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Date: November 25, 2019

To: EMS Distribution List

From: Tammi McConnell, MSN, RN
EMS Director

Subject: Distribution of 2019 American College of Surgeons Trauma System Consultation Report

Please find attached the American College of Surgeons (ACS) Final Report on the Orange County Trauma System. A multi-disciplinary review team consisting of Trauma Surgeons, Emergency Physicians, Trauma Program Managers and Technical Advisors conducted a comprehensive assessment of the Trauma System. This included an on-site review in which many stakeholders attended and participated, providing the evaluation team with valuable insights. Using the Health Resources and Services Administration (HRSA) *Model Trauma System Planning and Evaluation* guide and the template described in *Regional Trauma Systems*, the in-depth, independent analysis includes over fifty recommendations organized into three sections:

- Trauma System Assessment
- Trauma System Policy Development
- Trauma System Assurance

During the consultation, Orange County Emergency Medical Services (OCEMS) asked a set of questions (Appendix B) concerning our local EMS and Trauma System. Specifically, ACS was asked to "Describe the impact of changes to trauma center configuration on various system components such as access, volume and transport times." The report section containing their response is found within Definitive Care Facilities (pages 50-56). In sum:

- Geographic and population coverage of the county is excellent.
- The distribution of trauma centers is well-matched to the population density.
- Simple geospatial (GIS-based) analysis suggests that over 99% of the county's injured population is within 30 minutes from point of injury to a Level I or Level II center by ground and over 50% are within 15 minutes.
- The current Orange County Trauma System has worked well for many years.
- The decision to continue the current model or to reconfigure the system must be made locally and potential impacts to existing trauma centers should be considered.

Orange County Emergency Medical Services (OCEMS) has received and reviewed the report, identified key findings, and shared these with the Health Care Agency leadership. Based on the ACS Final Report analysis, current resource capabilities and knowledge of our local EMS and Trauma System, OCEMS finds it unnecessary to increase the number of trauma centers. The Trauma System Plan will be updated annually and the system re-evaluated every 3-5 years to validate appropriate trauma care access.

ACS has identified several high priority recommendations that include, but are not limited to:

Trauma System	High Priority Recommendations
Assessment	• Dedicate epidemiologic support to the Trauma System to inform system priorities, benchmark system performance and develop public policy • Report population-based injury surveillance data including types of injuries sustained, mechanism, severity, patient-characteristics & outcomes to system stakeholders
Policy Development	• Refine and expand the organizational structure, functions, expectations for the Regional Trauma Operations Committee with broadened stakeholder engagement to advance system development • Prioritize leadership commitment to Trauma System through development by OCEMS, focusing on optimizing operational components, data collection and analysis, and quality assurance functions • Augment the OCEMS Agency with a Trauma System Manager position to provide the following: subject matter expertise, system oversight, and a focused effort to advance the vision and mission of the regional trauma system • Dedicate a full time position for a Trauma Data Analyst within OCEMS to manage the trauma registry and other data sources both for quality and data usage perspectives
Assurance	• Establish a clear and transparent process, utilizing data from EMS, trauma centers and emergency receiving centers to ensure the trauma system meets the needs of all injured patients according to locally accepted standards • Ensure that all acute care facilities, as participants in the inclusive trauma system, have appropriate resources/training to care for injured patients during disasters and mass casualty events

On January 10, 2020, at the regularly scheduled Emergency Medical Care Committee, this item will
be placed on the agenda for discussion and review of OCEMS recommendations on addressing these high priority items. Thank you to all who supported and participated in this comprehensive evaluation.

Attachment
TM:em #3592

AMERICAN COLLEGE OF SURGEONS COMMITTEE ON TRAUMA
Trauma Systems Evaluation and Planning Committee

Trauma System Consultation Report

Orange County, CA

Santa Ana, CA

July 15 – 18, 2019

AMERICAN COLLEGE OF SURGEONS
Inspiring Quality: Highest Standards, Better Outcomes

An interdisciplinary panel of nationally recognized experts prepared this document, based upon the American College of Surgeons (ACS) Trauma System Consultation (TSC) site visit to Orange County, CA, which took place July 15 – 18, 2019. Panel members included the following:

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Orange County is a diverse, densely populated county along the Southern Coast of California. Although geographically one of the smaller California counties, its population of over 3 million residents residing in 34 incorporated cities, make it the third most populated county in California, and the sixth most populated in the United States. The county is bordered on the West by the Pacific Ocean, and to the East by the Santa Ana mountains, with large freeways traversing the interior. It is ethnically diverse: 40% of the population is non-Hispanic whites, 35% Hispanic/Latino, and 20% Asian. It is also economically diverse, with a median income of $80,000/yr, but with averages in some zip codes of over $150,000/yr and others less than $40,000/yr. The county is home to beaches, theme parks, and major league sports, as well as academic institutions and corporate headquarters.

The county trauma system was established in 1980, and in fact some of the early work validating trauma systems was performed in Orange County. The lead agency is the Orange County Emergency Medical Services Agency (OCEMS) of the Health Care Agency, and under state statute, OCEMS is responsible for designation of trauma centers and oversight of the trauma care system. The system currently includes a Level I Adult/Level II Pediatric center, a Level II Adult/Level II Pediatric center, and a Level II Adult center. A Level II center in neighboring Los Angeles County is also an active participant. All centers are verified by the American College of Surgeons, and the County does have the statutory authority to designate new facilities wishing to pursue trauma center status. The current centers are very collaborative, and their leadership is engaged and committed to improving trauma care within the county. Specialty services, such as pediatrics, burn care, and reimplantation are readily available. In addition to the trauma centers, there are 25 emergency receiving centers (ERC's) and seven base hospitals, which direct the triage of trauma patients. There are well-defined regional triage and transfer protocols, and a robust EMS system.

While OCEMS is charged with trauma system oversight, the Agency's primary emphasis is on EMS. In those instances in which trauma is addressed, the focus is on the designated centers, with a relatively narrow vision of a system of trauma care. As a result, system development has stagnated, and there is a sense from some stakeholders that the system is exclusive. While trauma centers are part of the trauma system, they are only a part. Development of a mature trauma system in Orange County will require resource allocation in three key areas: system infrastructure, inclusivity, and data management.

Key to the continued development of a trauma system is the creation of the infrastructure to support the system and its activities. Fundamentally, the system needs to affirm its mission to be an inclusive and integrated system, from pre-injury through rehabilitation. In order to fulfill this mission, the OCEMS agency must dedicate personnel resources to operationalize, manage, and provide technical assistance to the trauma system. At a minimum, the system requires a full-time trauma system manager who can provide subject matter expertise, as well as, system oversight and support, and a data analyst to assure data integrity and provide analysis of data at the system level. With the support of the trauma system manager, and using the data provided by the system analyst, the Regional Trauma Operations Committee (RTOC) needs to develop a system trauma plan to guide system development, as well as a trauma specific performance improvement plan, to measure and benchmark outcomes.

Currently, membership in the RTOC is predominately limited to trauma centers and EMS. Expanding the committee to include other stakeholders will strengthen the system as a whole, make the process more transparent, and ensure that all components of the system have a

voice. Inclusion of the ERCs in the RTOC would give these institutions a formal opportunity to participate within the trauma system and a forum to voice issues of concern. Other important stakeholders include: representatives from public health, law enforcement, injury prevention, rehabilitation and burns, among others. Beyond the formal RTOC, the system needs to engage a more diverse group of stakeholders, in order to demonstrate the importance of the trauma system to the community at large. Media and elected officials are important partners in this endeavor.

Finally, advancement of the trauma system requires accurate data. The system needs to understand the total number of injured patients within the county and their outcomes. Data submitted needs to be validated and routine benchmarking reports generated. All facilities that admit patients should provide at least a limited data set to the system registry. Accurate data allows for the prioritization of activities and is fundamental to quality improvement initiatives. With improved data, difficult and often political decisions such as those involving the designation of additional centers are more transparent.

In summary, the trauma system in Orange County is poised to grow from a collection of trauma centers to a fully integrated trauma system.

Listed below are both assets and advantages and challenges and vulnerabilities faced by system:

Assets and Advantages

- Robust Public Health Services Agency within HCA
- All trauma centers participate in TQIP for benchmarking
- EMS participates in NEMSIS
- County has the authority to designate and provide oversight to the trauma system
- County has some policies in place (e.g. policy revision)
- System leaders with significant knowledge and experience – depth
- Strong trauma center engagement and collaboration among centers
- EMCC- includes broad group of stakeholders
- Committed trauma program manager and injury prevention coordinator (IPC) groups are reaching out to other stakeholders
- Collaborative Stop the Bleed efforts
- Some allotted FTE (.20) to the trauma system from the lead agency
- Lead agency provides support to RTOC
- Information Systems Chief is an asset
- Elements of a trauma system plan are in place
- Good integration between the lead agency and trauma centers
- There is a funding stream for participating trauma centers
- EMS personnel are required to be nationally registered and to attend an accredited training program
- Universal 911 access
- EMS patient care reports are NEMSIS compliant and agencies report to CEMSIS
- Base hospital (BH) oversight model is robust
- County-wide EMS protocols in place
- 800 megahertz system-wide
- Good geographic coverage of the county by trauma centers

- Inclusion of Long Beach Memorial in neighboring LA County
- CHOC has been elevated to a Level II Pediatric trauma center
- All trauma centers are ACS verified
- Regional triage protocols based on CDC guidelines
- Few trauma patients transferred out of county
- Orange County supports adjoining county with resources
- Air medical evacuation is well codified
- Established criteria for inter-facility transfer
- Trauma centers accept all patients
- Specialty services available (burns, peds, reimplants)
- 911 inter-facility transfers are 100% reviewed
- Community resource to assist with underfunded and homeless rehab care
- Interaction of trauma centers and preparedness system
- Good understanding of vulnerabilities
- Disaster drills based on risks, and the system is proactive about identifying opportunities for improvement and development of remediation strategies
- Preparedness system integrated into state incident command system
- Capacity to do regional bed tracking (ReddiNet)
- Independent healthcare regulatory process
- Academic Level I conducts robust research to support system development

Challenges and Vulnerabilities

- Minimal interaction between epidemiology resources and trauma system within the Health Care Agency
- Injury data not used to inform system activities
- No standardized epidemiology reports
- Lack of human resource support for preparation and interpretation of data
- No system benchmarking tools related to trauma outcomes
- Policies are not reviewed on a scheduled basis
- Lack enforcement capabilities except de-designation
- Policy to support a trauma system is not fully developed
- Limited involvement of external stakeholders (e.g. school system, entertainment industry, transportation, elected officials, rehab, home health, burns)
- System leadership responsibilities are largely delegated
- RTOC membership is very exclusive
- Stakeholders group interactions not codified at system level and there is a lack of stakeholder participation
- System promulgation efforts limited to trauma center level
- Lead agency under resourced to drive system development, and no staff has primary responsibility to the trauma system
- Non-trauma center stakeholders have no voice in the system
- Insufficient trauma system subject matter expertise within HCA
- Lead agency focused on EMS and other conditions (e.g. stroke) and lacks ability to lead system in development and collaboration
- Lead agency lacks trauma system manager, dedicated trauma data analyst
- There is no strategic, comprehensive trauma system plan

- Limited or lack of integration between lead agency and other entities including: ERCs, trauma centers, public health, emergency preparedness, behavioral health, and other constituent groups
- Myopic view of trauma system
- Unclear how trauma system infrastructure is funded, and no stakeholder involvement in funding decisions
- No consistent system-wide data to inform prevention initiatives and minimal involvement of the system in prevention activities (with the exception of drowning)
- No EMS workforce assessment
- Do not require trauma education with recertification of EMS providers
- EMS providers are not required to maintain national registry (national best practice)
- Exclusive model of trauma care—ERCs not involved in formal system activities
- Absence of data regarding patients treated at ERCs (non-trauma centers)
- EMS under/ over triage not evaluated
- Rehab not part of RTOC
- No outcome data from rehab
- Lack of oversight of hospital preparedness program (HPP) and trauma system integration efforts
- Minimal non-trauma center engagement in system response to disaster
- Limited surge capacity within system
- Limited collaboration with military
- No trauma specific system performance improvement (PI) plan
- Don't use the data to inform system-level decision making
- No system data audit
- No consequence for not submitting Hospital Discharge Dataset
- No way to track patient across the system
- Not using data use agreements (DUA) to advantage
- Capacity to do research limited by data integrity and access issues
- Untapped potential research partnerships within the community

Themes

Major Theme

- Trauma Centers are ONE component of the Trauma System

Other Themes

- Lead agency under-resourced, underfunded and trauma appears to be a low priority
- Non-trauma centers not included in the system
- Not using system data to inform decision making
- Lack of understanding of the continuity of care- from prevention through rehab and repatriation

PRIORITY RECOMMENDATIONS

From the list of all recommendations proposed by the ACS TSC Review Team for the 2019 Orange County TSC, a select group of recommendations was identified as requiring the most focus and attention. By addressing this select group of Priority Recommendations first, the Trauma System will be better aligned to address the general recommendations proposed for each of the 18 sections presented within this TSC Report.

