**Appendix Table 1: Codebook**

|  |  |
| --- | --- |
| **Title** | **Description** |
| 0. Irrelevant Article | (not EMS or NO quality measures) |
| 1. Article Type | This is used to mark what type of article this is |
| * 1.1 Original Article | This is used to mark original articles that are not review articles |
| * 1.2 Review Article | This is used to mark if an article is a literature review article |
| 2. Type of Measure |  |
| * 2.1 Outcome | Outcome contains all the effects of healthcare on patients or populations, including changes to health status, behavior, or knowledge as well as patient satisfaction and health-related quality of life. |
| * 2.2 Process | Process is the sum of all actions that make up healthcare. These commonly include diagnosis, treatment, preventive care, and patient education but may be expanded to include actions taken by the patients or their families. |
| * 2.3 Structure | Structure includes all the factors that affect the context in which care is delivered. This includes the physical facility, equipment, and human resources, as well as organizational characteristics such as staff training and payment methods. |
| 3. Level of Measure | The level at which the measure describes quality. Should be coded concurrently with Existing Measure or Proposed Measure |
| * 3.1 Oversight Agency | A level above EMS agencies, perhapsmultiple agencies or any oversight structure that exists and is spoken of in the article. E.g. MCA or even a State department of health and human services. |
| * 3.2 EMS Agency | Agency level measures or recommendations. This may be an aggregate of an agencies personal or crews. |
| * 3.3 EMS Personnel | A team of EMS Personnel (2+) or an Ambulance Vehicle  Single EMS person e.g. 1 EMT or 1 Paramedic |
| * 3.4 Systems of Care | A measure of the entire system of care taken at the level of an illness or condition in a specific patient or the patient as a whole e.g. Myocardial Infarction, Patient Satisfaction not aggregated |
| 4. Proposed Measure | These are measures that were not used in the study or article OR were explicitly not uncovered by a review article. It may be described as a "gap" in quality measurement. This should be coded concurrently with '3. Level of Measure'. |
| 5. Recommendations | Recommendations regarding the measurement of EMS/EMS oversight agencies. |

