R. The Emotional Content and Cooperation Score in Emergency Medical. Prehospital Emergency Care. 2001, 5(1); 29-35.	**Study Design:** Retrospective Analysis **Sample Size:** 6,000 cases from two communication centers **Population:** Communication Centers	To assess the Emotional Content and Cooperation Scores (ECCS) of callers to emergency medical technicians to identify if the callers could handle a structured interrogation or act on life-saving instructions.	The study dispels the notion that callers are emotional and uncooperative. ECCS scores were low reflecting the ability of the callers to be interrogated and responsive to medical advice.	http://www.ncbi.nlm.nih.gov/pubmed/11194066
Growing Pains Report	Dieckman R, Athey, J, Bailey B. A Pediatric Survey for the National Traffic Safety Administration: Emergency Medical Services System Re-Assessments. Prehospital Emergency Care. 2001, 5(3); 231-236.	**Study Design:** Survey **Sample Size:** N/A **Population:** N/A	To establish a survey that can be used by states to evaluate their EMSC programs.	The survey will improve EMS understanding of EMSC operations and procedures.	http://www.ncbi.nlm.nih.gov/pubmed/11446536
2006 IOM Report	Gerlacher G, Sirbaugh P, Macias C. Prehospital Evaluation of Non-Transported Pediatric Patients by a Large Emergency Medical Services System. Pediatric Emergency Care. 2001,	**Study Design:** Cross-sectional and nested case-control **Sample Size:** 15,359 **Population:**	To examine the demographics of non-transported patients. It also explored the documentation and cause of patient complaints.	A non-transport rate of just under 20% was recorded. Children under two years of age were transported more often than older children. Over 50% of EMS calls were related to injuries, motor vehicle accidents, and choking. It was also noted that Caucasian	http://www.ncbi.nlm.nih.gov/pubmed/11753185

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	17(6); 421-424.	Children 12 years of age or less who were not transported over a one- year period.		parents or guardians were more likely than Hispanic parents to opt for non-transport. Increased rates of transport were noted during early morning hours.	
2006 IOM Report	Kahn C, Pirrallo R, Kuhn E. Characteristics of Fatal Ambulance Crashes in the United States: an 11-Year Retrospective Analysis. 2001, 5(3); 261-269.	**Study Design:** Retrospective Analysis **Sample Size:** 333 **Population:** All fatal ambulance crashes reported to the Fatality Analysis Reporting System (FARS) from 1987-97.	To classify fatal ambulance crashes and to further subdivide these into emergency and non-emergency situations.	The majority of fatal ambulance crashes involved emergency situations and took place at an intersection. Numerous measures may be taken to reduce these fatalities.	http://www.ncbi.nlm.nih.gov/pubmed/11446540
Growing Pains IOM Report, 2006 IOM Report, NHTSA Agenda, National EMS Research Strategic Plan	Kamper M, Mahoney B, Nelson S et al. Feasibility of Paramedic Treatment and Referral of Minor Illness and Injuries. Prehospital Emergency Care. 2001, 5(4); 371-8.	**Study Design:** Review of Records **Sample Size:** 1,103 **Population:** All patients transported by Hennepin County Medical Center's ambulance service, insured through the Metropolitan Health Plan, and classified as an ALS minor transport in 1996.	To identify certain high-volume, minor health conditions that may only require in field treatment by EMS. This would be effective in saving EMTs time and money. Further training EMS to treat these health conditions could then be integrated into their curriculum.	Conditions varied making it impossible to identify the most common high-volume, minor health conditions that could be treated in the field. Integrating curriculum development and training would require substantial funding limiting its budgetary efficiency.	http://www.ncbi.nlm.nih.gov/pubmed/11642587
NHTSA Agenda	Ufberg J, Jaslow D, Thom S, et al. Scene diagnosis of carbon monoxide poisoning by emergency medical services personnel. Prehospital	**Study Design:** Case study **Sample Size:** 2	Present a case of carbon monoxide (CO) poisoning that was detected through the City of Wilmington EMS (CWEMS) CO detection program.	Following dispatch, EMS personnel were alerted by the CO meter provided by the CWEMS CO detection program. Two males were located and successfully removed from the	http://www.ncbi.nlm.nih.gov/sites/entrez /11642595