Injury Epidemiology

- Dedicate epidemiologic support to the Trauma System to inform system priorities, benchmark system performance, and develop public policy.

System Leadership

- Develop a shared vision and mission for an inclusive Orange County Trauma System.
- Support inclusion and integration of trauma care elements from prehospital through rehabilitation.
- Prioritize leadership commitment to Trauma System development by the Orange County EMS Agency, focusing upon optimizing operational components, data collection and analysis, and quality assurance functions.
- Refine and expand the organizational structure, functions and expectations for the Regional Trauma Operations Committee with broadened stakeholder engagement to advance system development. Stakeholders to consider for inclusion are, but are not limited to:
    - Pediatrics
    - Burns
    - Rehabilitation
    - Emergency management
    - EMS
    - Public health
    - Law enforcement
    - Injury prevention
    - ERC's
- Augment the Orange County EMS Agency with a Trauma System Manager position to provide the following:
    - Subject matter expertise
    - System oversight
    - Focused effort to advance the vision and mission of the regional trauma system

Coalition Building and Community Support

- Identify and engage a more broadly based group of stakeholders for the County Trauma System to include consumers, media and elected officials.

Lead Agency and Human Resources within the Lead Agency

- Dedicate full time equivalent positions within the Orange County EMS Agency to operationalize, manage, and provide technical assistance to the trauma system. These positions include at a minimum:
    - Trauma System Manager
    - Trauma Data Analyst

Trauma System Plan

- Develop a Trauma System Plan to identify discrete operational objectives, completion timelines, and accountable stakeholders.
    - Ensure the plan is consistent with current standards in trauma care.
    - Outline goals, objectives, timelines, and accountable stakeholders.
    - Disseminate the plan to all trauma system stakeholders.

System Integration

- Partner with other areas within the Health Care Agency (HCA) to leverage activities involving mental health, social services, and child protection.

Financing

- Dedicate stable and sustainable funding to trauma system planning, oversight, and evaluation.

Prevention and Outreach

- Produce routine injury surveillance reports to inform prevention priorities and evaluate effectiveness of programs.

Definitive Care Facilities

- Establish a clear and transparent process, utilizing data from EMS, trauma centers, and emergency receiving facilities, to ensure the trauma system meets the needs of all injured patients according to locally accepted standards.
    - Integrate emergency receiving hospitals into the inclusive Trauma System.
    - Require that all facilities submit a minimum trauma dataset to form a comprehensive profile of injury care in the county

Disaster Preparedness

- Ensure that all acute care facilities, as participants in the inclusive trauma system, have appropriate resources and training to care for the injured patient in the event of a disaster or mass casualty event.

System-wide Evaluation and Quality Assurance

- Develop, implement, and monitor a trauma system performance improvement plan.

Trauma Management Information Systems (MIS)

- Dedicate a full time equivalent position for a Trauma Data Analyst within the Orange County EMS Agency to manage the trauma registry, and other data sources, both from data quality and data usage perspectives.
- Validate the quality of registry data and implement solutions for improvement.
- Mandate submission of a minimal data set to the trauma registry for all hospitals caring for injured patients.

TRAUMA SYSTEM ASSESSMENT

Injury Epidemiology

Purpose and Rationale[1]

Injury epidemiology is concerned with the evaluation of the frequency, rates, and pattern of injury events in a population. Injury pattern refers to the occurrence of injury-related events by time, place, and personal characteristics (for example, demographic factors such as age, race, and sex) and behavior and environmental exposures, and, thus, it provides a relatively simple form of risk-factor assessment.

The descriptive epidemiology of injury among the whole jurisdictional population (geographic area served) within a trauma system should be studied and reported. Injury epidemiology provides the data for public health action and becomes an important link between injury prevention and control and trauma system design and development. Within the trauma system, injury epidemiology has an integral role in describing the root causes of injury and identifying patterns of injury so that public health policy and programs can be implemented. Knowledge of a Region's injury epidemiology enables the identification of priorities for directing better allocation of resources, the nature and distribution of injury prevention activities, financing of the system, and health policy initiatives.

The epidemiology of injury is obtained by analyzing data from multiple sources. These sources might include vital statistics, hospital administrative discharge databases, and data from emergency medical services (EMS), emergency departments (EDs), and trauma registries. Motor-vehicle crash data might also prove useful, as would data from the criminal justice system focusing on interpersonal conflict. It is important to assess the burden of injury across specific population groups (for example, children, elderly people and ethnic groups) to ensure that specific needs or risk factors are identified. It is critical to assess rates of injury appropriately and thus, to identify the appropriate denominator (for example, admissions per 100,000 population). Without such a measure, it becomes difficult to provide valid comparisons across geographic Regions and over time.

To establish injury policy and develop an injury prevention and control plan, the trauma system, in conjunction with the state or Regional epidemiologist, should complete a risk assessment and gap analysis using all available data. These data allow for an assessment of the "injury health" of the population (community, state, or Region) and will allow for the assessment of whether injury prevention programs are available, accessible, effective, and efficient.

An ongoing part of injury epidemiology is public health surveillance. In the case of injury surveillance, the trauma system provides routine and systematic data collection and, along with its partners in public health, uses the data to complete injury analysis, interpretation, and

[1] See Appendix A: Methodology for a description of and references for the Purpose and Rationale and Optimal Elements for each core section.

dissemination of the injury information. Public health officials and trauma leaders should use injury surveillance data to describe and monitor injury events and emerging injury trends in their jurisdictions; to identify emerging threats that will call for a reassessment of priorities and/or reallocation of resources; and to assist in the planning, implementation, and evaluation of public health interventions and programs.

Optimal Elements

I. There is a thorough description of the epidemiology of injury in the system jurisdiction using population-based data and clinical databases. **(B-101)**

   a. There is a thorough description of the epidemiology of injury mortality in the system jurisdiction using population-based data. **(I-101.1)**

   b. There is a description of injuries within the trauma system jurisdiction, including the distribution by geographic area, high-risk populations (pediatric, elderly, distinct cultural/ethnic, rural, and others), incidence, prevalence, mechanism, manner, intent, mortality, contributing factors, determinants, morbidity, injury severity (including death), and patient distribution using any or all the following: vital statistics, ED data, EMS data, hospital discharge data, state police data (data from law enforcement agencies), medical examiner data, trauma registry, and other data sources. The description is updated at regular intervals. **(I-101.2)**
   Note: Injury severity should be determined through the consistent and system-wide application of one of the existing injury scoring methods, for example, Injury Severity Score (ISS).

   c. There is comparison of injury mortality using local, Regional, statewide, and national data. **(I-101.3)**

   d. Collaboration exists among EMS, public health officials, and trauma system leaders to complete injury risk assessments. **(I-101.4)**

   e. The trauma system works with EMS and public health agencies to identify special at-risk populations. **(I-101.7)**

II. Collected data are used to evaluate system performance and to develop public policy. **(B-205)**

   a. Injury prevention programs use trauma management information system data to develop intervention strategies. **(I-205.4)**

III. The trauma, public health, and emergency preparedness systems are closely linked. **(B-208)**

   a. The trauma system and the public health system have established linkages, including programs with an emphasis on population based public health surveillance and evaluation for acute and chronic traumatic injury and injury prevention. **(I-208.1)**

IV. The jurisdictional lead agency, in cooperation with the other agencies and organizations, uses analytic tools to monitor the performance of population-based prevention and trauma care services. **(B-304)**

a. The lead agency, along with partner organizations, prepares annual reports on the status on injury prevention and trauma care in the state, Regional, or local areas. **(I-304.1)**

b. The trauma system management information system database is available for routine public health surveillance. There is concurrent access to the databases (ED, trauma, prehospital, medical examiner, and public health epidemiology) for the purpose of routine surveillance and monitoring of health status that occurs regularly and is a shared responsibility. **(I-304.2)**

Current Status

Orange County is a densely populated, diverse region located along the coast of Southern California. In 2016, accidental injury ranked sixth among all causes of death within the county, with a crude rate of 26.9/100,000 population. Injury rates among whites are higher (43.2/100,000) than Hispanics (16.5/100,000), African Americans (36.2/100,000), and Asians (12/100,000). The overall accidental injury death rate is lower than that of the state as a whole, although it has been increasing slowly over the past several years. Other information available from state-wide dashboards include: "ER rate due to falls in adults >65 years", which is increasing in Orange County and "adults delayed or difficulty obtaining care," which is above the overall California value.

Reports on health-related information are prepared by the Orange County Health Care Agency Public Health Services Division, which also maintains a robust website (www.ochealthiertogether.org). For example, fact sheets regarding the 10 leading causes of death per city in Orange County are available. Unfortunately, there is no detailed information regarding the "accidental injuries," nor does injury appear to have been identified as a significant public health concern. The *Orange County Health Improvement Plan* was developed by the Health Improvement Partnership (HIP), a multi-disciplinary stakeholder group. Again, the development of this plan was without trauma or injury stakeholders, and does not include any injury-related information.

Detailed reports are available for other conditions, most notably, stroke. For example, in 2016, an interim report was published by the Orange County Emergency Medical Services Agency (OCEMS) regarding the Orange County Stroke-Neurology Program, which included: patient demographics, specific information regarding the type of stroke and treatments, system performance metrics, and outcomes. As special projects, reviews of both pediatric (2014) and adult trauma (2018) care have been performed. In both cases, the monographs were focused on the issues related to trauma center designation, not overall injury surveillance. No routine reports are generated regarding county-wide injury surveillance.

While epidemiologic resources within the Health Care Agency are robust, there appears to be minimal interaction between Public Health Services and Emergency Medical Services, and within OCEMS, little attention is focused on injury epidemiology. Injury trends and patient outcomes are not systematically evaluated. A County trauma registry exists, but the data has not been validated, nor are standard reports generated. In addition, the trauma registry only includes data from the four Orange County trauma centers and neighboring Long Beach Memorial; injury related data from non-trauma, emergency-receiving hospitals (ERCs) is not captured. Other sources of data, such as hospital discharge data, vital statistics, and EMS are

not utilized for injury surveillance. The coroner does prepare a detailed report, but it is unclear how this information has been used by the Trauma System.

At this time, it does not appear that injury data has been utilized to accomplish meaningful and systematic change that results in improved population outcomes. What injury data is available lacks the granularity from which to prioritize prevention efforts and to affect performance improvement initiatives. There is also little use of data to inform the public and other stakeholders regarding the burden of injury within the county. Going forward, it is imperative that the system invest in dedicated epidemiologic resources with developed expertise in trauma in order to have the data to inform system priorities, benchmark performance, and develop policy. This investment could come from existing resources within the Agency. At a minimum, an annual report of county-wide injury surveillance data should be compiled and disseminated widely to stakeholders, including elected officials and policy makers. Information in the report should include types of injuries sustained, mechanism, severity, patient characteristics, outcomes throughout the continuum of trauma care, as well as injury trends.

Recommendations

- **Dedicate epidemiologic support to the Trauma System to inform system priorities, benchmark system performance, and develop public policy.**

- Report population-based injury surveillance data including (at a minimum) types of injuries sustained, mechanism, severity, patient-characteristics, and outcomes (including rehabilitation) to system stakeholders.

Indicators as a Tool for System Assessment

Purpose and Rationale

In the absence of validated national benchmarks, or norms, the benchmarks, indicators and scoring (BIS) process included in the Health Resources and Services Administration's (HRSA) *Model Trauma System Planning and Evaluation* document provides a tool for each trauma system to define its system-specific health status benchmarks and performance indicators and to use a variety of community health and public health interventions to improve the community's health status. The tool also addresses reducing the burden of injury as a community-wide public health problem, not strictly as a trauma patient care issue.

This BIS tool provides the instrument and process for a relatively objective state and sub-state (regional) trauma system self-assessment. The BIS process allows for the use of state, Regional, and local data and assets to drive consensus responses to the BIS. It is essential that the BIS process be completed by a multidisciplinary stakeholder group, most often the equivalent of a state trauma advisory committee. The BIS process can help focus the discussion on various system strengths and weaknesses, can be used to set goals or benchmarks, and provides the opportunity to target often limited resources and energies to the areas identified as most critical during the consensus process. The BIS process is useful to develop a snapshot of any given system at a moment in time. However, its true usefulness is in repeated assessments that reveal progress toward achieving various benchmarks identified in the previous application of the BIS. This process further permits the trauma system to refine goals to be attained before future reassessments using the tool.

Optimal Element

I. Assurance to constituents that services necessary to achieve agreed-on goals are provided by encouraging actions of others (public or private), requiring action through regulation, or providing services directly. **(B-300)**

Current Status

The Orange County EMS Agency (OCEMS) reported not having completed a HRSA Benchmarks, Indicators, and Scoring (BIS) assessment in the past. However, interest in this process was expressed through the submission of a focus question inquiring about the value and importance of a BIS self-assessment. The advantage of the BIS self-assessment is the opportunity the process creates for system stakeholders to work together to identify areas in the greatest need of improvement and to measure progress toward the attainment of various objectives over time. Using this tool repeatedly, states and regions can benchmark their performance related to various system components.