# Appendix Table 2: Systematic Review Data Extraction Template

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Citation** | **Article Type** | **Measure Level(s)** | **Measure Type(s)** | **Measure(s) and Tool(s)** |
| Ailsby RL., Transportation of the Critically Ill and Injured Can Fam Physician. 1987 Jul;33:1661-4. | Original Article  Canada | Patient | Outcome | 1. Blood Loss 2. Pulse Rate |
| Aringhieri R, Carello G, Morale D. Supporting decision making to improve the performance of an Italian Emergency Medical Service. Annals of Operations Research. 2016 Jan 1;236(1):131-48. | Original Article  Italy | Agency | Process | 1. Percentage of Agency’s responses served within the LAW time. |
| Aufderheide TP, Yannopoulos D, Lick CJ, Myers B, Romig LA, Stothert JC, Barnard J, Vartanian L, Pilgrim AJ, Benditt DG. Implementing the 2005 American Heart Association Guidelines improves outcomes after out-of-hospital cardiac arrest. Heart Rhythm. 2010 Oct 31;7(10):1357-62. | Original Article  USA | Personnel  Patient  Agency | Process  Outcome | 1. Average ambulance response time, 2. Survival to hospital discharge, 3. Proper treatment protocol (Effective compression intervals, CPR timing, etc), |
| Bayley R, Weinger M, Meador S, Slovis C. Impact of ambulance crew configuration on simulated cardiac arrest resuscitation. Prehospital Emergency Care. 2008 Jan 1;12(1):62-8. | Original Article  USA | Patient  Personnel | Outcome | Cardiac Arrest Resuscitation errors:   1. Errors of omission, addition, 2. Or sequence (failure to administer drug, performance of extra defibrillation, intubation before defibrillation, etc.). |
| Bowron JS, Todd KH. Job stressors and job satisfaction in a major metropolitan public EMS service. Prehospital and disaster medicine. 1999 Dec 1;14(04):32-5. | Original Article  USA | Personnel  Agency | Structure  Process | EMS Staff (EMT and Paramedic) Reported Measures   1. Quality of training provided by ambulance service 2. Quality of interactions with hospital clinicians 3. On-line communications 4. Dispatching 5. Relationship with supervisors 6. Standing orders as presently employed by the ambulance service |
| Braun O. EMS system performance: the use of cardiac arrest timelines. Annals of emergency medicine. 1993 Jan 31;22(1):52-61. | Original Article  USA | Agency | Process | 1. Average time to treatment 2. Average time to patient |
| Cady G, Scott T. 1995 almanac. EMS in the United States. 1995 survey of providers in the 200 most populous cities. JEMS: a journal of emergency medical services. 1995 Jan;20(1):76-82. | Original Article  USA | Personnel  Agency | Process  Structure | 1. Response time, 2. Presence of QI practices, 3. Employment of Quality management Directors |
| Callaham M, Madsen CD. Relationship of timeliness of paramedic advanced life support interventions to outcome in out-of-hospital cardiac arrest treated by first responders with defibrillators. Annals of emergency medicine. 1996 May 31;27(5):638-48. | Original Article  USA | Patient  Personnel | Process  Outcome | 1. Response time 2. Survival to hospital discharge, 3. Time from medic arrival to intubation, 4. Time from medic arrival to administration o first ALS drugs, 5. Time from medic arrival to first pulse, 6. Time from first pulse to ED arrival |
| Carriere J, Bourque C. The effects of organizational communication on job satisfaction and organizational commitment in a land ambulance service and the mediating role of communication satisfaction. Career Development International. 2009 Feb 20;14(1):29-49. | Original Article  Canada | Agency  Personnel | Structure | 1. Internal Communication Practices (of agency) via Communication Audit Survey. 2. Satisfaction with internal communication via Communication Satisfaction Survey 3. Job Satisfaction (Likert) via Minnesota Satisfaction Questionnaire 4. Commitment to organization (EMS Agency) via Affective Organizational Commitment Scale. |
| Chen TT, Ma MH, Chen FJ, Hu FC, Lu YC, Chiang WC, Ko PC. The relationship between survival after out-of-hospital cardiac arrest and process measures for emergency medical service ambulance team performance. Resuscitation. 2015 Dec 31;97:55-60. | Original Article  Taiwan | Personnel  Patient | Outcome  Process  Structure | 1. Survival to discharge 2. EMS Response time 3. Pre-hospital returns of spontaneous circulation 4. Scene time 5. Time from scene arrival to scene departure 6. Transport time from arrival to hospital arrival 7. Presence of ALS-level paramedics |
| Citerio G, Galli D, Cesana GC, Bosio M, Landriscina M, Raimondi M, Rossi GP, Pesenti A. Emergency system prospective performance evaluation for cardiac arrest in Lombardia, an Italian region. Resuscitation. 2002 Dec 31;55(3):247-54. | Original Article  Italy | Personnel  Patient | Process  Outcome | 1. Interval between call and activation of ambulance 2. Interval between call and departure of the ambulance 3. Interval between call and arrival on scene of ambulance 4. Interval between call and arrival at the hospital 5. Death on scene 6. Death at ED 7. Death at hospital discharge 8. Death at 1 month |
| Coster, J, Irving A, Turner J, Siriwardena N, Wilson R., How should we measure ambulance service performance? European Journal of Emergency Medicine, 2014; 21(6): 458 | Conference proceedings  Review Article/Delphi study  United Kingdom | Agency  Personnel  Patient | Process  Outcome | 1. Time to definitive care 2. Pain score 3. Patient Survival 4. Patient Safety 5. Correct identification of call urgency 6. Patient experience 7. Proportion of ambulance service calls referred for telephone advice who recontact with ambulance service within 24h 8. Proportion of patients given analgesia who report having pain 9. Endotracheal intubation 10. Wound infection 11. Compliance with training 12. Completion of patient records 13. Time spent on scene |
| Dantas RA, Torres GD, Salvetti MD, Dantas DV, Mendonça AE. Instrument for assessing the quality of mobile emergency pre-hospital care: content validation. Revista da Escola de Enfermagem da USP. 2015 Jun;49(3):380-6. | Original Article  Brazil | Agency  Personnel | Structure  Process | Instrument of “Quality Assessment on Pre-Hospital Care (QA-PHC)”.   1. Ambulance Conservation Status 2. Physical Structure 3. Comfort in the Ambulance 4. Availability of material resources 5. User/staff safety 6. Continuous education 7. Safety demonstrated by the team 8. Access 9. Welcoming 10. Humanization 11. Response time 12. Customer privacy 13. Guidelines on care 14. Relationship between professionals and customers 15. Opportunity for customers to make complaints 16. Multi-professional conjunction/actuation. |
| Daudelin DH, Kulick ER, D’Amore K, Lutz JS, Barrientos MT, Foell K. The Massachustess Emergency Medical Service Stroke Quality Improvement Collaborative, 2009-2012. Preventing Chronic Disease 2013; 10:130126. DOI: http://10.5888/pcd10.130126 | Original Article  USA | Personnel | Process | 1. Stroke Screening Performed 2. Blood Glucose Tested 3. Time last-known-well documented 4. Time of symptom discovery documented 5. Stroke pre-notification to hospital |
