Continuous Quality Improvement in Emergency Medical Services: A Proposal for a Comprehensive Model

By

Jose G. Cabanas MD, FACEP

A Master’s Paper submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Public Health in the Public Health Leadership Program

Chapel Hill

2013

________________________________________

Advisor: William A. Sollecito DrPH

________________________________________

Second Reader: Jane H. Brice MD, MPH, FACEP

________________________________________ Date
Abstract

After beginning in the manufacturing industry, continuous quality improvement (CQI) practices have evolved to unprecedented applications across numerous industries, especially the field of medicine. Emergency Medical Services (EMS) is considered a fundamental component of healthcare’s safety net because it provides medical treatment and transport for patients with illnesses and injuries 24 hours a day. In 2006, the IOM published a report entitled “Emergency Medical Services at the Crossroads” that identified critical vulnerabilities for the future of EMS systems in the United States. Quality improvement was one of those areas identified where EMS lacks clear standards. Measuring quality and implementing consistent CQI programs in EMS is challenging. Based on a review of the literature as well as my experiences in the field of out-of-hospital medicine, I propose a framework for EMS systems that is built on three interrelated dimensions of CQI while recommending a comprehensive approach that EMS medical directors can launch or use to in their EMS system. These include prospective, retrospective, and concurrent CQI practices that impact patient care. Prospective CQI should include activities that promote quality through continuing medical education, sharing clinical performance, and engaging in prevention activities. For retrospective CQI, clinical teams rely on patient care records to evaluate clinical management, decision making and identify potential adverse events. Concurrent CQI includes direct review of individual clinical concerns through a defined process. The overall goal is to have a modern EMS system that better serves the community, but most importantly, provides better patient care.
Introduction

The continuous pursuit for excellence in what we do every day is the core foundation of the continuous quality improvement (CQI) movement. Across the last five decades, the CQI movement has revolutionized numerous industries around the world (Sollecito & Johnson, 2013). From manufacturing industries, to business practices, to more recently the healthcare industry, the application of CQI techniques has made a significant contribution in process improvement, reducing variability, improving industry standards, and most importantly improving the quality of the services the industry provides.

The concept of CQI began in the early twentieth century with the development of more efficient inspection methods in the manufacturing industry to ensure the quality of finished products. Its biggest momentum likely came after World War II when the Japanese manufacturing industry was facing significant issues with the quality of their products. With the implementation of robust quality-assurance methods and sound statistical analysis based on the experiences from Shewhart and Deming, Japanese industry became more efficient, dependable, and of a higher standard. These experiences became an example for other industries and created the conditions that allowed the quality improvement movement to grow and evolve until it reached the healthcare industry (Deming, 1986).

There is an underlying similarity between the practice of medicine and key principles of CQI. Both medicine and CQI require common steps: observing a phenomenon, isolating variables of interest, changing the process through intervention, and observing the results. If the results are favorable, the next area to improve is
sought. The fundamental principle is the commitment to ongoing improvement and not limiting the data analysis to a snapshot in time. On the contrary, if the results are adverse, the data analysis continues to determine the next steps for potential areas to improve.

Quality improvement is not a new concept in healthcare. The infancy of CQI in medicine can be traced to the Crimean War of 1854 when Florence Nightingale found a relationship between hospital sanitation practices and mortality rates among injured soldiers (L. McDonald, 2001). However, its modern application in medicine came in the 1950s after the successful experience of the manufacturing industry. Quality improvement gained more attention in the hospital sector when several physicians organizations came together to create a volunteer accreditation process for institutions by adopting the recommendations that Avedis Donabedian presented in his landmark publication *Evaluating the Quality of Medical Care* (Donabedian, 2005). In this publication Donabedian presented the structure-process-outcomes model as a framework for healthcare quality. He believed quality had three main domains: who provides care (structure); how care is provided (process); and the impact of care provided (outcomes). This model was applied in hospital settings across the country and became a foundation for quality improvement in health care.

Besides Donabedian, other great scholars like Shewhart and Deming had a significant impact on the development of CQI in the healthcare industry. Shewhart is credited with the Plan-Do-Study-Act model (PDSA) for improvement practices (Shewhart, 1931). The cycle offers a systematic approach for implementation of new initiatives. Often the desired improvement is not achieved in one cycle, so the process is
continuously repeated until the desired improvement is achieved. Similarly, Deming made enormous contributions to the development of CQI with his well-known 14-program recommendations that focus on management to improve quality (Deming, 1993). His main concern was always process rather than organizational structures. He believed in the need for objective data make good management decisions. Deming believed in a top-down approach to CQI because management had the final responsibility for quality in an organization. This philosophy has significant implications in the healthcare industry where professionals must work together across boundaries to ensure a high-quality outcome.