Although utilization of the BIS tool itself has been found challenging for some states and regions due to its complexity, it is the only system evaluation tool that has been used widely across the US. The tool and process itself, however, may benefit from an update in the future, as it was published in 2006. Whether OCEMS decides to use the BIS or to identify another set of system metrics or tools, it will be necessary for the system to establish a structure and process, based on national guidelines, to benchmark the performance and outcomes of the components of the

trauma system such as EMS, triage destination, trauma activation compliance, timelines of care, and outcomes to include complications and deaths.

The current multidisciplinary stakeholder group involved in evaluating the system is the Regional Trauma Operations Advisory Committee (RTOC). The Advisory Committee stakeholders include the four Orange County trauma center trauma medical directors, the four trauma program managers, plus a trauma program manager representative from Long Beach Memorial. The Orange County Medical Director, Associate Medical Director, EMS Administrator, System and Standards Chief, ALS/CQI Coordinator, Facilities Coordinator, and the Information Systems Chief are members of RTOC as well. This committee consistently reviews trauma diversion times, trauma related policies, clinical practice performance improvement reviews, and various reports provided by the EMS Data System Chief. A structured consistent data review of outcomes and compliance to the trauma system plan is not in place. The PRQ provided by Orange County noted that the performance improvement reviews are completed by the trauma program managers in a `setting other than the Advisory Committee. The lead agency has the opportunity to expand stakeholder participation.

Standard data reports that the RTOC can utilize to monitor the system's progress should be identified and developed. The stakeholder discussions reflected a level of frustration regarding the epidemiology data and reports currently available. This is an identified opportunity for improvement for the system.

One opportunity for system benchmarking lies in the participation of all Orange County trauma centers in the ACS Trauma Quality Improvement Program (TQIP). Although the implementation of a formal ACS TQIP Collaborative for Level I and II centers might not be feasible at this time, as noted by a stakeholder during the on-site meetings, a collaborative effort, formal or informal, to share risk-adjusted outcomes will provide stakeholders with insights into system level issues.

The RTOC should establish a timeline for the development of a system benchmarking process and methods to address any weaknesses and opportunities identified in this process. The trauma system plan components and objectives may provide indicators for system review and benchmarking outcomes. The trauma system outcomes should be published in the annual Trauma System Report.

Recommendations

- Benchmark performance and outcomes of trauma system components against national standards.

- Define timelines for the development and implementation of a process for system benchmarking and planning to address any weaknesses and opportunities identified by the process.

- Publish outcomes and performance metrics in the annual Trauma System Report.

TRAUMA SYSTEM POLICY DEVELOPMENT

Statutory Authority and Administrative Rules

Purpose and Rationale

Reducing morbidity and mortality due to injury is the measure of success of a trauma system. A key element to this success is having the legal authority necessary to improve and enhance care of injured people through comprehensive legislation and through implementing regulations and administrative code, including the ability to regularly update laws, policies, procedures, and protocols. In the context of the trauma system, comprehensive legislation means the statutes, regulations, or administrative codes necessary to meet or exceed a pre-described set of standards of care. It also refers to the operating procedures necessary to continually improve the care of injured patients from injury prevention and control programs through post-injury rehabilitation. The ability to enforce laws and rules guides the care and treatment of injured patients throughout the continuum of care.

There must be sufficient legal authority to establish a lead trauma agency and to plan, develop, maintain, and evaluate the trauma system during all phases of care. In addition, it is essential that as the development of the trauma system progresses, included in the legislative mandate are provisions for collaboration, coordination, and integration with other entities also engaged in providing care, treatment, or surveillance activities related to injured people. A broad approach to policy development should include the building of system infrastructure that can ensure system oversight and future development, enforcement, and routine monitoring of system performance; the updating of laws, regulations or rules, and policies and procedures; and the establishment of best practices across all phases of intervention. The success of the system in reducing morbidity and mortality due to traumatic injury improves when all service providers and system participants consistently comply with the rules, have the ability to evaluate performance in a confidential manner, and work together to improve and enhance the trauma system through defined policies.

Optimal Elements

I. Comprehensive state statutory authority and administrative rules support trauma system leaders and maintain trauma system infrastructure, planning, oversight, and future development. **(B-201)**

   a. The legislative authority states that all the trauma system components, emergency medical services (EMS), injury control, incident management, and planning documents work together for the effective implementation of the trauma system (infrastructure is in place). **(I-201.2)**

   b. Administrative rules and regulations direct the development of operational policies and procedures at the state, Regional, and local Levels. **(I-201.3)**

II. The lead agency acts to protect the public welfare by enforcing various laws, rules, and regulations as they pertain to the trauma system. **(B-311)**

a. Laws, rules, and regulations are routinely reviewed and revised to continually strengthen and improve the trauma system. **(I-311.4)**

Current Status

The State of California has enabling legislation that provides broad trauma system authority to the California EMS Authority and Local EMS Agencies (LEMSAs). In 1980, the Emergency Medical Services System and Prehospital Emergency Care Personnel Act (SB125) was passed. The Act provided the foundation for emergency medical services in California by creating the EMS Authority and adding Division 2.5 to the Health and Safety Code (sections 1797-1799).

California has a two-tier structure for managing and regulating the statewide EMS and trauma system. The California EMS Authority is the lead agency for establishing minimum statewide standards and performing overall monitoring of the statewide system. LEMSAs are the lead agency for the day-to-day EMS system management at the county or regional level. Each LEMSA has regulatory authority within its own jurisdiction.

The Orange County EMS Agency (OCEMS) is the LEMSA responsible for developing, planning, and implementing the EMS and trauma system policies for Orange County. This is accomplished through agreements with emergency receiving centers (ERCs), base hospitals, trauma centers, public safety fire department first responders, private ambulance contracted services, and through OCEMS policy.

The policies of OCEMS are scheduled for review annually. This process was described as being very time and human resource intensive, and some policies were reported as not having been reviewed in over two years. OCEMS has seemingly increased focus on trauma system related policies over the past four years.

The trauma system remains an exclusive model, as acute care ERC facilities are not formally integrated into the trauma system. It was apparent from the consultation process, that these ERC facilities are seeing injured patients, though the number and acuity are not well codified at the system level. OCEMS has established designation criteria for hospitals as emergency receiving centers and for base hospitals. OCEMS is authorized to exercise a designation process with all acute care facilities to assure that an organized system of care exists for residents and the community. It is unclear how the current policies and designation processes assure the inclusion of all acute care facilities in the overall trauma system, as the trauma system development dialog has historically been exclusively with the designated trauma centers. Designated emergency receiving centers are not required to submit data to OCEMS or directly to the trauma registry.

OCEMS reported that it has limited authority to mandate trauma system participation of the emergency receiving centers, except by prohibiting the acceptance of 911 patients. Current OCEMS policies fall short of including financial penalties. Policies are silent regarding the imposition of penalties to trauma centers and emergency receiving centers that are noncompliant with designation criteria, with the exception of suspending designation.

OCEMS engagement in the development of the trauma system is limited by substantial EMS regulatory mission. OCEMS was initially established to regulate the provisions of emergency medical services that operate within Orange County. The provision of regulating the trauma care system came much later. This regulatory oversight of first responder agencies and personnel

continues to be the primary focus of the agency. This is evident by the structure of various EMS committees and functions reported by the agency and providers.

Recommendations

- Codify policies that will direct the growth and maturation of the Trauma System to include penalties for non-compliance.

- Revise the emergency receiving center criteria for participation in the inclusive Trauma System:
    - Enhance criteria for participation, including submission of a minimal trauma dataset
    - Develop penalties for failure to comply with criteria

System Leadership

Purpose and Rationale

In addition to lead agency staff and consultants (for example, trauma system medical director), there are other significant leadership roles essential to developing mature trauma systems. A broad constituency of trauma leaders includes trauma center medical directors and nurse coordinators, prehospital personnel, injury prevention advocates, and others. This broad group of trauma leaders works with the lead agency to inform and educate others about the trauma system, implements trauma prevention programs, and assists in trauma system evaluation and research to ensure that the right patient, right hospital, and right time goals are met. There is a strong role for the trauma system leadership in conveying trauma system messages, building communication pathways, building coalitions, and collaborating with relevant individuals and groups. The marketing communication component of trauma system development and maintenance begins with a consensus-built public information and education plan. The plan should emphasize the need for close collaboration between coalitions and constituency groups and increased public awareness of trauma as a disease. The plan should be part of the ongoing and regular assessment of the trauma system and be updated as frequently as necessary to meet the changing environment of the trauma system.

When there are challenges to providing the optimal care to trauma patients within the system, the leadership needs to effect change to produce the desired results. Broad system improvements require the ability to identify challenges and the resources and authority to make changes to improve system performance. However, system evaluation is a shared responsibility. Although the leadership will have a key role in the acquisition and analysis of system performance data, the multidisciplinary trauma oversight committee will share the responsibility of interpreting those data from a broad systems perspective to help determine the efficiency and effectiveness of the system in meeting its stated performance goals and benchmarks. All stakeholders have the responsibility of identifying opportunities for system improvement and bringing them to the attention of the multidisciplinary committee or the lead agency. Often, subtle changes in system performance are noticed by clinical care providers long before they become apparent through more formal evaluation processes.

Perhaps the biggest challenge facing the lead agency is to synergize the diversity, complexity, and uniqueness of individuals and organizations into an integrated system for prevention of injury and for the provision of quality care for injured patients. To meet this challenge, leaders in all phases of trauma care must demonstrate a strong desire to work together to improve care provided to injured victims.

Optimal Elements

I. Trauma system leaders (Lead Agency, trauma center personnel, and other stakeholders) use a process to establish, maintain, and constantly evaluate and improve a comprehensive trauma system in cooperation with medical, professional, governmental, and other citizen organizations. **(B-202)**

II. Collected data are used to evaluate system performance and to develop public policy. **(B-205)**

III. Trauma system leaders, including a trauma-specific statewide multidisciplinary, multiagency advisory committee, regularly review system performance reports. **(B-206)**

IV. The lead agency informs and educates state, Regional, and local, constituencies and policy makers to foster collaboration and cooperation for system enhancement and injury control. **(B-207)**

Current Status

The nascence of trauma system development in the United States began in southern California as a result of pioneering investigation by surgeons West and Trunkey in the late 1970's. Comparing injury outcomes in San Francisco with a centralized trauma center to Orange County, in which injured patients were taken to the closest hospital, demonstrated a substantial survival advantage for those patients transported to a trauma center. The implications of these results suggested that casualty survival could be improved by an organized and resourced system of trauma care delivery. As a consequence of these reports, public opinion championed the implementation of a trauma system in Orange County, which has resulted in a significant decrease in preventable injury mortality. Relatively small in geographic area, the Orange County Trauma System has developed and maintained an exclusive trauma system model whereby all trauma patients meeting activation criteria are transported to one of four Orange County trauma centers (and neighboring Long Beach Memorial).

Orange County EMS Agency (OCEMS) leadership is committed to improvement of the trauma system. However, the administrative structure and resource constraints within the organization largely limit their activities to the oversight and regulation of the prehospital phase of the trauma system. Most of the authority for functional development of the trauma system has effectively been delegated to EMS and the designated trauma centers. The recently retired OCEMS Medical Director supporting the Agency has been a long-standing advocate of the trauma system with a wealth of historical institutional knowledge regarding system development. His retirement leaves "big shoes to fill" within the organization.

The stakeholder leadership body that advises OCEMS is the Regional Trauma Operations Committee (RTOC). Membership is exclusive, consisting of the trauma medical directors and trauma program managers of the four designated regional trauma centers, the trauma program manager of the Long Beach Memorial Trauma Center supporting the northern section of Orange County, and OCEMS staff (Medical Director, Associate Medical Director, EMS Administrator, Systems & Standards Chief, ALS/CQI Coordinator, Facilities Coordinator, and Information Systems Chief).

The membership of the RTOC specifically lacks representation from EMS, specialty surgeons, rehabilitation, and non-designated acute care facilities, as well as the public. The stated mission of this group as described in Orange County EMS Policy/Procedure #160.10 is to serve as a multidisciplinary forum to monitor, evaluate, and report on the operation and quality of trauma services in Orange County. However, a number of inherent limitations in the trauma system including resource constraints, as well as data integrity, analysis, and access challenges, substantively limit the capability of the RTOC to consistently perform these vital mission functions. There is also no substantive input from several vital trauma system operational elements across the continuum of care to drive system development.

There appears to be strong cooperation and collaboration between OCEMS and the trauma centers. Likewise, the trauma centers have evolved strong working relationships highlighted by

their initiative to develop rudimentary system-based performance improvement and injury prevention programs. This is a collaborative effort, driven by the trauma program managers and injury prevention coordinators of the trauma centers and formalized through an ad hoc committee of the RTOC that evaluates and develops solutions to identified issues Though this analysis is consistently performed, the process is not well-described or codified in OCEMS administrative policy.

There have been limited efforts, mainly driven by individuals or trauma centers, to educate and inform the public, regional stakeholders, and policy makers regarding the function, accomplishments, and value of the trauma system and to gain support for much needed expansion of human resources within the lead agency.