| David G, Harrington SE. The quality of emergency medical services. Leonard Davis Institute of Health Economics Issue Brief. 2011 Nov;17(3):1-4. | Review Article  USA | Personnel | Process | 1. Response Time 2. Total Pre-hospital time |
| Dunford J, Domeier RM, Blackwell T, Mears G, Overton J, Rivera-Rivera EJ, Swor R. Performance measurements in emergency medical services, Prehospital Emergency Care. 2002 Jan 1;6(1):92-8. | Review Article  USA | Oversight  Agency  Patient  Personnel | Structure  Process  Outcome | 1. Facilities, 2. Equipment, 3. Provider training and knowledge base 4. Staff credentialing. 5. Multi-casualty event response plan 6. Defibrillation Capability 7. Extrication capability 8. Appropriate steps for treatment 9. Call Processing Time 10. Transport Time 11. Travel Time 12. Staffing 13. Patient Care protocol compliance 14. Survival 15. Change in physiologic status 16. Pain relief 17. Patient satisfaction 18. Deployment 19. Road Structure Coverage Capability 20. Patient Outcomes 21. Employee illness and injury 22. Employee turnover 23. Quality program 24. System user opinion |
| Dyson K, Bray J, Smith K, Bernard S, Finn J. A systematic review of the effect of emergency medical service practitioners’ experience and exposure to out-of-hospital cardiac arrest on patient survival and procedural performance. Resuscitation. 2014 Sep 30;85(9):1134-41. | Review Article  USA | Personnel  Patient | Outcome  Structure  Process | 1. Out of Hospital Cardiac Arrest Survival 2. Proper ETI Placement 3. Practitioner career experience (in general) 4. Practitioner exposure to ETI (previous experience in performing ETI) |
| Ebbs P, Middleton PM, Bonner A, Loudfoot A, Elliott P. Do clinical safety charts improve paramedic key performance indicator results? (A clinical improvement programme evaluation). Emergency medicine journal: EMJ. 2012 Jul;29(7):596-7. | Original Article  Australia | Agency | Structure  Process  Outcome | 1. Use of Clinical Safety Charts 2. Presence of education strategies: education sessions, staff-meetings, reading material. 3. Senior management and leadership engagement. 4. The percentage of emergency cases where two full sets of vital signs were recorded on the patient healthcare record. |
| El Sayed MJ. Measuring quality in emergency medical services: a review of clinical performance indicators. Emergency medicine international. 2011 Oct 15;2012. | Review Article  Lebanon | Agency  Patient  Personnel | Structure  Process  Outcome | 1. Facilities conditions 2. Equipment conditions 3. Staffing levels 4. Knowledge base of providers 5. Staff credentials 6. Presence of medical protocols. 7. Medication Administration 8. Transport to appropriate facility 9. Response times 10. Out of hospital cardiac arrest survival 11. Patient Satisfaction 12. Improvement in pain score |
| Fischer M, Kamp J, Riesgo LG, Robertson-Steel I, Overton J, Ziemann A, Krafft T, EED Group. Comparing emergency medical service systems—A project of the European Emergency Data (EED) Project. Resuscitation. 2011 Mar 31;82(3):285-93. | Original Article  USA, Germany, Spain, United Kingdom | Patient  Agency | Process  Structure  Outcome | 1. Supply of EMS Care: Unit hours of professional emergency life support available per 100,000 inhabitants. 2. Response time (% within 480 seconds) for high priority response. 3. Annual number of responses for which an EMS unit is dispatched to a perceived life-threatening emergency per 100,000 inhabitants. 4. EMS Demand: Rate of “First Hour Quintet” incidents (Cardiac arrest, severe respiratory failure, severe trauma, stroke and chest pain) per 100,000 inhabitants 5. Level of care provided by EMS system: Rate of ALS interventions (e.g. drug application, infusion, tracheal intubation, assisted ventilation) per 100,000 inhabitants. 6. Organization 7. Funding 8. Dispatch Technology 9. Provided unit hours 10. Type and number of vehicles 11. Numbers of and qualifications of EMS personal. 12. Survival Rates for conditions |
| Henderson AC. Examining policy implementation in health care: rule abidance and deviation in emergency medical services. Public Administration Review. 2013 Nov 1;73(6):799-809. | Original Article  USA | Oversight  Personnel | Process | 1. Rule Deviation 2. Rule Abidance 3. Medical Direction’s attitude towards protocol deviation and abidance by personnel. |
| Hopkins CL, Burk C, Moser S, Meersman J, Baldwin C, Youngquist ST. Implementation of Pit Crew Approach and Cardiopulmonary Resuscitation Metrics for Out‐of‐Hospital Cardiac Arrest Improves Patient Survival and Neurological Outcome. Journal of the American Heart Association. 2016 Jan 26;5(1):e002892. | Original Article  USA | Personnel  Patient | Process  Outcome | 1. Return of spontaneous circulation 2. Call to dispatch time 3. EMS response time 4. Call to defibrillation time |
| Ji R, Wang D, Liu G, Shen H, Wang Y, Li H, Schwamm LH, Wang Y. Impact of macroeconomic status on prehospital management, in-hospital care and functional outcome of acute stroke in China. Clinical Practice. 2013 Nov;10(6):701-12. | Original Article  China | Personnel | Structure  Process | 1. Transportation mode to hospital 2. Time from symptom onset to hospital arrival |
| Joyce SM, Dutkowski KL, Hynes T. Efficacy of an EMS quality improvement program in improving documentation and performance. Prehospital Emergency Care. 1997 Jan 1;1(3):140-4. | Original Article  USA | Personnel | Process | 1. Response time (Arrival-Dispatch times) 2. Scene time (Depart-arrival times) 3. Transport time (Hospital-depart times) 4. Documentation of chief Complaint 5. Documentation of mechanism of Injury 6. documentation history 7. documentation of vital signs 8. documentation of physician examination 9. protocol or standing order documented 10. protocol followed or deviation justified 11. all appropriate treatment fields completed 12. triage and transport elements 13. disposition 14. transport destination 15. outcome recorded 16. release at scene 17. appropriate signatures obtained |
| Kingsbury KJ, Natarajan MK, Forsey A, Oakes GH, Bakar-Irwin S. A Provincial Approach To Improving Stemi Care In Ontario. Canadian Journal Of Cardiology. 2014 Oct 1;30(10):S81. | Conference Proceeding  Original Article  Canada | Patient  Agency | Outcome  Process | 1. Morbidity 2. Mortality 3. Care within the recommended timeline. |
| Ko PC, Chen WJ, Lin CH, Ma MH, Lin FY. Evaluating the quality of prehospital cardiopulmonary resuscitation by reviewing automated external defibrillator records and survival for out-of-hospital witnessed arrests. Resuscitation. 2005 Feb 28;64(2):163-9. | Original Article  Taiwan | Patient | Outcome | 1. Return of spontaneous circulation 2. Survival to hospital admission |