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Main Findings	Link to Abstract
	Emergency Care. 2001 Oct-Dec;5(4):407-10.	**Population:** 34 year old male and 19 year old male		building and transported for treatment. The CO meter was determined to be cost effective, easy to use, and able to detect possibly dangerous CO levels while in the field before a patient suffers from CO poisoning.	
2006 IOM Report	Franklin G, Boaz P, et al. Prehospital Hypotension as a valid indicator of trauma team activation. The Journal of Trauma. 2000, 48(6); 1034-39.	**Study Design:** Retrospective database review **Sample Size:** 791 patients **Population:** Patients with pre-hospital hypotension	Should prehospital hypotension be used as an indication for activation of the trauma team?	Trauma team activation can be very beneficial but has several barriers such as cost and resource utilization. There is a correlation between need for operation & hypotension after injury. Activation of a trauma team should be based on unstable prehospital/ED vital signs.	http://www.ncbi.nlm.nih.gov/sitesentrez/10866247
EMS Research Strategic Plan	Peckinpaugh K, Izsak E, Lindstrom D et al. The Advanced Pedi-Bag Program: A hospital- EMS partnership to implement prehospital training, equipment, and protocols. Pediatric Emergency Care. 2000, 16(6); 409-412.	**Study Design:** Descriptive study **Sample Size:** 180 paramedics **Population:** N/A	To advance cooperation between a trauma center and an EMS agency to promote better emergency medicine for pediatric patients.	The partnership led to improved training for EMS personnel and enhanced the medical equipment and treatment available to prehospital pediatric patients.	http://www.ncbi.nlm.nih.gov/pubmed/11138883
CDC, 2006 IOM Report, NHTSA Agenda, EMS Strategic Research Agenda	Thomsen, T W, et al. Emergency medical services providers and weapons in the prehospital setting. Prehospital Emergency Care. 2000, 4(3); 209-16.	**Study Design:** Cross sectional survey **Sample Size:** 2,224 received surveys **Population:** Convenience sample of EMS providers in metro Boston and Los Angeles	Investigate EMS providers' experience with weapons and evaluate training received to manage patient weapons.	42% of the respondents reported searching patients for weapons, and 62% reported finding weapons with a greater propensity in Los Angeles over Boston. Knives were most common (57%), followed by guns (30%). Violent situations (75%), patient intoxication (50%) and psychiatric problems (30%) were the most common triggers for search. 27% of the participants found more than five weapons. Providers with more experience and education were more likely to	http://www.ncbi.nlm.nih.gov/pubmed/10895914

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Main Findings	Link to Abstract
				search for weapons. Only 20% of the respondents reported receiving training in weapons searching.	
Cone Agenda	Yeh E, Cone D. Cancellation of Responding ALS Units by BLS Providers: A National Survey. Prehospital Emergency Care. 2000, 4(3); 227-33.	**Study Design:** Survey **Sample Size:** 94 City Physician Medical Directors of EMS Services **Population:** 125 of the Largest US Cities Physician Medical Directors of EMS Services	To examine (advanced life support) ALS cancellations.	Medical oversight of canceled ALS services varied and less than half of canceled ALS services involved the use of written protocols.	http://www.ncbi.nlm.nih.gov/pubmed/10895917
Emergency Care for Children Growing Pains: IOM Report (Growing Pains) Future of Emergency Care: Emergency Medical Services at the Crossroads (2006 IOM Report), Seidel Article	Bissell R, Seaman K, Bass R, et al. Change The Scope Of Practice Of Paramedics? An EMS/Public Health Policy Perspective. Prehospital Emergency Care. 1999, 3(2).	**Study Design:** Retrospective chart review **Sample Size:** 42,918 **Population:** Patients from 2 Baltimore emergency departments over a six-month period who were transported by EMS	To analyze the potential for expanding the scope of practice of paramedics.	The ten most frequently defined conditions of the reviewed charts were trauma, seizure, obstetric-gynecologic conditions (Ob/gyn), asthma, overdose, diabetes, gastrointestinal (GI) disorder, chronic obstructive pulmonary disease (COPD), behavioral problem, and myocardial infarction (MI). Ambulance reports were matched to the hospital medical record for 3,329 patients. Infections accounted for 31.6% of the top 50% of diagnoses by volume, followed by injuries (24%) and cardiovascular cases (17%). Author discussions included a call to expand the role of prehospital providers as physician extenders.	http://www.ncbi.nlm.nih.gov/pubmed/10225648