Recommendations

- **Develop a shared vision and mission for an inclusive Orange County Trauma System.**

- **Support inclusion and integration of trauma care elements from prehospital through rehabilitation.**

- **Prioritize leadership commitment to Trauma System development by the Orange County EMS Agency, focusing upon optimizing operational components, data collection and analysis, and quality assurance functions.**

- **Refine and expand the organizational structure, functions and expectations for the Regional Trauma Operations Committee with broadened stakeholder engagement to advance system development. Stakeholders to consider for inclusion are, but are not limited to:**
    - **Pediatrics**
    - **Burns**
    - **Rehabilitation**
    - **Emergency management**
    - **EMS**
    - **Public health**
    - **Law enforcement**
    - **Injury prevention**
    - **ERC's**

- **Augment the Orange County EMS Agency with a Trauma System Manager position to provide the following:**
    - **Subject matter expertise**
    - **System oversight**
    - **Focused effort to advance the vision and mission of the regional trauma system**

- Promote the value of the Orange County Trauma System to the general public and the legislature.

- Create additional subcommittees for stakeholder participation in trauma system planning and development.

Coalition Building and Community Support

Purpose and Rationale

Coalition building is a continuous process of cultivating and maintaining relationships with constituents (interested citizens) in a state or Region who agree to collaborate on injury control and trauma system development. Key constituents include health professionals, trauma center administrators, prehospital care providers, health insurers and payers, data experts, consumers and advocates, policy makers, and media representatives. The coalition of key constituents comprises the trauma system's stakeholders. The involvement of these key constituents is important for the following:

- Trauma system plan development
- Regionalization: promoting collaboration rather than competition between trauma centers
- System integration
- State policy development: authorizing legislation and regulations
- Financing initiatives
- Disaster preparedness

The coalition should be effectively organized through the formation of multidisciplinary state and Regional advisory groups to coordinate trauma system planning and implementation efforts. Constituents also communicate with elected officials and policy leaders regarding the development and sustainability of the trauma system. Information and education are needed by constituents to be effective partners in policy development for trauma system planning. Regular communication about the status of the trauma system helps these key partners to recognize needs and progress made with trauma system implementation.

One of the most effective ways to educate elected officials and the public is through an organized public information and education effort that may involve a media campaign about the burden of injury in the state and the need for trauma system development. Information and education are important to reduce the incidence of injury in all age groups and to demonstrate the value of an effective trauma system when a serious injury occurs.

Optimal Element

I. The lead agency informs and educates state, regional, and local constituencies and policy makers to foster collaboration and cooperation for system enhancement and injury control. **(B-207)**

Current Status

Coalition building is a continual process of relationship development with the stakeholders within a community or system. The lead agency can utilize these coalition relationships and community engagement to assist in assessing injury within the region as well as in defining priorities. The stakeholders of Orange County have the opportunity to build on the rich history of system development, to advance the system design, and to promote regional system integration.

Key coalition members within the trauma system have the opportunity to participate in the following areas:

- Development of the written trauma system plan
- Promotion of regionalization and collaboration; breaking down of silos between the disciplines
- System integration
- Policy and regulation development
- Trauma system funding initiatives
- Disaster preparedness, response, and recovery initiatives
- Public education and education of elected officials regarding the trauma system

Orange County currently utilizes multiple standing committees to serve as their coalition for stakeholder participation. The Emergency Medical Care Committee (EMCC) is the primary lead agency committee that has members representing the various stakeholders and constituents. The Regional Trauma Operations Committee (RTOC) is a multidisciplinary forum to monitor, evaluate, and report on the operations and quality of trauma services in Orange County. The RTOC is responsible for the related policies, planning, and clinical practice performance reviews.

EMCC members include the following:

- Board of Supervisors
- Ambulance Association of Orange County
- American Red Cross
- Hospital Association of Southern California
- Orange County Emergency Nurses Association
- Orange County Business Council
- Orange County City Managers
- Orange County Fire Chiefs Association
- Orange County Police Chiefs & Sheriff Association
- Orange County Senior Citizens Council

The EMCC receives several system prehospital reports from Disease Control and Epidemiology within the Public Health Services division, as well as reports reflecting the diversion times and EMS patient offload times and EMS response reports. The EMCC review of these reports is a system strength. Other reports, including data on patient demographics, geographic location and mechanism of injury, disability, and death can improve EMCC's knowledge of trauma injuries and decision-making regarding trauma system design and public collaboration opportunities.

The RTOC includes the following members:

- Trauma medical directors from all four existing trauma centers
- Trauma program representatives from the four existing trauma centers and Long Beach Memorial
- Orange County EMS Staff to include the Medical Director, Associate Medical Director, EMS Administrator, Systems and Standards Chief, ALS/CQI Coordinator, Facilities Coordinator, and Information Systems Chief

The RTOC meeting minutes were reviewed by the consultation team. Past meetings have focused on injury coding, registry inclusion criteria, TQIP, and performance improvement. Meeting documentation reflects the trauma program managers and trauma medical directors as

leaders in the system and highlights system strengths. The Data Subcommittee of the RTOC is addressing high level priorities related to data consistency and validation. The ad hoc Injury Prevention Committee of the RTOC has significantly broadened community coalition participation opportunities. The organizations represented in these coalition initiatives include the schools, legal system, senior programs, and water safety programs.

Individual members of the trauma system have developed processes for building community partners to improve the trauma system through effective communication and through education and outreach. For example, Children's Hospital of Orange County (CHOC) has committed to providing education to the prehospital providers regarding spinal motion restriction, pediatric trauma center criteria, and the integration of pediatric care in the trauma system.

Although the trauma program managers have expanded stakeholder participation through their injury prevention meetings, it was noted by the Trauma System Consultation Review Team that the trauma system would benefit from broader support and engagement in system planning, design, and funding. The stakeholder coalition, with leadership and technical support from the Orange County EMS Agency (OCEMS), should be expanded to include all members of the trauma system, not just the trauma centers or even non-trauma emergency receiving hospitals. Examples of additional coalition members to consider are representatives from school systems, the entertainment and sports industries, the transportation industry, rehabilitation, and home health organizations.

The system coalition has the opportunity to serve as the public messaging platform for county-wide resources and activities for the general public and elected officials. The coalition should be charged with developing a public injury awareness educational plan, a part of which would be the development of a trauma system webpage designed to educate the public about the trauma system plan, the impact of injuries, and the true value of the system.

Utilizing current and future stakeholders, OCEMS needs to develop an annual county-based trauma system report that reflects the current system progress, needs, and outcomes. This report is a tool to educate the consumers, media, and elected officials and should be posted on the trauma system webpage.

Recommendations

- **Identify and engage a more broadly based group of stakeholders for the County Trauma System to include consumers, media, and elected officials.**

- Develop and disseminate standardized reports to inform standing stakeholder committees in making data driven decisions. Reports reflective of age and demographic breakdown, should include the following:
    - Leading injury mechanisms
    - Death and disability
    - Cost of trauma care and the system
    - Outcomes

- Develop an educational plan to inform the public about the trauma system's value.

- Develop an annual community-based trauma system report utilizing the participants of the Emergency Medical Care Committee, the Regional Trauma Operations Committee, and other stakeholders that reflects the current system progress, needs, and outcomes.

Lead Agency and Human Resources within the Lead Agency

Purpose and Rationale

Each trauma system (state, Regional, local, as defined in state statute) should have a lead agency with a strong program manager who is responsible for leading the trauma system. The lead agency, usually a government agency, should have the authority, responsibility, and resources to lead the planning, development, operations, and evaluation of the trauma system throughout the continuum of care. The lead agency, empowered through legislation, ensures system integrity and provides for program integration with other health care and community-based entities, namely, public health, EMS, disaster preparedness, emergency management, law enforcement, social services, and other community-based organizations.

The lead agency works through a variety of groups to accomplish the goals of trauma system planning, implementation, and evaluation. The ability to bring multidisciplinary, multiagency advisory groups together to accomplish trauma system goals is essential in developing and maintaining the trauma system and is part of providing leadership to evolving and mature systems.

The lead agency's trauma system program manager coordinates trauma system design, the adoption of minimum standards (prehospital and in-hospital), and provides for overall system evaluation through performance indicator assessment and assurance. In addition to a trauma program manager, the lead agency must be sufficiently staffed to actively participate in each phase of development and in maintaining the system through a clearly defined structure for decision making (policies and procedures) and through proactive surveillance and evaluation. *Minimum* staffing usually consists of a trauma system program manager, data entry and analysis personnel, and monitoring and compliance personnel. Additional staff resources include administrative support and a part-time commitment from the public health epidemiology service to provide system evaluation and research support.

Within the leadership and governance structure of the trauma system, there is a role for strong physician leadership. This role is usually fulfilled by a full- or part-time trauma medical director within the lead agency.

Optimal Elements

I. Comprehensive state statutory authority and administrative rules support trauma system leaders and maintain trauma system infrastructure, planning, oversight, and future development. **(B-201)**

   a. The legislative authority (statutes and regulations) plans, develops, implements, manages, and evaluates the trauma system and its component parts, including the identification of the lead agency and the designation of trauma facilities. **(I-201.1)**

   b. The lead agency has adopted clearly defined trauma system standards (for example, facility standards, triage and transfer guidelines, and data collection standards) and has sufficient legal authority to ensure and enforce compliance. **(I-201.4)**.

II. Sufficient resources, including financial and infrastructure-related, support system planning, implementation, and maintenance. **(B-204)**

Current Status

The State of California has a two-tier structure for administrative leadership. The California EMS Authority, a department of the California Health and Human Services Agency, is the state lead agency for the trauma system. Each county designates a Local Emergency Medical Services Agency (LEMSA) that serves as the lead agency for the implementation and operation of the local trauma system. The Orange County EMS Agency (OCEMS) is the designated LEMSA for Orange County. OCEMS is charged with implementation and oversight of comprehensive emergency care delivery services that includes the trauma system, as well as emergency medical services, stroke, and STEMI.

OCEMS does not have personnel that are solely dedicated to the trauma system. Personnel resources are leveraged from or shared with other programs within OCEMS to accomplish much of the trauma system work. Specifically, the resources available include a Coordinator, EMS Medical Director, and Administrator. OCEMS is unable to report the specific full-time equivalents dedicated to leading trauma system development, collaboration, injury prevention and data management.

- The EMS Administrator provides the administrative direction and leadership for the trauma system.
- The Medical Director position provides clinical leadership and medical control for EMS, the trauma system, and other time-sensitive conditions.
- The Facilities Coordinator (FC) is a registered nurse within OCEMS. The day-to-day activities required to manage the comprehensive trauma system are the responsibility of this individual. The FC attends most facility committee meetings involving acute care facilities and trauma centers. The workload for this continues to build with the integration of the stroke and STEMI programs. While passionate about the trauma system, the FC is not solely dedicated to trauma system activities.
- The Information Systems Chief is responsible for maintaining the Orange County Medical Emergency Data System (OC-MEDS) and EMS Core Measures reporting. This position is not directly involved in trauma registry validation, or research related to the trauma system. The time spent on data collection limits this individual's ability to focus on traditional epidemiology functions that could enhance the reports and research centered on trauma and EMS.

Combining all positions, a total of 0.20 FTE is dedicated to the trauma system. The most significant impediment to further trauma system development is the limited personnel within OCEMS to promote planning and implementation.

The lack of OCEMS staff dedicated to trauma system oversight and leadership has perpetuated the development of a trauma center focused, exclusive trauma system in Orange County. It would appear that OCEMS works closely with designated trauma centers and excludes emergency receiving centers and other stakeholders from the care and coordination of trauma patients. Furthermore, the trauma centers and RTOC note that they receive minimal reports from the County trauma registry. This absence of feedback results in an inability to benchmark at a system level. The lack of dedicated trauma data support within OCEMS significantly contributes to these issues.

Therefore, the provision of consistent oversight and leadership of the trauma system will require the addition of a trauma program manager. This individual's position should be dedicated exclusively to the trauma system. In addition, the agency needs an individual with both content and technical expertise to manage the trauma registry, and other data sources, both from data quality and data usage perspectives.

Recommendations

- **Dedicate full time equivalent positions within the Orange County EMS Agency to operationalize, manage, and provide technical assistance to the trauma system. These positions include at a minimum:**
  - **Trauma Systems Manager**
  - **Trauma Data Analyst**

- Develop policy to ensure that the Orange County EMS Agency has sufficient personnel resources to fulfill its mandate to regulate and lead all aspects of the trauma system.

Trauma System Plan

Purpose and Rationale

Each trauma system, as defined in statute, should have a clearly articulated trauma system planning process resulting in a written trauma system plan. The plan should be built on a completed inventory of trauma system resources identifying gaps in services or resources and the location of assets. It should also include an assessment of population demographics, topography, or other access enhancements (location of hospital and prehospital resources) or barriers to access. It is important that the plan identify special populations (for example, pediatric, elderly, in need of burn care, ethnic groups, rural) within the geographic area served and address the needs of those populations within the planning process. A needs assessment (or other method of identifying injury patterns, patient care review/preventable death study) should also be completed for initial trauma system planning and updated periodically as needed to assess system changes over time.