| Krarup NH, Lassen JF, Clemmensen P, Trautner S, Hansen TM, Johnsen SP, Terkelsen CJ. Out-of-Hospital Cardiac Arrest: Differences in the Quality of Care Provided by Emergency Medical Services with Advanced Versus Basic Life Support Capabilities---a Nationwide Study. Circulation. 2014 Nov 25;130(Suppl 2):A112-. | Conference Proceeding  Original Article  Denmark | Patient  Personnel | Structure  Outcome | 1. Transthoracic impedance measurements of CPR 2. No Flow Fraction (the fraction of time during resuscitation where the patient is without circulation) 3. Return of spontaneous circulation 4. Cerebral performance category 5. ALS-capability of crew |
| Landman AB, Spatz ES, Cherlin EJ, Krumholz HM, Bradley EH, Curry LA. Hospital collaboration with emergency medical services in the care of patients with acute myocardial infarction: perspectives from key hospital staff. Annals of emergency medicine. 2013 Feb 28;61(2):185-95. | Original Article  USA | Agency | Structure | 1. Hospital respect for EMS personnel 2. Communication and coordination between hospital and EMS agencies/providers. 3. Active engagement of EMS in quality improvement processes 4. Monthly meetings to review care |
| Mackenzie CF, Hu P, Sen A, Dutton R, Seebode S, Floccare D, Scalea T. Automatic pre-hospital vital signs waveform and trend data capture fills quality management, triage and outcome prediction gaps. InAMIA Annual Symposium Proceedings 2008 (Vol. 2008, p. 318). American Medical Informatics Association. | Original Article  USA | Patient | Outcome | 1. Pulse oximeter oxygen saturation 2. Validated Heart Rate |
| Martin-Gill C, Guyette FX, Rittenberger JC. Effect of crew size on objective measures of resuscitation for out-of-hospital cardiac arrest. Prehospital Emergency Care. 2010 Jun 1;14(2):229-34. | Original Article  USA | Personnel  Patient | Process  Structure  Outcome | 1. Number of paramedics in dispatch team 2. No-flow fraction as measure of CPR effectiveness 3. Time to defibrillation 4. Time to endotracheal intubation 5. Time to establishment of intravenous access 6. Time to medication administration |
| Mears GD, Pratt D, Glickman SW, Brice JH, Glickman LT, Cabañas JG, Cairns CB. The North Carolina EMS Data System: a comprehensive integrated emergency medical services quality improvement program. Prehospital Emergency Care. 2010 Jan 1;14(1):85-94. | Original Article  USA  . | Oversight  Agency | Structure  Process | 1. Use of reporting system and related quality improvement tools. 2. Timeliness of care |
| Moody-Williams JD, Krug S, O'Connor R, Shook JE, Athey JL, Holleran RS. Practice guidelines and performance measures in emergency medical services for children. Annals of emergency medicine. 2002 Apr 30;39(4):404-12. | Review Article  USA | Patient | Process | In general, when available, guidelines are known to improve patient care. There is a lack of evidenced based practice guidelines for pediatric-specific EMS. |
| Moore L. Measuring quality and effectiveness of prehospital EMS. Prehospital Emergency Care. 1999 Jan 1;3(4):325-31. | Original Article  USA | Oversight  Agency  Personnel | Structure  Process  Outcome | 1. Job Satisfaction 2. Timeliness of Care 3. Patient Satisfaction 4. Quality of training 5. Public confidence in the system 6. Crew and equipment appearance 7. Change in complaints 8. Patient outcomes 9. Quality of calls 10. Internal satisfaction 11. Symptomatic improvement 12. Cost-effectiveness 13. Mutual aid relationships 14. Research activities 15. Vehicle safety 16. Availability of resources 17. Accuracy of 911 communications |
| Munk MD, White SD, Perry ML, Platt TE, Hardan MS, Stoy WA. Physician Medical Direction andClinical Performance at an Established Emergency Medical Services System. Prehospital Emergency Care. 2009 Jan 1;13(2):185-92. | Original  USA | Agency | Process  Outcome | 1. Chart reviews by medical directors/EMS physicians 2. Number of cases requiring remediation 3. Proportion of charts rated as clinically acceptable, 4. Proportion of misplaced endotracheal tubes 5. Appropriate administration of aspirin |
| Murphy A, Wakai A, Walsh C, Cummins F, O'Sullivan R., Development of key performance indicators for prehospital emergency care., Emerg Med J. 2016 Apr;33(4):286-92. doi: 10.1136/emermed-2015-204793. Epub 2016 Jan 21., | Review  USA | Patient  Personnel | Process  Outcome | 1. Less than 90 min transport time of patients with STEMI to PCI capable facility with an ECG 2. Rate of recording Face Arm Speech Time (FAST) test for patients with stroke 3. Rate of aspirin administration to patients with acute coronary syndrome |
| Myers JB, Slovis CM, Eckstein M, Goodloe JM, Isaacs SM, Loflin JR, Mechem CC, Richmond NJ, Pepe PE. Evidence-Based Performance Measures for Emergency Medical Services Systems: A Model for Expanded EMS Benchmarking: A Statement Developed by the 2007 Consortium US Metropolitan Municipalities' EMS Medical Directors. Prehospital Emergency Care. 2008 Jan 1;12(2):141-51. | Original Article  USA | Agency  Patient | Process  Structure  Outcome | 1. Response Time 2. Survival rate 3. Administration of condition-appropriate drugs 4. Transport time 5. Provision of appropriate medical technology |
| O'Connor RE, Megargel RE. The effect of a quality improvement feedback loop on paramedic skills, charting, and behavior. Prehospital and disaster medicine. 1994 Mar 1;9(01):35-8. | Original Article  USA | Agency | Process  Outcome | 1. Performing QI feedback loop 2. Trauma scene times 3. Charting completion 4. Resuscitation rates from cardiac arrest 5. Endotracheal intubation success rates 6. Trauma scene times |
| Olasveengen TM, Wik L, Steen PA. Quality Of Cardiopulmonary Resuscitation Before And During Transport In Out-of-hospital Cardiac Arrest. Circulation. 2007 Oct 16;116(Suppl 16):II\_928-. | Original Article  USA | Personnel | Process  Outcome | 1. Supervisor administered CPR performance evaluation 2. Rate of compression per minute |
| Olasveengen TM, Wik L, Steen PA. Quality of cardiopulmonary resuscitation before and during transport in out-of-hospital cardiac arrest. Resuscitation. 2008 Feb 29;76(2):185-90. | Original Article  USA  . | Personnel | Process | 1. Rate of compression per minute 2. Hands-off ratio during CPR performance |
| Peralta LM. The prehospital emergency care system in Mexico City: A system's performance evaluation. Prehospital and Disaster Medicine. 2006 Apr 1;21(02):104-11. | Review  Mexico | Agency  Patient | Process  Outcome | 1. Response time performance 2. Clinical quality and sophistication 3. Economic efficiency 4. Customer satisfaction |
| Pozen MW, Berezin MM, Modne L, Riggen R, Davis DD, Hood Jr WB. An assessment of emergency medical technicians' performance as related to seasonal population influx. Journal of community health. 1978 Mar 1;3(3):227-35. | Original Article  USA | Personnel | Outcome | EMT misdiagnosis rate |