Given the pressures to increase quality and lower cost, CQI is widely considered an important component of modern health care as it gains more acceptance in the industry. The application of CQI concepts in the daily practice of medicine has gained momentum and acceptance during the last decade, especially in the era of healthcare reform where quality will be linked to reimbursement models utilizing a more patient-centered approach. The emphasis on regionalization of care demands both quality improvement and quality assurance not only because of healthcare economics but also because of public demands and expectations for excellence, including efficiency in processes (Glickman et al., 2010). Numerous regulatory agencies like The Joint Commission of Accreditation of Health Care Organizations (TJC) continue to expand the role of CQI in their accreditation standards and procedures with a particular emphasis on improving clinical processes and patient safety. This has led to an increased demand for effective methodologies that focus on continuous improvement practices while decreasing costs.
The publication of two landmark Institute of Medicine (IOM) reports in 1999 and 2001 brought national attention to the critical need for a more consistent application of CQI in health care. Both reports came under the domain of patient safety, which caught the attention of thousands of healthcare professionals and hospital administrators throughout the US. The first report, “To Err Is Human” (2000), magnified the safety gaps in the healthcare system, noting that approximately 98,000 people die every year due to avoidable medical errors (Institute of Medicine, National Academy of Sciences, 2000). The second report, “Crossing the Quality Chasm” (2001), had a broader view of the delivery of healthcare services in the US but still indicated the healthcare system was failing to provide “consistent, high-quality medical care to all people” (Institute of Medicine, National Academy of Sciences, 2001). Both reports drew attention across medical specialties and caused unexpected reactions within the walls of the house of medicine through editorials in high impact journals that questioned the validity of the data presented in the IOM's reports (C. J. McDonald, Weiner, & Hui, 2000).

Given that these published reports created a significant momentum, the IOM’s definition of quality—“The extent to which health services increase the likelihood of desired health outcomes and are consistent with current professional knowledge” (Institute of Medicine, National Academy of Sciences, 2001)—brings together six crucial “aims” to provide a framework for improving the delivery of care (Figure 1). Any CQI program must keep these aims in perspective when creating a quality improvement initiative within the system, with the ultimate goal of improving patient outcomes.
Despite increasing acceptance in medicine over the last decade, CQI still lacks a consistent presence in certain domains of medicine including out-of-hospital medicine. Successful CQI programs have focused on processes rather than individuals with the goal of minimizing variation to improve outcomes. It is just not a methodology to study or criticize clinical performance, but instead it is a philosophy that promotes a commitment to ongoing improvement. Unlike quality assurance, which focuses on identifying and remedying individual problems, CQI focuses on the overall system first by examining all involved system processes that have an impact on the desired clinical outcome (Kelly, 2003).

**The Role of Emergency Medical Services (EMS) in Health Care**

In order to understand the application of CQI principles in EMS systems, it is first important to understand the fundamental role of EMS in the healthcare system. Historically, EMS was developed to manage two key critical conditions: trauma and cardiac arrest (Institute of Medicine, National Academy of Sciences, 1966; Pantridge & Geddes, 1967). However, its role in medicine has evolved over the past 30 years.
Many consider EMS to be an extension of emergency medical care into the prehospital setting (Eisenberg, Bergner, & Hallstrom, 1980; Eisenberg, 1997) while others believe it provides access to unscheduled health care in an alternative way. For these reasons, EMS is considered a fundamental component of healthcare’s safety net. EMS is characterized by providing medical treatment and transport to definitive care for patients with illnesses and injuries. Regardless of regional variations in EMS across jurisdictions, ongoing and frequent requests for emergency medical assistance are received at 9-1-1 emergency dispatch centers around the country. With a common characteristic of dedication for public service, EMS providers attend patients 24 hours a day in dynamic and challenging environments. For instance, first medical contact starts when a trained tele-communicator provides initial treatment instructions over the phone while dispatching all the necessary resources to the patient’s location. Once at the scene, pre-hospital providers must conduct a clinical decision process to determine each patient’s immediate needs and establish a treatment plan, which sometimes must be rapid for time-dependent emergencies (see Figure 2).