The trauma system plan is developed by the lead trauma agency based on the results of a needs assessment and other data resources available for review. It describes the system design, integrated and inclusive, with adopted standards of care for prehospital and hospital personnel and a process to regularly review the plan over time. The plan is built on input from trauma advisory committees (or stakeholder groups) that assist in analyzing data, identifying resources, and developing system standards of care, including system policies and procedures and overall system design. Ideally, although every stakeholder group may not be satisfied with the plan or system design, the plan, to the extent possible, should be based on consensus of the advisory committees and stakeholder groups. These advisory groups should be able to review the plan before final adoption and approve the plan before it is submitted to the lead agency with authority for plan approval.

The trauma system plan is used to guide system development, implementation, and management. Each component of the trauma system (for example, prehospital, hospital, communications, and transportation) is clearly defined and an established service Level identified (baseline) with goals for enhancement (benchmark). Within the plan are incorporated other planning documents used to ensure integration of similar services and build collaboration and cooperation with those services. Service plans for emergency preparedness, EMS, injury prevention and control, public health, social services, and mental health are examples of services for which the trauma system plan should include an interface between agencies and services.

Optimal Element

I. The state lead agency has a comprehensive written trauma system plan based on national guidelines. The plan integrates the trauma system with EMS, public health, emergency preparedness, and incident management. The written trauma system plan is developed in collaboration with community partners and stakeholders. **(B-203)**

   a. The trauma system plan clearly describes the system design (including the components necessary to have an integrated and inclusive trauma system) and is used to guide system implementation and management. For example, the plan includes references to

regulatory standards and documents and includes methods of data collection and analysis. **(I-203.4)**

Current Status

The Orange County EMS Agency (OCEMS) has the authority and oversight for the development of a trauma system. California Health and Safety Code 1798.165 gives authority to the local EMS Agency to designate trauma centers as an element of the trauma care system. The EMS Authority can specify additional and/or more rigorous trauma system or trauma center requirements than those specified in the current statutes. The trauma triage criteria, Policy 310.30 is in place. The Emergency Medical Care Committee (EMCC) and Regional Trauma Operations Committee (RTOC) provide the setting and organizational structure for trauma planning and the development of a written trauma system plan. However, stakeholder participation is limited.

The consultation team reviewed system planning documentation available including The *Orange County Trauma System 2018,* which specifies that injured patients meeting the trauma triage criteria are transported to five trauma centers: UC, Irvine, Orange County Global Medical Center, Mission Hospital Regional Medical Center, Children's Hospital of Orange County, and Long Beach Memorial Medical Center. The trauma system evaluation data elements used in this report included overall population data, 911 dispatch call data, transport times, trauma center volume and injury acuity, and diversion times. A second document, *Trauma Plan System Status Report 2016*, was reviewed by the consultation team as well. This document provides a trauma system plan status and includes an overview of the Orange County data system that includes data from EMS and patient reports, base hospital reviews, hospital trauma registries, and outcomes. This 2016 document defines the trauma system performance improvement program and the elements of review and includes appendices for the system objectives and status review as well as an implementation section.

Despite the development of the reports previously described, a current, comprehensive trauma system plan is not available. Key components of a trauma system plan such as system integration, prevention and outreach, rehabilitation, system-wide evaluation, and research are lacking formal structure with defined processes. Standardized trauma system reports generated by the various registries and data sources are lacking, which is currently impeding trauma system planning and development.

OCEMS should prioritize the development of a written trauma system plan to identify discrete operational objectives, completion timelines, and accountable stakeholders. The EMCC, RTOC, and other stakeholders should participate in the planning and development of the written trauma system plan, with the OCEMS being held responsible for approving the plan, updating it on a defined schedule to maintain relevance, and disseminating it to all trauma system stakeholders.

The trauma system plan should have a defined vision or mission with operational objectives, timelines for completion, and a specific agenda for future development. This plan should include the organizational structure that defines how the lead agency interfaces with other state and county agencies and departments and should serve as a blue print integrating the individual components of the trauma system. The timelines for review and re-approval of the plan should be clearly defined and included in the system plan.

Recommendations

- **Develop a Trauma System Plan to identify discrete operational objectives, completion timelines, and accountable stakeholders.**
    - **Ensure the plan is consistent with current standards in trauma care.**
    - **Outline goals, objectives, timelines, and accountable stakeholders.**
    - **Disseminate the plan to all trauma system stakeholders.**

- Update Trauma System Plan on a defined schedule (every 3 to 5 years) to maintain contemporary relevance and build upon interval Trauma System developmental successes.

System Integration

Purpose and Rationale

Trauma system integration is essential for the daily care of injured people and includes such services as mental health, social services, child protective services, and public safety. The trauma system should use the public health approach to injury prevention to contribute to reducing the entire burden of injury in a state or Region. This approach enables the trauma system to address primary, secondary, and tertiary injury prevention through closer integration with community health programs and mobilizing community partnerships. The partnerships also include mental health, social services, child protection, and public safety services. Collaboration with the public health community also provides access to health data that can be used for system assessment, development of public policy, and informing and educating the community.

Integration with EMS is essential because this system is linked with the emergency response and communication infrastructure and transports severely injured patients to trauma centers. Triage protocols should exist for treatment and patient delivery decisions. Regulations and procedures should exist for online and off -line medical direction. In the event of a disaster affecting local trauma centers, EMS would have a major role in evacuating patients from trauma centers to safety or to other facilities or to make beds available for patients in greater need.

The trauma system is a significant state and Regional resource for the response to mass casualty incidents (MCIs). The trauma system and its trauma centers are essential for the rapid mobilization of resources during MCIs. Preplanning and integration of the trauma system with related systems (public health, EMS, and emergency preparedness) are critical for rapid mobilization when a disaster or MCI occurs. The extensive impact of disasters and MCIs on the functioning of trauma centers and the EMS and public health systems within the affected Region or state must be considered, and joint planning for optimal use of all resources must occur to enable a coordinated response to an MCI. Trauma System leaders need to be actively involved in emergency management planning to ensure that trauma centers are integrated into the local, Regional, and state disaster response plans.

Optimal Elements

I. The state lead agency has a comprehensive written trauma system plan based on national guidelines. The plan integrates the trauma system with EMS, public health, emergency preparedness, and incident management. The written trauma system plan is developed in collaboration with community partners and stakeholders. **(B-203)**

   a. The trauma system plan has established clearly defined methods of integrating the trauma system plan with the EMS, emergency, and public health preparedness plans. **(I-203.7)**

II. The trauma, public health, and emergency preparedness systems are closely linked. **(B-208)**

Current Status

The OCEMS Agency (OCEMS) reports that they are not engaged with mental health, social services, child protective services, or public safety to reduce the burden of injury within the county. It is noted that the overarching Health Care Agency (HCA) possesses resources and programs within its agencies (e.g. Behavioral Health Services Agency, Public Health Services Agency), which could provide leadership and guidance to OCEMS in order to promote system integration. Under the purview of the Behavioral Health Services (BHS) Agency, activities in Behavioral Health Operations, Children, Youth & Prevention BHS, and Adult and Older Adult BHS may be helpful to OCEMS. Within the Public Health Services Agency, ongoing activities in California Children's Services, Disease Control & Epidemiology, and Health Promotion may similarly inform and assist OCEMS with system integration. Such collaborative efforts at the county level would energize integrated efforts in primary, secondary, and tertiary injury prevention.

During day-to-day operations, individual trauma centers and base hospitals engage with EMS providers and community resources at the local level. Integration between EMS and base hospitals is quite robust with a focus on field trauma triage, online medical control, and transport destination decisions. This is a strength of the system.

OCEMS reports there is no codified plan for or inclusion of law enforcement, business, schools, or faith groups, in devising local programs for injury prevention or other trauma system activities. Partnering with law enforcement agencies would promote safety initiatives for impaired drivers, stranger danger, and school security and safety.

In the event of a mass casualty incident (MCI), OCEMS has a seat at the table at the Emergency Operations Center (EOC), which is commendable. However, in the event that a trauma center is impacted (impaired due to earthquake damage); system integration to effect facility evacuation is not clearly defined. The lead agency should work with emergency management to develop a surge capacity and mass casualty plan, which is based upon local risk hazards, population, and hospital bed census assessments.

Recommendations

- **Partner with other areas within the Health Care Agency (HCA) to leverage activities involving mental health, social services, and child protection.**

- Develop relationships with state, county, and municipal law enforcement agencies to devise community-based programs which promote safety initiatives.

- Collaborate with trauma centers and EMS Providers to inform disaster response relative to surge capacity and mass casualty planning based upon risk, population, and bed census assessments.

Financing

Purpose and Rationale

Trauma systems need sufficient funding to plan, implement, and evaluate a statewide or Regional system of care. All components of the trauma system need funding, including prehospital, acute care facilities, rehabilitation, and prevention programs. Lead agency trauma system management requires adequate funding for daily operations and other important activities such as advisory committee meetings, development of regulations, data collection, performance improvement, and public awareness and education. Adequate funding to support the operation of trauma centers and their state of readiness to care for seriously injured patients within the state or Region is essential. The financial health of the trauma system is essential for ensuring its integrity and its improvement over time.

The trauma system lead agency needs a process for assessing its own financial health, as well as that of the trauma system. A trauma system budget should be prepared, and costs should be reported by each component, if possible. Routine collection of financial data from all participating health care facilities is encouraged to fully identify the costs and revenues of the trauma system, including costs and revenues pertaining to patient care, administrative, and trauma center operations. When possible, the lead agency financial planning should integrate with the budgets and costs of the EMS system and disaster, rehabilitation, and prevention programs to enable development of a comprehensive financial health report.

Trauma system financial planning should be related to the trauma plan outcome measures (for example, patient outcome measures such as mortality rates, length of stay, and quality-of-life indicators). Such information may demonstrate the value added by having a trauma system in place.

Optimal Elements

I. Sufficient resources, including financial and infrastructure-related, support system planning, implementation, and maintenance. **(B-204)**

   a. Financial resources exist that support the planning, implementation, and ongoing management of the administrative and clinical care components of the trauma system. **(I 204.2)**

   b. Designated funding for trauma system infrastructure support (lead agency) is legislatively appropriated. **(I-204.3)**

   c. Operational budgets (system administration and operations, facilities administration and operations, and EMS administration and operations) are aligned with the trauma system plan and priorities. **(I-204.4)**

II. The financial aspects of the trauma systems are integrated into the overall performance improvement system to ensure ongoing fine tuning and cost-effectiveness. **(B-309)**

a. Collection and reimbursement data are submitted by each agency or institution on at least an annual basis. Common definitions exist for collection and reimbursement data and are submitted by each agency. **(I-309.2)**

Current Status

The Orange County EMS Agency (OCEMS) has several funding sources for the Agency's administrative components of planning, implementation, and evaluation, although minimal funding is dedicated specifically toward the trauma system. Sources of funding include the fees assessed for trauma center designation, ambulance contracts, EMS provider certifications, and the accreditation and approval of EMS training programs.

Health and Safety Code 1797.98a authorizes the collection of penalty assessments by the courts on certain penal code violations to fund County Emergency Medical Services. These funds are placed in the County's Emergency Medical Services Fund (EMSF) and must be allocated 58% for physician services, 25% for hospital services, and the remaining 17% to the County for Emergency Medical Services activities. In 2006, the legislation was amended to allow for an additional penalty to be assessed and deposited into the EMSF upon approval of the Board of Supervisors. The Board approved this additional assessment on December 18, 2007. In accordance with the legislation, an initial 15% of the new penalty funding is allocated to fund pediatric trauma care before the remaining 85% is allocated according to the percentages listed above.

The portion of the EMSF specified for hospitals is distributed to the County's trauma centers: Children's Hospital of Orange County, Mission Hospital, Orange County Global Medical Center, and UCI Medical Center. Each Orange County trauma center receives a base payment of $125,000 and the balance of the fund is distributed proportionately based on the number of trauma runs reported for the fiscal year, including those provided by Long Beach Memorial Hospital due to their proximity to the Orange County border. The funds specified for pediatric trauma care are distributed proportionately based on the number of pediatric trauma runs reported for the fiscal year. The Health Care Agency (HCA) of Orange County estimates the portion of the EMSF to be distributed to hospitals to be $2,472,947 each fiscal year.

The HCA reports that the total funding of these agreements amounted to $4,084,951 for Fiscal Year 2017-2018.

Trauma centers are required to pay a designation fee in the amount of $9,000 every three years to be included in the system. This fee is in addition to the internal financial burden incurred by each trauma center. Their internal financial burdens include dedicated staffing, trauma registries, research, and under-compensated care of the injured.

The financial data tracking for the trauma system is not clearly delineated within the annual budget for OCEMS. It is evident that trauma system stakeholders are unable to report the overall cost and fiscal profile for providing comprehensive trauma care in Orange County.

Trauma centers are reported to be submitting standardized trauma data to a central repository. This presents an opportunity to collect limited financial information on primary and secondary payor sources and total charges. If OCEMS were able to include the submission of these data elements as part of the designated trauma center and non-designated acute care facility agreements, it would be able to gain some financial information for the trauma system. These data could be easily analyzed and regularly reported in the annual reports.