| Rahman NH, Tanaka H, Do Shin S, Ng YY, Piyasuwankul T, Lin CH, Ong ME. Emergency medical services key performance measurement in Asian cities. International journal of emergency medicine. 2015 Apr 23;8(1):1. | Original Article  China, Korea, Japan | Oversight  Agency  Personnel  Patient | Structure  Process  Outcome | 1. Facilities 2. Equipment 3. Staffing 4. Provider knowledge 5. Credentials 6. Deployment 7. Response times 8. Medical protocols 9. Medication administration 10. Transport to appropriate facility 11. Out of hospital cardiac arrest survival 12. Patient satisfaction 13. Improvement in pain score |
| Schneider T, Mauer D, Diehl P, Eberle B, Dick W. Does standardized mega-code training improve the quality of pre-hospital advanced cardiac life support (ACLS)?. Resuscitation. 1995 Apr 30;29(2):129-34. | Original Article  USA | Personnel | Process | Time intervals from the arrival of the mobile intensive care unit until:   1. First ECG diagnosis 2. First defibrillation 3. Endotracheal intubation 4. First epinephrine administration |
| Schooley BL, Horan TA. Towards end-to-end government performance management: Case study of interorganizational information integration in emergency medical services (EMS). Government Information Quarterly. 2007 Oct 31;24(4):755-84. | Original Article  USA | Agency | Process  Outcome | 1. Timeliness (process) 2. Quality of care (outcome) 3. End to end performance (process) |
| Sharifi M, Baraz S, Mohammadi F, Ramezani M, Ali S, Vardanjani E. Patients perception and satisfaction of the ambulance service (115) at Shahrekord, Iran. | Original Article  Iran | Patient | Outcome | Patient satisfaction |
| Simpson N, Bartley B, Corfield AR, Hearns S. Performance measurement in British helicopter emergency medical services and Australian air medical services. Emergency Medicine Journal. 2011 Feb 3:emj-2010. | Original Article  United Kingdom and Australia | Agency  Patient | Outcome  Process | 1. Mortality data at 24 hours (most common) 2. Follow up post 24 hours (rare) 3. Physiological and/or anatomical scoring (e.g. Revised Trauma Score, Injury Severity Score, Rapid Emergency Medicine Score, Simplified Acute Physiology Score) 4. Adverse patient events 5. Use of a clinical support officer for data capture |
| Siriwardena AN, Shaw D, Donohoe R, Black S, Stephenson J. Development and pilot of clinical performance indicators for English ambulance services. Emergency Medicine Journal. 2010 Apr 1;27(4):327-31. | Original Article  United Kingdom | Agency  Patient | Outcome  Process | Stroke   1. FAST assessment recorded 2. Blood glucose recorded 3. Blood pressure recorded   STEMI   1. Asprin 2. GTN 3. Initial and final pain scores 4. Analgesia given 5. Morphine or alternate given 6. Prehospital thrombolysis   Cardiac Arrest   1. ROSC on arrival at hospital 2. Paramedic in attendance 3. Response time 4. Asthma 5. Respiratory rate recorded 6. PEFR recorded before treatment 7. SpO2 recorded 8. Beta-2 agonist given 9. Oxygen administered 10. Hypoglycemia 11. Blood glucose before and after treatment 12. Treatment for hypoglycemia recorded |
| Siriwardena AN, Shaw D, Essam N, Togher FJ, Davy Z, Spaight A, Dewey M. The effect of a national quality improvement collaborative on prehospital care for acute myocardial infarction and stroke in England. Implementation Science. 2014 Jan 23;9(1):1. | Original Article  United Kingdom | Agency  Patient | Process | Same as above.  Key strategies for improvement:   1. Local quality improvement teams in each ambulance service supported by a national coordinating group 2. Regular meetings between QI teams |
| Siu VW, Pau Y, Lok PY, Lee LL, Tang SY, Chan JT. An evaluation of compliance and performance following the introduction of the Inter-Facility Transport Triage Guideline. World journal of emergency medicine. 2011;2(2):99. | Original Article  Taiwan | Personnel | Process  Structural | 1. Pre-transport communication 2. Pre-transport triage 3. Transport team configuration 4. Equipment adequacy 5. Mode and frequency of monitoring 6. Preparation of appropriate pharmacological agents 7. Documentation 8. Handover phase |
| Stewart RD, Burgman J, Cannon GM, Paris PM. A computer-assisted quality assurance system for an emergency medical service. Annals of emergency medicine. 1985 Jan 31;14(1):25-9. | Original Article  United Kingdom | Agency | Outcome | 1. Quantity of documentation errors resulting in missing but retrievable data 2. Quantity of documentation errors resulting in permanent loss of data 3. Quantity of errors directly affecting patient care |
| Su S, Shih CL. Modeling an emergency medical services system using computer simulation. International journal of medical informatics. 2003 Dec 31;72(1):57-72. | Original Article  Taiwan | Agency | Process  Structure  Outcome | 1. Preparation time 2. Response time 3. Processing time 4. Transport time 5. Caring time 6. Departure time |
| Swor RA, Hoelzer M. A computer-assisted quality assurance audit in a multiprovider EMS system. Annals of emergency medicine. 1990 Mar 31;19(3):286-90. | Original Article  USA | Agency  Personnel | Process | 1. Runsheet completeness 2. Performance criteria 3. Compliance with protocol |
| Tobin, John; Stout, Todd. Drowing in Data, Thristing for Knowledge: The benefits of real time & near real time data feedback; JEMS; May 2015. | Review Article  USA | Personnel | Process | 1. CPR Oxygen saturation, Rate, Depth, Release, recoil, compressor fatigue, transportation, advanced airway placement, EtCO2 monitoring. 2. Dispatch time |
| Whyte BS, Ansley R. Pay for performance improves rural EMS quality: investment in prehospital care. Prehospital Emergency Care. 2008 Jan 1;12(4):495-7. | Original Article  USA | Personnel | Process  Outcome | 1. Completing run reports within three hours of completion 2. Call-to-en route times of less than 90 seconds 3. Use of aspirin in adults with non-traumatic chest pain 4. ECG performance in adults with non-traumatic chest pain 5. Documentation of pain assessment and intervention in patients with traumatic hip pain 6. Documentation of the time of onset of symptoms in stroke calls |
| Williams KA, Rose WD, Simon R, Med Teams Consortium. Teamwork in emergency medical services. Air Medical Journal. 1999 Dec 31;18(4):149-53. | Original Article  USA | Personnel | Process  Outcome | 1. Human factor errors 2. Supportive teamwork climate 3. Effective communication 4. Teamwork planning 5. Problem solving 6. Team based errors (free riding, social loafing, Ringlemann effect, risk shift, group think, Abilen paradox) |
| Youngquist S, Burk C, Reilly D, Baldwin C. The Adoption of Multiple Best Practices to Improve Out-of-Hospital Cardiac Arrest in Salt Lake City, Utah. Circulation. 2014 Nov 25;130(Suppl 2):A204-. | Conference Abstract  Original article  USA | Patient | Outcome | Cerebral performance category of patient |
| Zavada CA. Quality assurance: the effects of a prehospital data system on patient care. Journal of the American Medical Record Association. 1982 Oct;53(5):89. | Original  USA | Personnel | Process | Algorithm (Treatment Protocol) Compliance |