EMS Operations				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
NHTSA Agenda	Bowron JS, Knox TH. Job Stressors and Job Satisfaction in a Major Metropolitan Public EMS Service. Prehospital and Disaster Medicine.1999; 14 (4): 236-239.	**Study Design:** Cross-Sectional Survey **Sample Size:** 90 paramedics and EMTs participated in study **Population:** Paramedics and Emergency Medical Technicians (EMTs) in the ambulance service in Atlanta, GA	Researchers wanted to identify job stressors that foresee the level of job satisfaction within prehospital personnel.	Reported global job satisfaction. Of the 90 EMT and paramedics that participated, 11% - Extremely Satisfied, 29% - Very Satisfied, 45% - Satisfying, 15% - Not Satisfying. Quality of physician interactions and the perceived quality of career choice were predictive of global satisfaction among paramedics and EMTs.	http://www.ncbi.nlm.nih.gov/pubmed/10915409
2006 IOM Report,	Macnab A, Richards J, et al. Family oriented care during pediatric inter-hospital transport. Patient Education and Counseling. 1999, 36; 247-57.	**Study Design:** Survey **Sample Size:** 100 people **Population:** British Columbia Children's Hospital transport team	The objective of this study was to ask families to rate conditions on an ambulance.	Communication/management of transport team has significant impact on ability of family to deal with situation Family oriented care is essential Families need to feel like they are in control of their children.	http://www.ncbi.nlm.nih.gov/sites/entrez /14528560
Seidel Agenda, Growing Pains IOM Report	Robertson DN. A mother's care: do we include the family when the situation is critical? Journal of Emergency Nursing. 1999, 25(3); 206-07.	**Study Design:** Case study **Sample Size:** 1 family **Population:** N/A	This case study examined the involvement of a mother in a tense medical situation.	**Purpose:** should we include family in intense medical situations? EMTs find that family members being present can be helpful	http://www.ncbi.nlm.nih.gov/pubmed /10346844
NHTSA Agenda, 2006 IOM Report, CDC Report, EMS Strategic Research Plan	Gausche M, Tadeo RE, Zane MC, et al. Out-of-hospital intravenous access: unnecessary procedures and excessive cost. Academic Emergency Medicine. 1998 Sept; 5(9):878-82.	**Study Design:** Retrospective consecutive case series **Sample Size:** 452 people	To develop criteria for out of hospital patients for saline lock (SL) and intravenous (IV) placement; examine paramedic practice for SL and IV; apply new criteria to cases; and estimate the	Criteria for IV placement included signs of shock, mandatory trauma triage or burns. Criteria for SL included chest pain, palpitations, dysrhythmia, seizure, weakness, nausea/vomiting, or trauma triage guidelines.	http://www.ncbi.nlm.nih.gov/sites/entrez /9754500

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Main Findings	Link to Abstract
		Population: Patients ages 0-101 years at Harbor-UCLA Medical Center.	over-treatment cost.	Evaluation of paramedic practice showed over-treatment in adults and under-treatment for children. Adherence to the criteria for SL and IV could result in considerable cost savings.	
2006 IOM Report, NHTSA Agenda	Pavlopoulos S, Berler A, Kyriacou E, et al. Design and Development of a Multimedia Database for Emergency Telemedicine. Technology and Health Care. 1998, 6(2-3); 101-10.	**Study Design:** N/A **Sample Size:** N/A **Population:** Users of emergency telemedicine	This article describes the benefits of implementing usage of this device into EMS systems. This instrument aids in pre-hospital patient care.	This instrument would improve the quality of pre-hospital care by allowing doctor's to provide an accurate and quick diagnosis. The technology will allow doctors to know the patient's condition and other important information prior to arrival at the hospital.	http://www.ncbi.nlm.nih.gov/sites/entrez/9839856
NHTSA Agenda	Price, Timothy G.; Goldsmith, L. Jane. Changes In Hearing Acuity In Ambulance Personnel Prehospital Emergency Care. 1998, 2(4)	**Study Design:** Retrospective medical record review. **Sample Size:** 81 **Population:** Prehospital providers from Louisville Emergency Medical Service	To determine EMTs hearing loss from occupational noise exposure and determine noise levels in an ambulance.	Negative study that did not find correlation between occupational exposure and hearing loss. Age-adjusted threshold shifted from -23 to 34. The highest recorded noise level was in transit code 3, forward cab, windows down at 84 dBA. The lowest level was stationary, patient treatment compartment at 58 dBA.	http://www.ncbi.nlm.nih.gov/pubmed /9799020
EMS Research Strategic Plan, NHTSA Agenda, 2006 IOM Report	Whiting J, Dunn K, March J, et al. EMT Knowledge of Ambulance Traffic Laws. Prehospital Emergency Care. 1998, 2(2); 136-40.	**Study Design:** 5 question survey **Sample Size:** 308 **Population:** EMTs (Emergency Medical Technicians)	The purpose of this study was to determine EMT ambulance drivers' depth of knowledge of ambulance operation (warning lights and sirens).	Results show that EMT knowledge of ambulance traffic laws is very low. Of the 5 questions on the survey, the range of correct responses to any one question ranged from 2-33%. The authors concluded that further education on ambulance traffic laws could increase safety.	http://www.ncbi.nlm.nih.gov/sites/entrez/9709334