There appears to be no specific funding identified for or dedicated toward trauma system planning, oversight, and evaluation. Trauma system functions such as coalition building, injury prevention, outreach, performance improvement, data system management, and data analysis would benefit from additional funding. Additional funding is also needed to educate the public and policymakers about the need for a trauma system; assess the effectiveness of the patient care provided; enhance system integration with acute care facilities without trauma designation; and to ensure the implementation of an inclusive trauma system for the citizens of Orange County.

Recommendations

- **Dedicate stable and sustainable funding to trauma system planning, oversight, and evaluation.**

- Involve broad stakeholder participation in preparation of the annual trauma system budget.

TRAUMA SYSTEM ASSURANCE

Prevention and Outreach

Purpose and Rationale

Trauma systems must develop prevention strategies that help control injury as part of an integrated, coordinated, and inclusive trauma system. The lead agency and providers throughout the system should be working with business organizations, community groups, and the public to enact prevention programs and prevention strategies that are based on epidemiologic data gleaned from the system.

Efforts at prevention must be targeted for the intended audience, well defined, and structured, so that the impact of prevention efforts is system-wide. The implementation of injury control and prevention requires the same priority as other aspects of the trauma system, including adequate staffing, partnering with the community, and taking advantage of outreach opportunities. Many systems focus information, education, and prevention efforts directly to the general public (for example, restraint use, driving while intoxicated). However, a portion of these efforts should be directed toward emergency medical services (EMS) and trauma care personnel safety (for example, securing the scene, infection control). Collaboration with public service agencies, such as the department of health is essential to successful prevention program implementation. Such partnerships can serve to synergize and increase the efficiency of individual efforts. Alliances with multiple agencies within the system, hospitals, and professional associations, working toward the formation of an injury control network, are beneficial.

Activities that are essential to the development and implementation of injury control and prevention programs include the following:

- A needs assessment focusing on the public information needed for media relations, public officials, general public, and third-party payers, thus ensuring a better understanding of injury control and prevention
- Needs assessment for the general medical community, including physicians, nurses, prehospital care providers, and others concerning trauma system and injury control information
- Preparation of annual reports on the status of injury prevention and trauma care in the system
- Trauma system databases that are available and usable for routine public health surveillance

Optimal Elements

I. The lead agency informs and educates state, Regional, and local constituencies and policy makers to foster collaboration and cooperation for system enhancement and injury control. **(B-207)**

   a. The trauma system leaders (lead agency, advisory committees, and others) inform and educate constituencies and policy makers through community development activities, targeted media messaging, and active collaborations aimed at injury prevention and trauma system development. **(I-207.2)**

II. The jurisdictional Lead Agency, in cooperation with other agencies and organizations, uses analytic tools to monitor the performance of population based prevention and trauma care services. **(B-304)**

    a. The Lead Agency, along with partner organizations, prepares annual reports on the status of injury prevention and trauma care in state, Regional, or local areas. **(I-304.1)**

III. The Lead Agency ensures that the trauma system demonstrates prevention and medical outreach activities within its defined service area. **(B-306)**

    a. The trauma system is active within its jurisdiction in the evaluation of community based activities and injury prevention and response programs. **(I-306.2)**

    b. The effect or impact of outreach programs (medical and community training and support and prevention activities) is evaluated as part of a system performance improvement process. **(I-306.3)**

Current Status

The four trauma centers within Orange County have a robust commitment to injury prevention, and are involved in multiple programs. The individual center trauma program managers and injury prevention coordinators have recently organized an ad hoc committee of the Regional Trauma Operations Committee (RTOC) to improve center coordination in injury prevention activities. All centers have participated in Stop the Bleed, and have taught the program to scouting groups, schools, police, and fire. Other current projects include: “Matter of Balance”, which focuses on geriatric falls, teen/youth alcohol related deterrence programs, the Safe Ride Program, and safe water programs. The ad hoc injury prevention committee is actively engaging community stakeholders on their prevention initiatives. Examples of partners include:

- Safe Kids Orange County (SKOC)
- Local police departments
- School districts
- Municipal court

Other examples of programs in the county include a multi-faceted program addressing pediatric window falls and a water safety program, initiated by one of the non-trauma hospitals involving the local lifeguards.

While there are multiple examples of injury prevention activities occurring in the county, there is minimal involvement of the Orange County Emergency Services Agency (OCEMS) in these projects (with the exception of a project involving drowning). In addition, there is little evidence that injury surveillance data is being utilized to inform the injury prevention agenda, identify trends in injury incidence, or determine effectiveness of interventions. In addition, there is minimal dissemination of injury-related information to the general public and other stakeholders.

Going forward, injury surveillance data needs to be routinely collected and analyzed. Standard reports should be available to stakeholders, including the ad hoc injury prevention committee, to help guide activities and provide evidence to partners of the significance of injury in the community. The ability to provide specialized reports on particular injuries or mechanisms should also be readily available, and is particularly relevant for program evaluation. In addition, an annual injury report should be published to inform the community at large, including elected officials, of the burden of injury to the residents of Orange County. Cost of injury data should

also be made available, particularly to enhance the opportunity for obtaining external funding for prevention activities.

In order for the new injury prevention committee to be successful, it needs accurate injury surveillance data to inform priorities. The ability to follow injury trends is vitally important to understand the impact of prevention activities, and to develop a sustainability plan. With this information, the committee can effectively approach community partners, and better inform them of the impact of injury on particular populations. In addition, this group needs to be broad-based and involve all stakeholders, including those from non-trauma centers.

Recommendations

- **Produce routine injury surveillance reports to inform prevention priorities and evaluate effectiveness of programs.**

- Disseminate an annual injury report to community stakeholders and elected officials.

Emergency Medical Services

Purpose and Rationale

The trauma system includes, and/or interacts with, many different agencies, institutions, and systems. The EMS system is one of the most important of these relationships. EMS is often the critical link between the injury-producing event and definitive care at a trauma center. Even though at its inception the EMS system was a very broad system concept, over time, EMS has come to be recognized as the prehospital care component of the larger emergency health care system. It is a complex system that not only transports patients, but also includes public access, communications, personnel, triage, data collection, and quality improvement activities.

The EMS system medical director must have statutory authority to develop protocols, oversee practice, and establish a means of ongoing quality assessment to ensure the optimal provision of prehospital care. If not the same individual, the EMS system medical director must work closely with the trauma system medical director to ensure that protocols and goals are mutually aligned. The EMS system medical director must also have ongoing interaction with EMS agency medical directors at local Levels, as well as the state EMS for Children program, to ensure that there is understanding of and compliance with trauma triage and destination protocols.

Ideally, a system should have some means of ensuring whether resources meet the needs of the population. To achieve this end, a resource and needs assessment evaluating the availability and geographic distribution of EMS personnel and physical resources is important to ensure a rapid and appropriate response. This assessment includes a detailed description of the distribution of ground ambulance and aeromedical locations across the Region. Resource allocations must be assessed on a periodic basis as needs dictate a redistribution of resources. In communities with full-time paid EMS agencies, ambulances should be positioned according to predictable geographic or temporal demands to optimize response efficiencies. Such positioning schemes require strong prehospital data collection systems that can track the location of occurrences over time. Periodic assessment of dispatch and transport times will also provide insight into whether resources are consistent with needs. Each Region should have objective criteria dictating the Level of response (advanced life support [ALS], basic life support [BLS]), the mode of transport, and the disposition of the patient based on the location of the incident and the severity of injury. A mechanism for case-based review of trauma patients that involves prehospital and hospital providers allows bidirectional information sharing and continuing education, ensuring that expectations are met at both ends. Ongoing review of triage and treatment decisions allows for continuing quality improvement of the triage and prehospital care protocols. A more detailed discussion of in-field (primary) triage criteria is provided in the section titled: System Coordination and Patient Flow (p 20) (White Book).

Human Resources

Periodic workforce assessments of EMS should be conducted to ensure adequate numbers and distribution of personnel. EMS, not unlike other health care professions, experiences shortages and maldistribution of personnel. Some means of addressing recruitment, retention, and engagement of qualified personnel should be a priority. It is critical that trauma system leaders work to ensure that prehospital care providers at all Levels attain and maintain competence in trauma care. Maintenance of competence should be ensured by requiring standards for credentialing and certification and specifying continuing educational requirements for all

prehospital personnel involved in trauma care. The core curricula for First Responder, Emergency Medical Technician (EMT) Basic, EMT-Intermediate, EMT Paramedic, and other Levels of prehospital personnel have an essential orientation to trauma care for all ages. However, trauma care knowledge and skills need to be continuously updated, refined, and expanded through targeted trauma care training such as Prehospital Trauma Life Support®, Basic Trauma Life Support®, and age-specific courses. Mechanisms for the periodic assessment of competence, educational needs, and education availability within the system should be incorporated into the trauma system plan.

Systems of excellence also encourage EMS providers to go beyond meeting state standards for agency licensure and to seek national accreditation. National accreditation standards exist for ground-based and air medical agencies, as well as for EMS educational programs. In some states, agency licensure requirements are waived or substantially simplified if the EMS agency maintains national accreditation.

EMS is the only component of the emergency health care and trauma system that depends on a large cadre of volunteers. In some states, substantially more than half of all EMS agencies are staffed by volunteers. These agencies typically serve rural areas and are essential to the provision of immediate care to trauma patients, in addition to provision of efficient transportation to the appropriate facility. In some smaller facilities, EMS personnel also become part of the emergency resuscitation team, augmenting hospital personnel. The trauma care system program should reach out to these volunteer agencies to help them achieve their vital role in the outcome of care of trauma patients. However, it must be noted that there is a delicate balance between expecting quality performance in these agencies and placing unrealistic demands on their response capacity. In many cases, it is better to ensure that there is an optimal BLS response available at all times rather than a sporadic or less timely response involving ALS personnel. Support to volunteer EMS systems may be in the form of quality improvement activities, training, clinical opportunities, and support to the system medical director.

Owing to the multidisciplinary nature of trauma system response to injury, conferences that include all Levels of providers (for example, prehospital personnel, nurses, and physicians) need to occur regularly with each Level of personnel respected for its role in the care and outcome of trauma patients. Communication with and respect for prehospital providers is particularly important, especially in rural areas where exposure to major trauma patients might be relatively rare.

Integration of EMS within the Trauma System

In addition to its critical role in the prehospital treatment and transportation of injured patients, EMS must also be engaged in assessment and integration functions that include the trauma system and also public health and other public safety agencies. EMS agencies should have a critical role in ensuring that communication systems are available and have sufficient redundancy so that trauma system stakeholders will be able to assess and act to limit death and disability at the single patient Level and at the population Level in the case of mass casualty incidents (MCIs). Enhanced 911 services and a central communication system for the EMS/trauma system to ensure field-to-facility bidirectional communications, inter-facility dialogue, and all-hazards response communications among all system participants are important for integrating a system’s response. Wireless communications capabilities, including automatic crash notification, hold great promise for quickly identifying trauma-producing events, thereby reducing delays in discovery and decreasing prehospital response intervals.

Further integration might be accomplished through the use of EMS data to help define high-risk geographic and demographic characteristics of injuries within a response area. EMS should assist with the identification of injury prevention program needs and in the delivery of prevention messages. EMS also serves a critical role in the development of all-hazards response plans and in the implementation of those plans during a crisis. This integration should be provided by the state and Regional trauma plan and overseen by the lead agency. EMS should participate through its leadership in all aspects of trauma system design, evaluation, and operation, including policy development, public education, and strategic planning.