# Appendix 3: EMS Quality Improvement Grey Literature Resources Template and Guide

**PURPOSE OF THE RESOURCE GUIDE:** This guide provides an account of study results from the grey literature search regarding existing quality measures related to EMS and EMS oversight in the U.S.. The guide organizes the results of the search by specific identified strategies for EMS oversight and quality improvement. The resource guide includes references and guidance from national EMS advisory boards and professional associations, and federal, state, regional, and local EMS authorities. These resources can be retrieved on the Internet by inserting the name of the referenced resource into an Internet search engine (e.g., Google or Explorer).

1. **advance EMS “Systems approach” to bolster the statewide implementation and oversight of evidence-based quality improvement programming/measures**

**Innovation: System Transformation/Research/Best Practices Models**

* ***NEMSMA-EMS 3.0 Realizing the value of EMS in our Nation's Health Care Transformation (2016).*** This report provides vision and direction for EMS system transformation. It provides history of EMS, EMS value added - defines "community paramedicine" or EMS community healthcare.
* ***NHTSA-Progress of Evidence-Based Guidelines for Prehospital Emergency Care (2013).*** This report presents a federally approved quality improvement framework for EMS systems to implement evidence-based guidelines for prehospital emergency care; *Approved by the Federal Interagency Committee on EMS and the National EMS Advisory Council.*

**Oversight: State and REGIONAL System Level**

* ***NAESMSO-State Emergency Medical Services Systems: A Model (2008)*** offers policy guidance on implementing a "Systems Approach" to EMS response and evaluation. This document can be used to strategically develop and advance quality EMS system-wide benchmarks for MCAs.
* ***NAESMSO-EMS Education Agency for the Future: Systems Approach (2000)***. Provides background and makes a case for an EMS systems approach which can be used to support comprehensive educational assessment and system reform at multiple levels.
* ***NASEMSO-The Organization, Staffing and Function of State and Territorial EMS Offices (2005).*** This is a monograph of survey results from EMS state offices regarding organizational structure and staffing resources.
* ***NHTSA-EMS Agenda Implementation Guide (2010).*** This resource serves as a federally approved implementation guide for EMS systems; targeting community-based solutions for EMS.
* ***NAEMSP-White Paper: Evidence Based System Design (2011).*** This is an evidence-based medical analysis; commissioned by a local medical authority to optimize EMS system design.
* ***NHTSA-Prehospital EMS Essential Services and Public Good in Economic Theory (2014).*** This white paper positions EMS service as public health and safety commodity. It offers states guidance and discusses the key implications of this theory for EMS systems.

1. **establish network building opportunities for mcas that promotes a positive statewide quality improvement culture and incentivizes regional healthcare coalition building**

**Innovation: System Transformation/Leading Research/Best Practices Models**

* ***NAEMSP National Strategy to Promote Pre-Hospital Evidence Based Guidelines and Evaluation (2015).*** This resource provides national standards and key strategies for advancing evidence–based prehospital care practice guidelines and evaluation measures.