In 2006, the IOM published a report entitled “Emergency Medical Services at the Crossroads” (Institute of Medicine, National Academy of Sciences, 2006) that identified critical vulnerabilities for the future of EMS systems in the US. Quality improvement was one of those areas identified where EMS lacks clear quality standards. In part, this is due to the gap of knowledge in some areas of out-of-hospital care and lack of clear performance measures. Therefore, building evidenced-based clinical performance measures within a strong CQI program is a high priority for EMS systems.
The practice of out-of-hospital medicine is a field that interfaces with multiple domains within the healthcare system, and also represents an area of high risk for medical errors and adverse events with numerous opportunities for performance improvement and process redesign. In this paper, I provide an overall review of fundamental CQI concepts, discuss its potential application to the practice of out-of-hospital medicine, and recommend a comprehensive framework for EMS agencies to implement locally.

**Methodology for Literature Review**

I completed a comprehensive search of the literature on January 2013 using different search strategies in Medline, Google Scholar, and the Cochrane database. In addition to the literature search, I also hand-searched references of review articles, key chapters on EMS, and quality improvement textbooks. I also visited websites of key federal agencies that have an oversight role in health care and consulted with content experts to make sure we did not miss important reference material for this paper. All material utilized for this paper is referenced at the end of the manuscript.
Key Words for Literature Search

- Continuous quality improvement
- Performance improvement
- Out-of hospital
- Evidenced-based measures
- Performance measures
- Emergency medical services
- Patient safety
- Medication errors

Discussion

The Quality Improvement Movement in EMS

Traditionally the public’s expectations in 9-1-1 emergency situations, regardless of true time-dependency in a clinical condition, have been based on how quickly pre-hospital responders arrive and attend to their family members as a surrogate measure for quality care. Response time analyses on time-dependent conditions provide an important description of the interrelationship between operational and clinical performance. However, this only represents one component of emergency medical care which is not sufficient to demonstrate the overall delivery of quality care.

EMS agencies have embraced CQI over the last 20 years as part of their daily operations, but significant challenges with implementation into standard practice remain. Since 1991, the National Association EMS Physicians (NAEMSP) has promoted quality assurance practices as part of the core duties of EMS medical directors (Alonso-Serra, Blanton, & O'Connor, 1998). This same organization created a quality management textbook in 1994, which presented what was then a relatively new topic for EMS medical directors and its potential for application (Swor, 1994). In the 1996 landmark publication EMS Agenda for the Future, NHTSA defined key attributes for an EMS CQI program including the need for better and reliable data systems.
The Information Systems section states, “that the lack of organized information systems that produce data which are valid, reliable, and accurate is a significant barrier to coordinating EMS system evaluation, including outcomes analysis” (Delbridge et al., 1998; National Highway Traffic Safety Administration., 1996). Since that time, national EMS organizations and industry leaders have embraced CQI process and assessment tools, including the development of educational offerings on these topics at important scientific meetings and the publication of key consensus and position statements (Dunford et al., 2002).

Much has been changed, but more stayed the same until the 2006 report from the IOM. The report brought significant national attention because it described the state of EMS clinical performance and accountability with the following language: “Accountability has failed to take hold in EMS systems because responsibility is dispersed across many different components of the system; thus it is difficult for policy makers to determine when a system breakdown occurs, much less where it is located or how it can be adequately addressed” (Institute of Medicine, National Academy of Sciences, 2006). Since then, an evolving body of peer-reviewed literature on these topics is making its way to clinical practice in EMS (Cairns & Glickman, 2012; El Sayed, 2012; Glickman et al., 2012; Heffner, Pearson, Nussbaum, & Jones, 2012; Myers et al., 2008). Significant progress has been made by moving forward recommendations from the IOM, including the creation of better data structures at the national level to better measure performance and building more robust regional systems of care for time-dependent conditions.
The EMS Medical Director’s Role and Potential Challenges

Medical direction is a vital component for any EMS system because EMS physicians have the fiduciary responsibility to oversee medical care in the community assuring it is safe and effective. This responsibility exists at many levels and includes: defining the clinical practice for the community through the development of clinical standards, directing the educational content for EMS providers, and building a strong clinical team that collaborates to continuously improve performance throughout the systems. The medical director also interfaces with stakeholders in the healthcare system to implement innovative strategies and serves in advocacy roles for the patient, the EMS system, and the community.

Besides providing clinical leadership for the EMS system, medical directors must promote an environment that fosters and cultivates the value of teamwork within a system that has complex processes of care and delivers critical medical services. A close working relationship between field providers, management, and the clinical leadership team is critical to ensure a clear understanding of roles and responsibilities while maintaining a unified message across the system. Although we acknowledge teamwork is a vital component of pre-hospital care, CQI still lacks utilization of this concept. By having a team working together with a sense of purpose, all providers are empowered rather than just the clinical leadership in the system.