Optimal Elements

I. The trauma system is supported by an EMS system that includes communications, medical oversight, prehospital triage, and transportation; the trauma system, EMS system, and public health agency are well integrated. **(B-302)**

   a. There is well-defined trauma system medical oversight integrating the specialty needs of the trauma system with the medical oversight for the overall EMS system. **(I-302.1)**

   b. There is a clearly defined, cooperative, and ongoing relationship between the trauma specialty physician leaders (for example, trauma medical director within each trauma center) and the EMS system medical director. **(I-302.2)**

   c. There is clear-cut legal authority and responsibility for the EMS system medical director, including the authority to adopt protocols, to implement a performance improvement system, to restrict the practice of prehospital care providers, and to generally ensure medical appropriateness of the EMS system. **(I-302.3)**

   d. The trauma system medical director is actively involved with the development, implementation, and ongoing evaluation of system dispatch protocols to ensure they are congruent with the trauma system design. These protocols include, but are not limited to, which resources to dispatch, for example, ALS versus BLS, air ground coordination, early notification of the trauma care facility, pre-arrival instructions, and other procedures necessary to ensure that resources dispatched are consistent with the needs of injured patients. **(I-302.4)**

   e. The retrospective medical oversight of the EMS system for trauma triage, communications, treatment, and transport is closely coordinated with the established performance improvement processes of the trauma system. **(I-302.5)**

   f. There is a universal access number for citizens to access the EMS/trauma system, with dispatch of appropriate medical resources. There is a central communication system for the EMS/trauma system to ensure field- to- facility bidirectional communications, inter-facility dialogue, and all-hazards response communications among all system participants. **(I-302.7)**

   g. There are sufficient and well-coordinated transportation resources to ensure that EMS providers arrive at the scene promptly and expeditiously transport the patient to the correct hospital by the correct transportation mode. **(I-302.8)**

II. The lead trauma authority ensures a competent workforce. **(B-310)**

a. In cooperation with the prehospital certification and licensure authority, set guidelines for prehospital personnel for initial and ongoing trauma training, including trauma-specific courses and courses that are readily available throughout the state. **(I-310.1)**

b. In cooperation with the prehospital certification and licensure authority, ensure that prehospital personnel who routinely provide care to trauma patients have a current trauma training certificate, for example, Prehospital Trauma Life Support or Basic Trauma Life Support and others, or that trauma training needs are driven by the performance improvement process. **(I-310.2)**

c. Conduct at least 1 multidisciplinary trauma conference annually that encourages system and team approaches to trauma care. **(I-310.9)**

III. The lead agency acts to protect the public welfare by enforcing various laws, rules, and regulations as they pertain to the trauma system. **(B-311)**

a. Incentives are provided to individual agencies and institutions to seek state or nationally recognized accreditation in areas that will contribute to overall improvement across the trauma system, for example, Commission on Accreditation of Ambulance Services for prehospital agencies, Council on Allied Health Education Accreditation for training programs, and American College of Surgeons (ACS) verification for trauma facilities. **(I-311.6)**

Current Status

Emergency response in Orange County is delivered by fire-based and private EMS providers who operate at the Basic, Advanced, and Critical Care levels. All EMS personnel working in Orange County utilize the same treatment guidelines, which provides a standardized approach to patient care with all the advantages for process improvement. The off-line treatment protocols are provided by Orange County EMS (OCEMS) and are found to be up-to-date and revised on a recurrent basis. Most fire departments provide emergency first response and do not transport patients. However, the fire-based paramedic on scene rides with the transporting private ambulance agency to the designated facility. Each EMS provider is assigned to a designated base hospital (BH) for medical direction, quality review, and continuing education. All Orange County EMS providers utilize an Electronic Patient Care Reporting System (EPCRS) that is National EMS Information System (NEMSIS) compliant and feeds to the California NEMSIS (CEMSIS). This provides opportunity to compare EMS performance at the county level against both statewide and national metrics. The lead agency should establish EMS out-of-hospital benchmarks (such as over- and under-triage, and other EMS Core Measures) which conform to national standards. OCEMS should link NEMSIS data with both in-hospital data and rehabilitation data to establish a single record of the entirety of the patient care experience.

OCEMS designates seven BHs with the responsibility to monitor and oversee the out-of-hospital practice of EMS providers in their catchment area. Each BH has a designated medical director and coordinator (nurse) who oversee emergency medicine physicians and mobile intensive care nurses (MICN) in the provision of on-line medical control (OLMC). Each BH is required to audit OLMC calls, BH radio reports, and EMS Patient Care Reports; provide continuing education to EMS personnel targeted towards needs as identified by QI audits; and provide follow up for deviations from practice. Data from these activities are fed to the Orange County Medical Emergency Data System (OC-MEDS) for compliance audits, variance reports, and administrative reports. It’s not clear what is done with that data from a system-wide perspective.

Base hospitals must hold at least four Regional Emergency Advisory Committee (REAC) meetings each year providing a forum for information dissemination, communication, and continuing education. These efforts should be codified and used to inform system-wide performance improvement initiatives. This model may represent best practice for EMS oversight and quality improvement in this system. There are no metrics available for over- and under-triage and this should be assessed on a regular basis. Of note, the Children's Hospital of Orange County (CHOC) reports wanting to be more involved in triage and destination for pediatric patients. This excellent local resource should be leveraged to optimize their input into the system of care for children beyond what they are already doing as a BH.

EMS provider stakeholders report that regular and structured feedback on the quality of the prehospital care and outcomes data for individual patients is highly valued but not always provided. In addition, EMS providers did not perceive that regular and structured education pertinent to their needs is available on a routine basis. OCEMS should take an active role in monitoring and guiding BH activities to assure the requirements of operation as a BH are being fulfilled.

One private air medical service (AMS) provider offers coverage for Orange County and provides both ALS and critical care levels of services. While this AMS has a physician medical director, the parity of their treatment guidelines with the ground providers in the county is not known. Additionally, Orange County Fire Authority (OCFA) and the Orange County Sheriff's Department provide air rescue services and follow OCEMS guidelines. Stakeholders report that there is an infrequent need for AMS, but it is available if warranted.

Public access to emergency services is via 9-1-1, which is universally accessible. In addition, Public Safety Answering Points (PSAPS) utilize telecommunication device for the deaf (TDD) and text telephone (TTY) to receive requests for services from hearing impaired callers. Twenty PSAPs route 9-1-1 calls to five secondary PSAPs, who dispatch ambulances to medical calls. Four of these utilize Emergency Medical Dispatch (EMD) guidelines. The use of EMD is a value added in dispatch and is especially helpful in understanding the quality of care at the initiation of 911 access, if the performance improvement resources are also utilized. The County does not monitor or assess this aspect of the trauma system.

In California, emergency medical technicians (EMTs) and paramedics must complete an education program accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP) and pass the National Registry of Emergency Medical Technicians (NREMT) exam. Providers are not required to maintain NREMT for recertification. Although maintenance of the National Registry for recertification is not a State of California requirement once providers are initially certified, maintaining NREMT is considered a national best practice. Additionally, EMS personnel must be "accredited" or authorized to practice in Orange County. This credentialing for local practice assures EMS personnel are educated on the standards of emergency practice in Orange County and is considered to be a best practice for patient care and standardization of practice. EMS personnel must complete continuing education units (CEUs) every two years to maintain their California certificate or license; however, none are specific to trauma. OCEMS should consider avenues to assure all 911 field personnel receive recurrent education specifically focused on trauma care. This may be achieved by utilizing existing trauma centers (UCI, OCG, Mission, CHOC,) to provide recurrent trauma-focused education for EMS personnel. Alternatively, requiring all Orange County EMS providers to maintain National Registry would suffice since trauma CEUs are mandatory by NREMT. Efforts to bolster pediatric specific trauma education should leverage the expertise available at Children's Hospital of Orange County and could be aimed not only at 911 personnel, but could

promote pediatric trauma education for all facilities to include current trauma centers as well as Emergency Receiving Centers (ERCs).

EMS education programs in Orange County are offered by fire departments, colleges, and private entities. These programs provide initial, refresher, and continuing education. All programs are required to be accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP). This assures that the education programs are meeting national standards in higher education. No workforce studies have been performed in the county. As a result, it is not known if the number of program graduates will be able to keep pace with the needs for EMS personnel in the future. OCEMS should perform a county-wide workforce assessment to assure adequate numbers of personnel will be available to provide these integral services.

Recommendations

- Establish EMS benchmarks which conform to national standards for the following:
    - Over- and under-triage of trauma patients
    - EMS Core Measures

- Require ongoing and recurrent trauma education for all EMS personnel.

- Perform a workforce assessment to determine the needs for EMS personnel in the future.

Definitive Care Facilities

Purpose and Rationale

Inclusive trauma systems are the systems that include all acute health care facilities, to the extent that their resources and capabilities allow and in which the patient's needs are matched to hospital resources and capabilities. Thus, as the core of a Regional trauma system, acute care facilities operating within an inclusive trauma system provide definitive care to the entire spectrum of patients with traumatic injuries. Acute care facilities must be well integrated into the continuum of care, including prevention and rehabilitation, and operate as part of a network of trauma-receiving hospitals within the public health framework. All acute care facilities should participate in the essential activities of a trauma system, including performance improvement, data submission to state or Regional registries, representation on Regional trauma advisory committees, and mutual operational agreements with other Regional hospitals to address inter-facility transfer, educational support, and outreach. The roles of all definitive care facilities, including specialty hospitals (for example, pediatric, burn, severe traumatic brain injury [TBI], spinal cord injury [SCI]) within the system should be clearly outlined in the Regional trauma plan and monitored by the lead agency. Facilities providing the highest Level of trauma care are expected to provide leadership in education, outreach, patient care, and research and to participate in the design, development, evaluation, and operation of the Regional trauma system.

In an inclusive system, patients should be triaged to the appropriate facility based on their needs and facility resources. Patients with the least severe injuries might be cared for at appropriately designated facilities within their community, whereas the most severe should be triaged to a Level I or II trauma center. In rural and frontier systems, smaller facilities must be ready to resuscitate and initiate treatment of the major injuries and have a system in place that will allow for the fastest, safest transfer to a higher Level of care.

Trauma receiving facilities providing definitive care to patients with other than minor injuries must be specifically designated by the state or Regional lead agency and equipped and qualified to do so at a Level commensurate with injury severity. To assess and ensure that injury type and severity are matched to the qualifications of the facilities and personnel providing definitive care, the lead agency should have a process in place that reviews and verifies the qualifications of a particular facility according to a specific set of resource and quality standards. This criteria-based process for review and verification should be consistent with national standards and be conducted on a periodic cycle as determined by the lead agency. When centers do not meet set standards, there should be a process for suspension, probation, revocation, or de-designation.

Designation by the lead agency should be restricted to facilities meeting criteria or statewide resource and quality standards and based on patient care needs of the Regional trauma system. There should be a well-defined regulatory relationship between the lead agency and designated trauma facilities in the form of a contract, guidelines, or memorandum of understanding. This legally binding document should define the relationships, roles, and responsibilities between the lead agency and the medical leadership from each designated trauma facility.

The number of trauma centers by Level of designation and location of acute care facilities must be periodically assessed by the lead agency with respect to patient care needs and timely access to definitive trauma care. There should be a process in place for augmenting and restricting, if necessary, the number and/or Level of acute care facilities based on these periodic assessments. The trauma system plan should address means for improving acute care facility participation in the trauma system, particularly in systems in which there has been difficulty addressing needs.

Human Resources

The ability to deliver high-quality trauma care is highly dependent on the availability of skilled human resources. Therefore, it is critical to assess the availability and educational needs of providers on a periodic basis. Because availability, particularly of subspecialty resources, is often limited, some means of addressing recruitment, retention, and engagement of qualified personnel should be a priority. Periodic workforce assessments should be conducted. Maintenance of competence should be ensured by requiring standards for credentialing and certification and specifying continuing educational requirements for physicians and nurses providing care to trauma patients. Mechanisms for the periodic assessment of ancillary and subspecialty competence, educational needs, and availability within the system for all designated facilities should be incorporated into the trauma system plan. The lead trauma centers in rural areas will need to consider teleconferencing and telemedicine to assist smaller facilities in providing education on regionally identified needs. In addition, lead trauma centers within the Region should assist in meeting educational needs while fostering a team approach to care through annual educational multidisciplinary trauma conferences. These activities will do much to foster a sense of teamwork and a functionally inclusive system.

Integration of Designated Trauma Facilities within the Trauma System

Designated trauma facilities must be well integrated into all other facets of an organized system of trauma care, including public health systems and injury surveillance, prevention, EMS and prehospital care, disaster preparedness, rehabilitation, and system performance improvement. This integration should be provided by the state and/or Regional trauma plan and overseen by the lead agency.

Each designated acute care facility should participate, through its trauma program leadership, in all aspects of trauma system design, evaluation, and operation. This participation should include policy and legislative development, legislative and public education, and strategic planning. In addition, the trauma program and subspecialty leaders should provide direction and oversight to the development, implementation, and monitoring of integrated protocols for patient care used throughout the system (for example, TBI guidelines used by prehospital providers and non-designated transferring centers), including Region specific primary (field) and secondary (early transfer) triage protocols. The highest Level trauma facilities should provide leadership of the Regional trauma committees through their trauma program medical leadership. These medical leaders, through their activities on these committees, can assist the lead agency and help ensure that deficiencies in the quality of care within the system, relative to national standards, are recognized and corrected. Educational outreach by these higher Levels centers should be used when appropriate to help achieve this goal.