**Oversight: State and REGIONAL System Level**

* ***US DHHS ASPR-From Hospitals to Healthcare Coalitions Transforming Health Prepared and Response in Our Communities (2016).*** This resource provides an overview of federal programming and funding for the *Hospital Preparedness Program and Emergency Care Partnership Program.*
* ***NAESMSO-EMS Education Agency for the Future: Systems Approach (2000)***. Incorporates an EMS systems approach to support a culture of quality improvement and improved care delivery.
* ***NASEMSO-Alabama Administrative Board Emergency Medical Services Rules for Medical Direction (2016).***  These are administrative rules codifying medical direction for the State of Alabama.
* ***NASEMSO-New York State Statute S 3006. EMS Quality Improvement Program (2016).*** Information for state leadership for the development of a quality improvement program.
* ***NASEMSO-Federal Field EMS Bill Section by Section 112th Congress (2016).*** Federal leadership surrounding EMS quality, innovation and cost-effectiveness.
* **NACCHO-Road Map to Quality Improvement (2012).** This is an implementation guide and resource for promoting a statewide culture to support quality improvement.
* ***NAEMSP-Oakland County Michigan PSRO Standards System Protocols (2013).*** Recognize and showcase MCAs that have achieved a positive, systems level quality improvement culture.

1. **Adopt national quality improvement standards for mCA Oversight across varying levels of administrative and clinical Response (State Officials, Medical Directors, Paramedics, EMTs, etc.)**

**Innovation: System Transformation/Research/Best Practices Models**

* ***NAEMSP-Oakland County Michigan PSRO Standards System Protocols (2013).*** Includes system level protocols for all levels of EMS personnel developed by Oakland County’s PSRO.
* ***NAEMSP-EMS Quality Improvement Plan for Santa Clara, CA (2008).*** County level policies and procedures to include measures such as, system organizational structure, interagency relationships, education and licensing, and data collection and evaluation.

**Oversight: State and REGIONAL System Level**

* ***NEMSMA-Seven Pillars of National EMS-Officer-Competencies (2014).*** Describes the leadership knowledge and operational skill-set needed to be a successful leader within EMS. Presents principles for core competencies in EMS system management at the leadership level.
* ***NACCHO-ASTHO Quality Improvement Plan Toolkit Guidance and Resources to Assist State and Territorial Health Agencies in Developing a Quality Improvement Plan (2014).*** The following is a resource guide and toolkit for assisting state and local health department practitioners in engaging in performance improvement activities.
* ***NHTSA-ASTM Standard Practice for Emergency Medical Dispatch Management (1994).*** This resource provides national standards for emergency medical dispatch management.
* ***NHTSA-Guide for Interfacility Transfers (2016).*** This resource provides federal guidance on interagency transfers using a systems approach for interagency communication.

**Oversight: MEDICAL**

* ***NAEMSP-National Policy on Development of Position Statements and Resource Development (2014).*** Provides national policy guidance on EMS physician leadership in EMS systems.
* ***NHTSA-Medical Oversight Guidelines (2016).*** This document provides federal guidance on interfacility patient transfers by medical directors.
* ***NAEMSP-Handbook for EMS Medical Directors (2013).*** This handbook serves as a reference for establishing standards for medical director oversight.
* ***NHTSA-HRSA Guide for Preparing Medical Directors (2001).*** Federal guidelines on medical oversight.

1. **develop key strategic planning objectives and coordinate statewide planning initiatives for Continuous Quality improvement programming**

**Innovation: System Transformation/Research/Best Practices Models**

* ***NHTSA-EMS Scope of Practice Model (2014).*** Reports a vision for the future agenda of EMS. Covers history, overview of profession, licensure, and practice models. Can be used as a resource to inform quality measure development.
* ***NHTSA-National EMS Advisory Council-Guiding Principles and Core Issues in EMS System Design Systems Committee Final System Design Template (2009).*** This resource offers federal guidance on EMS system design and quality measures for EMS systems.

**Oversight: State and REGIONAL System Level**

* ***NHTSA-EMS Performance Measures for Systems and Service (2009).*** This report provides federal guidance to states on quality performance measures for EMS systems.
* ***NASEMSO\_NASEMSD Planning Emergency Medical Communication-State Level Planning Guide (1995).*** This plan focuses on factors necessary to ensure proper compatibility, interfacing, and coordination of local EMS communications within a statewide system.
* **NACCHO-ASTHO Quality Improvement Plan Toolkit Guidance and Resources to Assist State and Territorial Health Agencies in Developing a Quality Improvement Plan (2014).** This is a resource guide for quality improvement planning and evaluation in local jurisdictions.
* ***NAESMSO EMS Education Agency for the Future: Systems Approach (2000)***. Provides background and significance for an EMS systems approach which can be used to support the need for comprehensive assessment and system reform at multiple levels.
* ***NASEMSO\_NASEMSD Planning Emergency Medical Communication-Local Regional Level Planning Guide (1995)*.** Thisdocument containsspecific information and direction for use by local planners in preparing detailed second-tier local emergency medical telecommunications plans.
* ***NHTSA-Draft Manuscript for HEMS Evidence-based Guidelines (2016).*** This resource provides federal guidance for implementing evidence-based guidelines for HEMS.

1. **Adapt national, state and local resources to promote, plan, and develop a comprehensive assessment of MCA oversight and funding methodologies**

***Leadership***

**Innovation: System Transformation/Research/Best Practices Models**

* ***NAESMSO National EMS Systems Assessment Final*** **(2011)** provides a national picture of EMS in the U.S.
* ***NAESMSO EMSS: Lead Agency Model (2010).***This resource provides a model for lead agencies in organizational structure; considers governing authority, regulation, and quality measures.