Injury/Trauma				Appendix B Literature Review: Non Clinical Studies	
Applicable Research Agenda	**Citation**	**Study Characteristics**	**Stated Objective**	**Main Findings**	**Link to Abstract**
EMS Research Strategic Plan	Burton J, Dunn M, et al. A Statewide, prehospital emergency medical service selective patient spine immobilization protocol. The Journal of Trauma. 2006, 61(1); 161-67.	**Study Design:** Prospective collection of data **Sample Size:** 12,988 patients **Population:** patients with spine immobilization	The purpose of this article was to investigate spine immobilization procedures and the selection of patients receiving immobilization.	Decision of EMS providers to enact spinal immobilization affects treatment/transport of prehospital trauma patients Should EMS providers selectively immobilize prehospital trauma patients? Conclusion: EMS providers can evaluate prehospital trauma patients with a 4 step clinical assessment EMS providers can differentiate between patients who need to be immobilized and those who don't	http://www.ncbi.nlm.nih.gov/sites/entrez/16832265
Growing Pains IOM Report, 2006 IOM Report, Seidel Article	Jaronik J, Mikkelson P, Fales W; et al. Evaluation of prehospital use of furosemide in patients with respiratory distress. Prehospital Emergency Care. 2006; 10(2): 194-197.	**Study Design:** Retrospective chart review **Sample size:** 144 patients **Population:** Patients 18 years or older who received furosemide in the prehospital setting.	To investigate the use of furosemide in the pre-hospital setting.	Furosemide (a prehospital diuretic) is inappropriate when diagnoses didn't include congestive heart failure, pulmonary edema, IV fluid was ordered, or the brain-type natriuretic was <200. Furosemide could be harmful when diagnoses included sepsis, dehydration, pneumonia, without congestive heart failure, or a brain-type natriuretic >400. Conclusion: Furosemide is frequently used incorrectly.	http://www.ncbi.nlm.nih.gov/pubmed /16531376
EMS Research Strategic Plan	Davis DP, Peay J, Sise JM, et al. The impact of prehospital endotracheal intubation on outcome in moderate to severe traumatic brain injury. Journal of Trauma. 2005 May;58(5):933-9.	**Study Design:** Retrospective registry analysis **Sample Size:** 13,625 **Population:** Patients in the San Diego traumatic brain injury (TBI) database treated from January 1, 1987 to	Determine variables that impact TBI outcomes, primarily out of hospital intubation, through logistical regression.	A decrease in survival was observed for patients with moderate to severe TBI that received prehospital intubation, including adjustments for other clinical variables. Neural networks were developed from the study but may not be of great enough significance for use by prehospital personnel for	http://www.ncbi.nlm.nih.gov/sites/entrez/15920406

Applicable Research Agenda	Citation	Study Characteristics	Stated Objective	Main Findings	Link to Abstract
		December 31, 2003. The database includes patients with a head/neck abbreviated injury score (AIS) value of 3 or greater.		determining who would benefit from intubation. The logistical regression may not account for all variables that affect outcomes.	
NHTSA, 2006 IOM Report, EMS Research Strategic Plan, CDC Agenda	Wang HE, Peitzman AB, Cassidy LD, et al. Out-of-hospital endotracheal intubation and outcome after traumatic brain injury. Annals of Emergency Medicine. 2004 Nov; 44(5):439-50.	**Study Design:** Retrospective registry analysis **Sample Size:** 4,098 patients **Population:** Adult patients in the Pennsylvania Trauma Outcome Study with head/neck abbreviated injury score (AIS) of 3 or more that had out-of-hospital or ED endotracheal intubation that were not transferred.	To compare out-of-hospital intubation with emergency department (ED) intubation after severe traumatic brain injury (TBI) for mortality, neurological and functional outcomes.	Patients intubated in the field had a three fold increased odds of death compared to those intubated in the ED. Following adjustment for confounders, those intubated in the field had increased adjusted odds of poor neurological outcomes.	http://www.ncbi.nlm.nih.gov/pubmed/15520702
EMS Research Strategic Plan, 2006 IOM Report	Suominen P, Baillie C. Prehospitall Care and Survival of Pediatric Patients with Blunt Trauma. Journal of Pediatric Surgery. 1998, 33(9); 1388-92.	**Study Design:** N/A **Sample Size:** 121 children **Population:** 121 children (72 BLS & 49 ALS) with pediatric blunt trauma cases	This article discusses the differences in outcomes for ALS and BLS.	The article focused on a debate over whether ALS (advanced life support) should be performed on scene (especially in regards to pediatric trauma). The authors concluded that there was an improved outcome in pediatric blunt trauma cases found with ALS as compared to BLS.	http://www.ncbi.nlm.nih.gov/sites/entrez/9766360