Medical direction plays a role in the implementation of an effective CQI program which goes beyond being the leading clinical expert for the system. By articulating a clear vision and a clinical plan for the EMS system (Figure 3), the field providers display a sense of where the system is going and what will be accomplished. Deming called this
a “constancy of purpose” (Deming, 1993). This is a vital to foster an environment that values continuous improvement within its organizational culture. This has been referred to by various authors as a “culture of excellence” (Sollecito & Johnson, 2013).

From an overall systems perspective, a key challenge is that EMS medical directors come from a wide range of backgrounds. Many are emergency physicians who have had some exposure to EMS activities during training; some come from other specialties with or without previous exposure to EMS. This is a unique challenge given the potential variability in knowledge and experience on CQI and its application in the practice of pre-hospital medicine. In order to have an effective CQI program, EMS medical directors must recognize first the value of CQI practices before they can embrace a commitment toward implementing these practices in the EMS system.

The Austin/Travis County EMS System will be nationally known for continuously striving to:

- Utilize the latest clinical evidence to provide innovative OOH care to our community,
- Create a patient centric, safety oriented environment for both patients & providers,
- Provide meaningful contributions to the advancement of the practice & science of prehospital medicine.

*Figure 3. The medical director’s vision for the Austin/Travis County EMS system.*

Another potential challenge with applying CQI practices in EMS is the possibility of a disconnect between ongoing performance-improvement activities and the established vision from the clinical leadership for the system. Most EMS medical directors do not build a performance-improvement program from the beginning; rather, they may inherit operational procedures that are more focused on a disciplinary process
rather than a performance-improvement culture. Also, they may inherit a CQI process that may not reflect their own philosophical visions for the system's clinical practice.

Besides all the previously discussed potential challenges faced by EMS systems, organizational culture is perhaps the most important challenge of all because it is what keeps a CQI program functional. It is important for quality organizations to promote a culture that brings the system together by establishing core values that are patient-centered utilizing system-based thinking. This requires the system's leadership to focus more on investing in their personnel because it is their most valuable asset.

Besides having clear direction from the clinical leadership, it is also important for medical directors to cultivate a culture that promotes collaboration within and across organizational boundaries that represent the EMS system. Despite the importance of teamwork in emergency medical care, very little is known about how well EMS teams work together, what improves or derails teamwork, and what the implications are for conflict between field providers, especially across multiple levels of certification. Patterson and colleagues recently developed a tool to measure effective teamwork in EMS teams (Patterson et al., 2012). They designed a survey tool study which addressed team leadership, partner communication, trust, adaptability, and conflict. This tool could provide valuable information to better understand the potential impact of teamwork on clinical performance.

Having a leadership team with the right managerial style is essential for long-term sustainability and success. The leadership team needs to promote a culture that seeks to find systemic reasons for clinical errors and less-than-optimal performance. This includes communicating a message that reflects the core principle of mutual trust
and the fundamental objective of improving a process rather than placing blame on individuals. This is particularly critical to build a patient safety culture throughout the system so providers feel comfortable self-reporting potential clinical issues without being afraid of an adverse impact on their careers.

One aspect of EMS system design that can impact organizational culture and that medical directors must take into consideration is the historical-rank command structure. Most EMS systems can be integrated by several public safety agencies including the fire department and EMS agencies. These entities have a solid disciplinary foundation that focuses on a traditional public-safety rank structure, which can influence CQI initiatives because individuals may be afraid of losing their employment. Therefore, the clinical leadership team must be consistent and emphasize that the ultimate goal of an effective CQI program in a modern EMS system is to have better EMS personnel, a better service to the community, and most importantly, better patient care.

**Clinical Performance for High-Impact Clinical Conditions**

Establishing a comprehensive CQI program can be an overwhelming task; therefore, EMS systems must be prepared to start with small incremental changes as part of a comprehensive plan that is linked to the clinical mission for the system. One potential strategy to start building a CQI program is to focus first on high-impact clinical conditions that define the practice of out-of-hospital medicine (Bradley et al., 2010; Christenson et al., 2009; Sasser et al., 2012; Wang, Mann, Mears, Jacobson, & Yealy, 2011; Williams, Finn, Perkins, & Jacobs, 2013) and are evidenced-based (Figure 4).
EMS clinicians should not only look at clinical outcomes; they need to also look at potential harms avoided as a benefit from the intervention in the field. This approach must be accompanied by efforts towards building a culture that promotes continuous improvement and a plan to disseminate the information across the system and the community.