**Oversight: State and REGIONAL System Level**

* ***NAESMSO-State Emergency Medical Services Systems: A Model (2008)*** provides a “Systems Approach” assessment tool for states to evaluate EMS leadership and oversight.
* ***NAESMSO EMS Leadership Development Assessment (2013)***. Provides states with a resource for assessing EMS leadership.
* ***NAESMSO EMS Systems: Legislative and Regulatory Content (2010)***. Provides states with a regulatory content guide and self-assessment for governing state law and administrative rule. This resource offers State EMS leaders and policy makers with the necessary constructs to guide the development, regulation, and administrative oversight of EMS systems.
* ***NHTSA-EMS Technology Assessment Template (2008).*** This is an assessment tool for EMS officials to evaluate technology needs of EMS systems.
* ***NHTSA-Online Assessment of System Involvement (2016).*** This is an online self-assessment tool for state EMS officials and state highway safety professionals.

**Oversight: MEDICAL**

* ***NASEMSO-National Assessment of EMS Clinical Quality Programs (2016).*** National assessment tool for clinical quality programs.

**NACCHO-Story Board Template (2016).** This PowerPoint template is a resource for engaging EMS leadership via the “storyboarding” method of documenting atypical incidents (e.g., deviations from a treatment protocols or standard EMS practices). Storyboarding is an organized way of showcasing the quality improvement process conducted by a team that is working systematically to resolve a specific problem and/or improve a given process.

***Funding***

**Oversight: State and REGIONAL System Level**

* ***NASEMSO Funding Assistance Guide: For State EMS Offices (2016).*** This guide provides state officials with information regarding multiple funding opportunities for EMS systems. This document can help identify additional funding sources for MCAs.
* ***NASEMSD Linkages of Acute Care and EMS with State and Local Prevention Programs: Status of State EMS System Funding (2004).*** This document includes anassessment of state EMS system revenue sources that support state EMS office operation and services.
* ***NASEMSO Domestic Preparedness Funding (2016).*** This report provides findings from a national survey of state EMS agencies on the use of funding for domestic preparedness.
* **The Status of EMS Funding (2016).** Survey results of state EMS offices regarding funding sources; including multi-level government and special initiative funding sources.
* ***NASEMSO-Status of State Emergency Medical Service Office Funding and Utilization of Section 402 and 408 Highway Safety Funding (2009).*** This report provides survey results of state EMS offices’ use of federal highway safety funds.

***Data Reporting and System Integration***

**Oversight: State and REGIONAL System Level**

* **NASEMSO-Incorporation of EMS Patient Care Data in State Data Linkage Programs (2012).** This document discusses state EMS data collection practices and policies, including results from a survey of state EMS offices that evaluate the extent to which EMS patient care records are linked with other record systems in the states.

***Regional Priorities***

**Oversight: State and REGIONAL System Level**

* ***NAEMSO State EMS Rural Needs Survey (2004).*** This report captures needs and priorities of rural communities through a national survey of state EMS officials.
* **NASEMSO-NOSORH EMS Leadership Education State by State Compendium: Future of Rural EMS (2015).** This report includes information regarding EMS leadership education by state. The report reveals urban and rural leadership disparities.
* ***NASEMSD Linkages of Acute Care and EMS with State and Local Prevention Programs: Part I Involvement of EMS in Bioterrorism Grant and Planning Efforts (2004).*** National survey results of planning efforts in bioterrorism and the degree of EMS integration with prevention and preparedness.
* ***NASEMSD Linkages of Acute Care and EMS with State and Local Prevention Program: Part II Status of Programmatic State EMS Involvement with Prevention Activities (2004).*** National Survey of planning efforts in state with EMS involvement in local prevention activities.

1. **Deliver Education, TRAINING, AND Credentialing to enhance quality Measures and to develop continuous quality improvement programming**

***Quality Improvement Training Resources***

**Oversight: State and REGIONAL System Level**

* ***NAESMSO-EMS Education Agency for the Future: Systems Approach (2000)***. Provides background and significance for an EMS systems approach which can be used to support the need for comprehensive educational assessment and system reform at multiple levels.
* ***EMA-National Emergency Responder Credentialing EMS Job Titles (2008).*** This document describes baseline and additional EMS criteria for the National Emergency Responder Credentialing System.
* ***NASEMSO-Training and Certification of EMS Personnel (2007).*** This is a national snap shot of training and certification practices, including distribution of personnel roles, certification periods, and national registry requirements for credentialing.
* ***NASEMSO-The Status of EMS Office Involvement in EMS Communication (2008).*** This report compiles state practices of dispatch communication using communication system narratives.

***National Education Standards and Credentialing for EMS Personnel***

**OVERSIGHT: Agency-Level**

* ***NHTSA-National EMS Educational Standards for Advanced EMT Instructional Guidelines (2009).*** This resource provides national instructional guidelines for training Advanced EMTs.
* ***NHTSA-National EMS Educational Standards for Paramedics (2009).*** This resource provides national instructional guidelines for training paramedics.

***Educational Standards***

**Oversight: State and REGIONAL System Level**

* ***NHTSA-HRSA EMT Continuing Education National Guidelines (2016).*** This resource provides national guidelines for EMS continuing education.
* ***NHTSA-Module 2: Roles and Responsibilities (2002).*** National guidance for educating EMS personnel.
* ***NEMSMA-Mental Health and Stress in EMS (2016).*** This committee report reveals the mental health and stress concerns of EMS personnel and takes a position on addressing related issues.

**OVERSIGHT: Agency-Level**

* ***NHTSA-HRSA EMT National Standard Curriculum (2016).*** This is national training curriculum for EMTs.