<table>
<thead>
<tr>
<th>Clinical condition</th>
<th>STEMI</th>
<th>Pulmonary Edema</th>
<th>Asthma</th>
<th>Seizure</th>
<th>Trauma</th>
<th>Cardiac Arrest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicators or bundle elements</td>
<td>(1) ASA (2) 12-lead ECG (3) Direct transport to PCI interval from ECG to balloon &lt;90 minutes</td>
<td>(1) Nitroglycerin (2) Noninvasive positive pressure ventilation</td>
<td>(1) β2 agonist</td>
<td>(1) BGL (2) BZD</td>
<td>(1) Entrapment time &lt;10 minutes (2) transport to trauma center</td>
<td>(1) Response interval &lt;5 min for basic CPR and (AEDs)</td>
</tr>
<tr>
<td>Outcome</td>
<td>NNT = 15 Harm avoided: A stroke, 2nd myocardial infarction, or death</td>
<td>NNT = 6 Harm avoided: need for an endotracheal intubation</td>
<td>Not Specified</td>
<td>NNT = 4 Harm avoided: persistent seizure activity</td>
<td>NNT = 3 or 11 depending on criteria used Harm avoided: one death</td>
<td>NNT = 8 Harm avoided: one death</td>
</tr>
</tbody>
</table>

Figure 4. Evidenced-based practices in out-of-hospital medicine (Myers et al., 2008)

In many EMS systems, the perception of quality service has been dependent on response-time intervals and resuscitation rates for victims of cardiac arrest (Blackwell, Kline, Willis, & Hicks, 2009; Khalifah Al-Shaqsi, 2010; Myers et al., 2008). These historical metrics remain the primary measures of EMS system performance and quality standards because of institutional memory and inability to capture more granular clinical data. EMS agencies provide patient care for many conditions, of which cardiac arrest represents only 1% to 2% of all emergency calls (Myers et al., 2008; Nichol et al., 2008). This is powerful data that EMS shares with policymakers, given the expectations in the community are for cardiac arrest victims to survive. However, this is a narrow
view of clinical performance considering all the clinical emergencies EMS attends on a
daily basis, and caution should be taken to not focus on just achieving a measure to
comply with the expectations from management. Deming offered fourteen key principles
to transform organizations by making them more effective. One of his recommendations
was to eliminate the need for numerical quotas or management goals as a measure for
quality. Rather, organizations should target leadership that focuses on learning,
embracing, and implementing methods for improvement (Deming, 1993).

Therefore, new and effective clinical performance measures as part of a
comprehensive CQI plan are needed. The 2007 US Metropolitan Municipalities EMS
Medical Directors Consortium published a position statement which lays out a
multifactorial model for EMS system performance measurements (Myers et al., 2008).
This should serve as a working template. Simple measures allow for the clinical
leadership team to communicate the value of the system with nonclinical stakeholders
like public officials or community members in an understandable format. It also allows
for the development of specific educational content based on clinical data while
providers view the impact of their work.

One of the necessary components is a reliable data system that records clinical
performance but also, most importantly, reflects the clinical decision-making process.
For the last decade, there have been significant advances in defining standards for
electronic patient care records (Dawson, 2006; G. Mears, Glickman, Moore, & Cairns,
2009; G. D. Mears et al., 2010). Until recently, most EMS services across the country
relied on standard paper charts to document patient care, and all quality improvement
initiatives relied on manual retrospective reviews of paper patient care reports that
contain limited and variable information. Data collection through electronic data capture systems utilizing tablets can simplify this method while also providing a more consistent process for documenting clinical and operational data.

Given that less than optimal performance may be related to clinical decision making rather than process issues, it is important for the clinical leadership team to clearly communicate expectations to all practitioners in the system. Most systems rely on a retrospective analysis of patient care records after the fact to teach providers on specific findings without looking for common root-causes. This is a limited analysis of clinical performance and neither reflects total patient care nor predicts future performance.

In order to expand a CQI function, it is important to lay out a clinical vision for the system in a process that includes participation by EMS personnel. Field providers should have the opportunity to participate with the quality improvement team in the development of new quality initiatives. This promotes teamwork and collaboration with the clinical leadership team by allowing everyone to work together towards a clear goal. Gwande’s work in the implementation of surgical safety checklists is a great example that shows how a quality initiative was accepted as a result of effective teamwork during the development of a safety initiative (Gawande, 2009).

**CQI Framework for EMS**

EMS agencies have started to slowly embrace CQI as part of their daily operations (Dunford et al., 2002; El Sayed, 2012). The CQI process should include prospective, retrospective, and concurrent review of all aspects of the system that potentially impact patient care. These aspects include, but are not limited to, system
design and resource deployment, clinical performance, provider education, equipment implementation, response intervals, patient outcome, patient and provider satisfaction, patient and provider safety, and participation in EMS benchmarking activities. Figure 5 summarizes the interrelationship between the components of a CQI process for EMS systems.

One aspect that requires particular attention in the CQI model for EMS is the monitoring and detection of clinical adverse events. Philip Crosby, one of the giants of quality improvement, advocated for a greater emphasis on prevention as a measure of quality. He stated, “The performance standard must be zero defects” (Crosby, 1979). Clinical adverse events represent the greatest area of vulnerability for EMS services (Bigham et al., 2011; Fairbanks et al., 2008). More emphasis is required to prevent unnecessary risk or potential harms. There is a lack of standardized data collection processes and uniform reporting mechanisms for adverse events in prehospital medicine (Bigham et al., 2011).
Patient safety can be evaluated prospectively or retrospectively. In the retrospective model, an adverse event is identified through reporting or ideally through a system-wide surveillance process. Once detected, the performance-improvement team should analyze the event to take proper actions and prevent a recurrence. Most systems study adverse events in a reactive mode without knowing all the potential causal factors that lead to the event (Grayson & Gandy, 2012). Therefore, some systems continue to face similar adverse clinical events. On the contrary, a proactive approach would focus on studying weak processes that have an unacceptable level of risk for patients having an adverse event under the care of EMS personnel, thereby preventing the event. I propose a framework for EMS systems that is built on three interrelated dimensions of CQI.

**Prospective CQI.**

Prospective CQI includes various activities that promote quality patient care through continuing medical education, a credentialing process for new trainees, face-to-face meetings for in-service reviews, sharing clinical performance, and engaging in prevention activities. All of these processes are essential in maintaining a patient-centered EMS system that focuses on quality. However, this can sometimes become an overwhelming task for clinical leaders, given the broad scope of medical services that EMS provides on a daily basis. Therefore, clear direction and focus is important in order to be effective, especially when implementing changes across the system.

Given that EMS interacts with numerous stakeholders, it is important to communicate clinical performance to the community, including healthcare partners and policymakers. This can be accomplished by applying clinical performance measures
that center on high-impact clinical conditions utilizing process and outcome metrics. Process measures seek to evaluate the key steps EMS providers perform to produce a desirable clinical outcome, while outcome measures reflect the effect of clinical interventions in the field. These data can help drive clinical behaviors across the system to minimize variation while communicating the value of out-of-hospital interventions. A list of potential clinical performance indicators is listed in Figure 6.

One aspect of prospective performance management is to link clinical outcomes with evidence-based practices to improve patient care by utilizing effective clinical interventions. Even though evidenced-based medicine is not a new concept, its potential in out-of-hospital medicine is unrealized (Jensen, Petrie, Travers, & PEP Project Team, 2009). For the past decade, EMS has seen an exponential increase in quality clinical research literature. EMS clinical teams are now becoming more familiar with clinical effectiveness measures like number needed to treat (NNT) to better comprehend the impact of particular interventions. For example, EMS systems commonly use noninvasive ventilation as part of a standard treatment strategy for patients with acute congestive heart failure. The literature clearly shows this therapy reduces the need for intubation with an NNT = 6 (Williams et al., 2013). Therefore, this intervention reduces the potential harm of intubation, which is a risky procedure with potential comorbidities and complications. Therefore, CQI teams should also examine harms avoided as part of prospective clinical performance.

Customer satisfaction is another area that deserves particular attention as part of prospective CQI. Several studies have identified common areas of patient dissatisfaction with EMS (Colwell, Pons, & Pi, 2003; Persse, Jarvis, Corpening, &
Harris, 2004; Risavi, Buzzard, & Heile, 2013). The identification of areas of dissatisfaction will allow focused performance improvement programs directed at customer service and risk management (Colwell et al., 2003). From a quality improvement perspective, patient satisfaction is one aspect of ED care that sometimes lacks attention from clinicians. As part of my practicum experience, I developed a survey instrument for ED discharge telephone follow-up as part of an ongoing quality improvement initiative to improve patient satisfaction. EMS customer satisfaction could be assessed using telephone-survey methods as part of a prospective CQI process.

- STEMI Scene Time
- Stroke Scene Time
- Trauma Scene Time
- BGL in Altered Mental Status
- BGL in Seizure
- Aspirin administration in ACS
- Cardiac Arrest Survival Rates

*Figure 6.* Potential list of EMS clinical performance indicators.

**Retrospective CQI.**

This domain relies on patient care records to evaluate medical care provided by field personnel. Chart audits are useful to evaluate clinical management, decision making, protocol compliance, and adherence to documentation standards. Chart audits also provide an opportunity for the clinical leadership team to identify potential adverse events that may not have been reported through the system-defined process. However, this is one of multiple data sources that CQI programs should utilize to identify areas for improvement.
Some EMS services focus exclusively on retrospective chart reviews as their main component of a quality improvement program, which has limitations because it is based solely on what has been documented by providers. Although chart audits can be useful for a particular function or project, they can also provide a narrow perspective on quality. Therefore, the clinical leadership team must have a clear methodological approach to minimize bias and inaccurate analysis and to avoid reflecting solely the opinion of the reviewer. Also in order to be effective, it is important to have pre-established criteria with which charts will be reviewed for the process to be feasible and sustainable. For example, a small rural EMS system can review every patient care record, unlike a busy urban system where reviewing every record is not a manageable task.

The EMS clinical leadership team must define what they are seeking to accomplish by reviewing patient care records. This may be part of a quality improvement intervention, project, or initiative. For EMS systems, clinical audits can be useful for high-risk low-frequency clinical events to evaluate performance across the system but also at the individual provider level. Most of these are critical clinical interventions where adherence to clinical guidelines is essential. The information gathered can be utilized to develop new education strategies to assure competency in these critical skills.

One of the opportunities most commonly missed by quality improvement teams is recognizing and reinforcing good practices. Clinical audits not only provide an opportunity to identify areas for improvement, but they also allow the chance to reward
good clinical behavior. A list of potential clinical audits for EMS systems is listed in Figure 7.

<table>
<thead>
<tr>
<th>Individual Audit</th>
</tr>
</thead>
<tbody>
<tr>
<td># of advanced airway attempts / mos or year</td>
</tr>
<tr>
<td># of successful advanced airways managed / mos or year</td>
</tr>
<tr>
<td># of practice advanced airways (training)</td>
</tr>
<tr>
<td># of nasal intubations every mos</td>
</tr>
<tr>
<td># of oral intubations every mos</td>
</tr>
<tr>
<td># of surgical airways every 3 mos</td>
</tr>
<tr>
<td># of CPAP cases every mos</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System Audits</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Successful managed advanced airway rate (by technique)</td>
</tr>
<tr>
<td>% Reported esophageal intubations and % misplaced non-esophageal</td>
</tr>
<tr>
<td>% ETCO2 used</td>
</tr>
<tr>
<td>% of EMS witnessed cardiac arrest</td>
</tr>
</tbody>
</table>

**Figure 7.** List of clinical audits for low-frequency/high-risk events.

**Concurrent CQI.**

Concurrent CQI occurs during real-time activities that evaluate the quality of patient care. One is when the quality improvement team including, the medical director, engages in direct field response to observe personnel during patient care activities. This allows the clinical leadership team to better understand potential challenges that providers face in the field. It also allows the medical director to see how clinical protocols are implemented and to detect opportunities for improvement. Direct observation is a valuable strategy to better understand the quality of medical services.

Direct review of specific clinical concerns through a defined process is another form of real-time CQI. Like other patient-centered organizations, EMS systems must have a mechanism for clinical personnel to report concerns about less than optimal performance. This review should focus on understanding system issues rather than
individuals so providers can buy-in and feel they are part of the improvement process without conveying blame. For significant clinical issues like sentinel events, the clinical leadership should utilize root-cause analysis methods to identify causal factors that can be addressed through process redesign and education to improve clinical performance.

**Patient Safety as a Dimension of CQI**

EMS Systems must maintain a commitment to patient safety at all levels, from frontline personnel to the leadership team, as part of a comprehensive CQI plan. A culture of safety is an essential component of preventing or reducing errors and improving overall health care quality (AHRQ Patient Safety Network, 2012). Preventable harm from emergency medical care has been gaining more attention in EMS during the last decade (Bigham et al., 2011; Brice & Daniel Patterson, 2012; Institute of Medicine, National Academy of Sciences, 2006; McCallion, 2007; Moore, 1999). Specifically, it has gained more momentum with the publication of several key publications (Bigham et al., 2012; Brice et al., 2012; Weaver, Wang, Fairbanks, & Patterson, 2012). In particular, Bigham and colleagues recently published a comprehensive systematic review analyzing patient safety threats in the out-of-hospital setting (Bigham et al., 2012). They found a lack of literature on patient safety, especially the need to better understand the scope of the problem in the industry and the lack of interventions that may be applicable to the out-of-hospital setting. Some of the areas identified as requiring further study include adverse events, clinical decision making, and understanding of errors.
Medication errors.

The immediate need for life-saving medications can often tragically encounter a drastic error in administration. These incidents, such as giving the wrong dosage or the wrong medication, can expose the patient to unintended harm. Because the consequences of a medication error can be severe and so immediate, there is often no time to intervene before they occur. EMS systems must build a process to identify and classify medication errors and build a culture that promotes self-reporting. These events errors must be treated differently from operational errors because they are typically multifactorial and require revisions of clinical the process.

Case example

A young patient with a known ingestion of methadone due to suicidal intentions was found with minimal breathing. The EMS providers on scene administered 0.3 mg of naloxone (reversal agent); protocol states 2 mg should be administered in these situations. Given that providers administered a small dose, there was no clinical effect, and the paramedics proceeded to administered medications for intubation and placement of an advanced airway. Once in the hospital, the patient received a full dose of naloxone, woke up, and was extubated. The correct dose of naloxone would have prevented an unnecessary risky procedure.

This case shows a typical clinical situation that paramedics encounter on a regular basis in the field. They have to make rapid decisions while providing emergency care. Some of the factors related to medication incidents are technical, environmental, or knowledge-based. Another potential common factor is poor packaging design for medication vials. In this case, there seemed to be a skill-based slip due to confusion
with the needed dosage. A potential performance improvement intervention could be the introduction of a checklist to serve as a cognitive aid and standardize the process.

**Future Implications**

The practice of out-of-hospital medicine is evolving rapidly, and its future looks promising. Rapid changes are occurring in the industry, including the development of new areas of focus that have been traditionally outside the scope of EMS providers. This occurs out of necessity to have a more integrated and effective healthcare system in a time when growing healthcare cost continues to be an ongoing issue for communities across the country. EMS will need to integrate more with healthcare networks due to the increased demand for higher quality and more service with less financial resources. Multiple studies show that a small proportion of patients with chronic conditions, including asthma, renal failure, chronic pulmonary disease, hypertension, congestive heart failure, (Miller et al., 2013; Reinius et al., 2012) and mental health and substance abuse, consume a significant number of available healthcare dollars (Reinius et al., 2012). In part, this is related to the numerous hurdles that patients encounter when navigating the healthcare network to gain access to primary or specialty services once they are discharged from the emergency department. In the future, EMS will play a crucial role in helping these patients navigate local healthcare resources and in helping manage treatment plans for this population. EMS will need to use CQI practices to effectively implement all the future programs that will be part of its practice.
Conclusion

EMS systems continue to expand the role of CQI activities in their day-to-day functions. Although there are numerous challenges ahead, much progress has been made, especially in the domain of patient safety. EMS CQI activities should include prospective, retrospective, and concurrent review of all aspects of the EMS system that potentially impact patient care. It should also include the creation of educational curriculums to teach prehospital providers about quality improvement.

EMS medical directors should be prepared to lead their organizations in the new world of healthcare, where performance and CQI principles will play a crucial role in the practice of medicine and are linked to new reimbursement models that will expand the traditional role of EMS systems.

These aspects include, but are not limited to, system design and resource deployment, clinical performance, provider education, equipment implementation, response intervals, and patient outcomes. Using team approaches to modify practices, train personnel, and implement new initiatives will be an important step to building systems of care with a focus on CQI. The overall goal is to have a modern EMS system that better serves the community, but most importantly, provides better patient care.
References


tachycardia: Observations from the resuscitation outcomes consortium.


doi:10.1016/j.annemergmed.2012.05.031; 10.1016/j.annemergmed.2012.05.031

doi:10.1161/CIRCULATIONAHA.109.852202; 10.1161/CIRCULATIONAHA.109.852202


Grayson, S., & Gandy, W. E. (2012). Fatal mistakes in prehospital medicine. The laryngoscope, the syringe and the ink pen can all cause great harm. *EMS World, 41*(10), 28, 30, 32 passim.


Risavi, B. L., Buzzard, E., & Heile, C. J. (2013). Analysis of complaints in a rural emergency medical service system. *Prehospital and Disaster Medicine, 28*(2), 184-186. doi:10.1017/S1049023X1300046; 10.1017/S1049023X13000046


Emergency Care : Official Journal of the National Association of EMS Physicians and the National Association of State EMS Directors, 16(1), 43-52.