Optimal Elements

I. Acute care facilities are integrated into a resource efficient, inclusive network that meets required standards and that provides optimal care for all injured patients. **(B-303)**

   a. The trauma system plan has clearly defined the roles and responsibilities of all acute care facilities treating trauma and of facilities that provide care to specialty populations (for example, burn, pediatric, SCI, and others). **(I-303.1)**

II. To maintain its state, Regional, or local designation, each hospital will continually work to improve the trauma care as measured by patient outcomes. **(B-307)**

   a. The trauma system engages in regular evaluation of all licensed acute care facilities that provide trauma care to trauma patients and of designated trauma hospitals. Such evaluation involves independent external reviews. **(I-307.1)**

III. The lead trauma authority ensures a competent workforce. **(B-310)**

   a. As part of the established standards, set appropriate Levels of trauma training for nursing personnel who routinely care for trauma patients in acute care facilities. **(I-310.3)**

   b. Ensure that appropriate, approved trauma training courses are provided for nursing personnel on a regular basis. **(I-310.4)**

   c. In cooperation with the nursing licensure authority, ensure that all nursing personnel who routinely provide care to trauma patients have a trauma training certificate (for example, Advanced Trauma Care for Nurses, Trauma Nursing Core Course, or any national or state trauma nurse verification course). As an alternative after initial trauma course completion, training can be driven by the performance improvement process. **(I-310.5)**

   d. In cooperation with the physician licensure authority, ensure that physicians who routinely provide care to trauma patients have a current trauma training certificate of completion, for example, Advanced Trauma Life Support® (ATLS®) and others. As an alternative, physicians may maintain trauma competence through continuing medical education programs after initial ATLS completion. **(I-310.8)**

   e. Conduct at least 1 multidisciplinary trauma conference annually that encourages system and team approaches to trauma care. **(I-310.9)**

   f. As new protocols and treatment approaches are instituted within the system, structured mechanisms are in place to inform all personnel about the changes in a timely manner. **(I-310-10)**

Current Status

The Orange County trauma system was formalized in 1980, including a well-established process to designate trauma centers. Since 1982, designation has been contingent upon verification by the American College of Surgeons Committee on Trauma Verification Review process. The County has the ability to conditionally designate a new center so that the center can start to receive trauma patients and develop a “track record” in preparation for their verification visit. Since 1990, the system has been relatively stable in constitution, with one

Level I trauma center (University of California Irvine), two Level II trauma centers (Mission Hospital - Mission-Viejo, Orange County Global Medical Center) within Orange County and one Level II trauma center in Los Angeles County (Long Beach Memorial). The newest addition to the system is the Children's Hospital of Orange County (CHOC), which became a Level II pediatric trauma center in 2016.

All centers provide a comprehensive range of definitive care to the trauma patient with limited transfers between the trauma centers. Diversion hours were reviewed and were minimal for each definitive care facility. There were no concerns raised about the current capacity of the system in current day-to-day operations.

If a non-designated hospital requests to become a trauma center, OCEMS has the responsibility to review the application and the potential impact on the existing system as outlined by Orange County EMS Policy/Procedure #620.07. Factors considered in this review include population access, geography, trauma patient volume, and the potential impact on the current system. This process ensures that trauma centers are designated in response to assessed system need, with the goal to avoid unnecessary duplication of costly resources. Methods and benchmarks by which these factors are considered in the needs-assessment are not well defined. An analysis entitled *The Orange County Trauma System: 2018* was conducted by the County when a non-designated hospital considered application for trauma center designation. That white paper concluded that the addition of another center would add excess capacity to the system and significantly decrease the number of trauma patients seen at existing legacy centers. As a consequence, concerns were raised relative to the maintenance of quality with less volume, as well as potential financial implications to legacy centers potentially resulting in the closure of centers. The data integrity used to produce this report was questioned by some members of the system, which was a contributing factor for this ACS Trauma System Consultation visit.

Similar concerns regarding a decrease in volume with the addition of another center to the system were raised again at this consultation visit by the existing adult trauma centers. In contrast, centers applying to be new centers felt that the addition of their centers to the system would improve access, decrease transport times, and provide better care for patients which were already being transported to them. Without analysis of the Hospital Discharge Data Set (HDDS) from the emergency receiving centers (ERCs), it is impossible to know exactly how many trauma patients are receiving their definitive care outside of the trauma centers. This is a key element to understanding the true trauma patient volume of the inclusive trauma system in Orange County. Previous attempts at analysis have only included patients identified by base hospital trauma activations. From discussions during the consultation, it seems likely that trauma patients are being treated at non-designated ERCs, but the patient volume and acuity are unknown to the system.

The number and distribution of adult centers has largely remained static for many years. The trauma principals at these centers lead the Regional Trauma Operations Committee (RTOC). Overall, the system appears to operate more exclusively given that trauma care and system design and leadership is delegated to the existing trauma centers. It is worth noting that the definition of an inclusive system envisioned in the 2006 *Model Trauma Systems Evaluation and Planning* document (see Appendix A for reference), and as utilized by the Trauma Systems Consultation Program, defines an inclusive system as one in which all acute care facilities have a defined role (including data reporting requirements) in the care of injured patients, whether or not they are designated as trauma centers. This model specifically does not require that all acute care facilities be designated as trauma centers. From this point of view, the ERCs should be required to submit data to the system, and the system should be obligated to ensure that

appropriate system-wide triage has occurred. Currently, the ERCs do have a requirement of submitting the HDDS, but this is not being done consistently, and thus the true volume and quality of trauma patient care they are providing in the county is impossible to quantify. There is no representation from the ERCs on the RTOC. Benefits to the ERCs in being a part of an inclusive system include participation in system-wide process improvement initiatives, the ability to contribute to protocol development, and having a "seat at the table" as the system continues to evolve.

Geographic and population coverage of the county is excellent. The distribution of trauma centers is well-matched to the population density. The addition of Long Beach Memorial in Los Angeles County is vital to the trauma system as this center provides coverage to the northern part of the county and solves potential traffic issues going south during times of high congestion. Simple geospatial (GIS-based) analysis suggests that over 99% of the county's injured population is within 30 minutes from point of injury to a Level I or Level II center by ground, and over 50% are within 15 minutes (Figure 2). Air medical transport is available for the frontier areas in the western section of the county, but is infrequently utilized.

The county has three Level II designated pediatric trauma centers, two of which coincide with adult trauma centers. The distribution pattern parallels that of the adult centers. Stakeholders felt that ability to gain appropriate access to pediatric centers was good and the addition of CHOC benefitted the system. There are two burn centers in the county and access to specialized burn care did not appear to be an issue.

Focused Analysis

As a part of the consultation, the review team was asked to examine the impact of changes to trauma center configuration on various system components and to provide recommendations on appropriate methods that could be used for determining the need for additional trauma centers in the future. It must first be stated that there are no nationally accepted standards regarding the number, level, or distribution of trauma centers within a system. There are likewise no nationally accepted or validated metrics of trauma system or trauma center performance. Further, there are a number of critical design decisions that require policy-based trade-offs. These are inherently specific to a given region and inherently political.

Very few states or regions have specific regulations related to determining the number and location of trauma centers by objective criteria, and none are strongly evidence-based. Current Orange County policy does allow for a needs-assessment of the system prior to the addition of trauma centers. Specific methods by which to perform that assessment are not defined. This gap (common across many systems in the country) led the ACS COT to create the Needs Based Assessment of Trauma Systems (NBATS) process. This system relied primarily on base population coverage and transport times, while utilizing several other factors derived from prior academic consensus and local politics, and aimed to assign a specific number of trauma centers to a region. The approach has been tested in several regions as part of the NBATS project, and the predictions were found to depend almost entirely upon its population-based scoring elements. The approach tended to overestimate the number of trauma centers in rural regions, and underestimate the number found in urban and suburban regions as compared to the existing distribution, but there is no experience that validates the number of centers predicted by such a tool as the true ideal. There is fairly extensive literature on the use of various geospatial approaches to generate optimized system configurations. These approaches can optimize various parameters, also based upon volume and transportation time, but suffer from the same ultimate limitation; there is no data that validates such "optimized" configurations

as the best operational solution. These observations have led the ACS COT to re-evaluate the NBATS process, with the central assumption, summarized above, that trauma system configuration inherently relies on policy-based trade-offs, and that objective metrics are best utilized to provide a basis to help choose between various options, rather than to define a single best configuration.

The ACS TSC Review Team was specifically asked to address the impact of changes to the trauma center configuration on various system components such as access, volume, and transport times. Ultimately, the decision to continue the current model, which has worked well over many years, or to reconfigure the current system is one that should be made as part of the collective vision for the future of Orange County. This decision must be made locally and potential financial or verification impacts to existing centers should be considered. The potential financial instability at existing centers with the loss of trauma patients is beyond the scope of this consultation.

For more detailed analysis of trauma center access, the County provided trauma registry data for a 27-month period (January, 2017 – March, 2019) for patients transported directly from the scene of injury to current trauma centers, including destination hospital, zip code or city of injury, and injury severity. This data set included 12,743 patients transported from within Orange County with known location of injury. This data allows only limited precision with respect to geo-localization of injury. Figure 1 below shows the location of the current three trauma centers in the county and the approximate location of injury of the patients each received. Table 1 shows the current volume distribution and the potential shifts in the volume based on closest facility if other hospitals become trauma centers. Table 2 is the same analysis but includes only patients with an ISS > 15.

Geospatial modelling allows the testing of various hypothetical system configurations to determine the effects and provides the opportunity to select the optimal solution based on objective estimates of population coverage and transport times. Transport time analysis was conducted by OCEMS and verified utilizing the data set above. This analysis shows excellent geospatial coverage of the existing centers with > 99% of trauma patients less than 30 minutes from a trauma center by ground transport. It should be noted that these models are based on normal traffic conditions and do not account for potential congestion. Future work on Interstate 405 may cause further traffic issues but true impact is not defined at this time. The addition of trauma centers to the county does not significantly impact geographical access to care or transport times. Figure 2

It is generally accepted that a high-level center must treat a minimum number of injured patients to justify resource expenditure and to maintain institutional experience. There is data to suggest that high-volume centers may have better outcomes than low volume centers, but this data is inconsistent, and its interpretation is controversial. Volume requirements for high-level trauma centers are most often expressed in terms of raw population coverage, which is more easily calculated, or in terms of number of injured patients in the region, which is more difficult to assess. Across US trauma systems, the population served by a single high-level center most commonly lies between about 250,000 to 1,000,000, with a few systems in which the value is significantly higher. Lower population coverage per center is seen in systems that favor flexibility and surge capacity, with higher population coverage per center favored by those that feel care is improved at high-volume centers, and in regions that are served by well-established high-volume centers. It must be re-stated that in almost all cases the actual number of trauma centers in a region within the US is operationally determined by market forces. The choice of necessary population base is the most objective and reproducible method to set the number of

centers within a trauma service area. Metrics of system access, such as geographic coverage and transportation times can be used to add specificity to the choice of optimal geographic location, and to fine-tune population-based estimates. UC Irvine as an ACS Level I center must keep the volume requirement of 1,200 patients admitted per year or have 240 admissions with an ISS > 15. The analysis below is based only on closest facility to the zip code of injury and is only an estimate. The only validation attempt at this methodology did not show that the estimates held true likely in the studied system due to a number of trauma patients that were not captured in the trauma system prior to the addition of another center. A similar issue has been implied by members of the ERCs of Orange County; however, this is impossible to confirm with current data. The estimates below may very well underestimate the true number of trauma patients in the county and additional centers may not affect volume deleteriously of the legacy centers. Unfortunately, we don't know what we don't know.

Recommendations

- **Establish a clear and transparent process, utilizing data from EMS, trauma centers, and emergency receiving centers, to ensure the trauma system meets the needs of all injured patients according to locally accepted standards.**
    - **Integrate emergency receiving hospitals into the inclusive Trauma System.**
    - **Require that all facilities submit a minimum trauma dataset to form a comprehensive profile of injury care in the county**

Figure 1: Current distribution of trauma patients

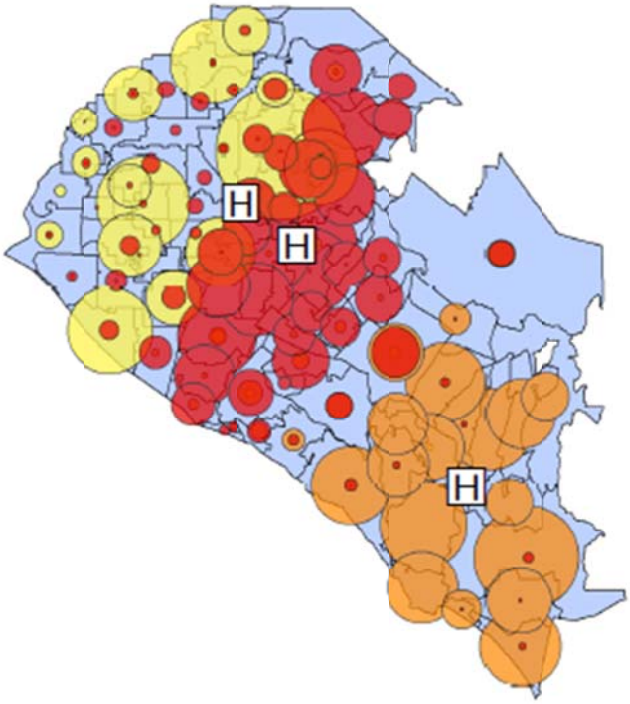

Table 1: Current volume distribution of all Orange County trauma patients and potential volume shifts with the addition of St. Jude, Hoag, or Fountain

Hospital	Injuries within OC with known location	Add. of St. Jude	# Inj to St. Jude	Add. of Hoag	# Inj to Hoag	Add. of Foun.	# Inj to Foun.
UC Irvine	**3389 (77%)**	2692	697	2865	524	2392	997
OC Global	**4838 (90%)**	4535	303	3584	1254	3159	1679
Mission	**4516 (80%)**	4497	19	4338	178	4338	178

Figure 2: Maps showing transport times provided by OCEMS

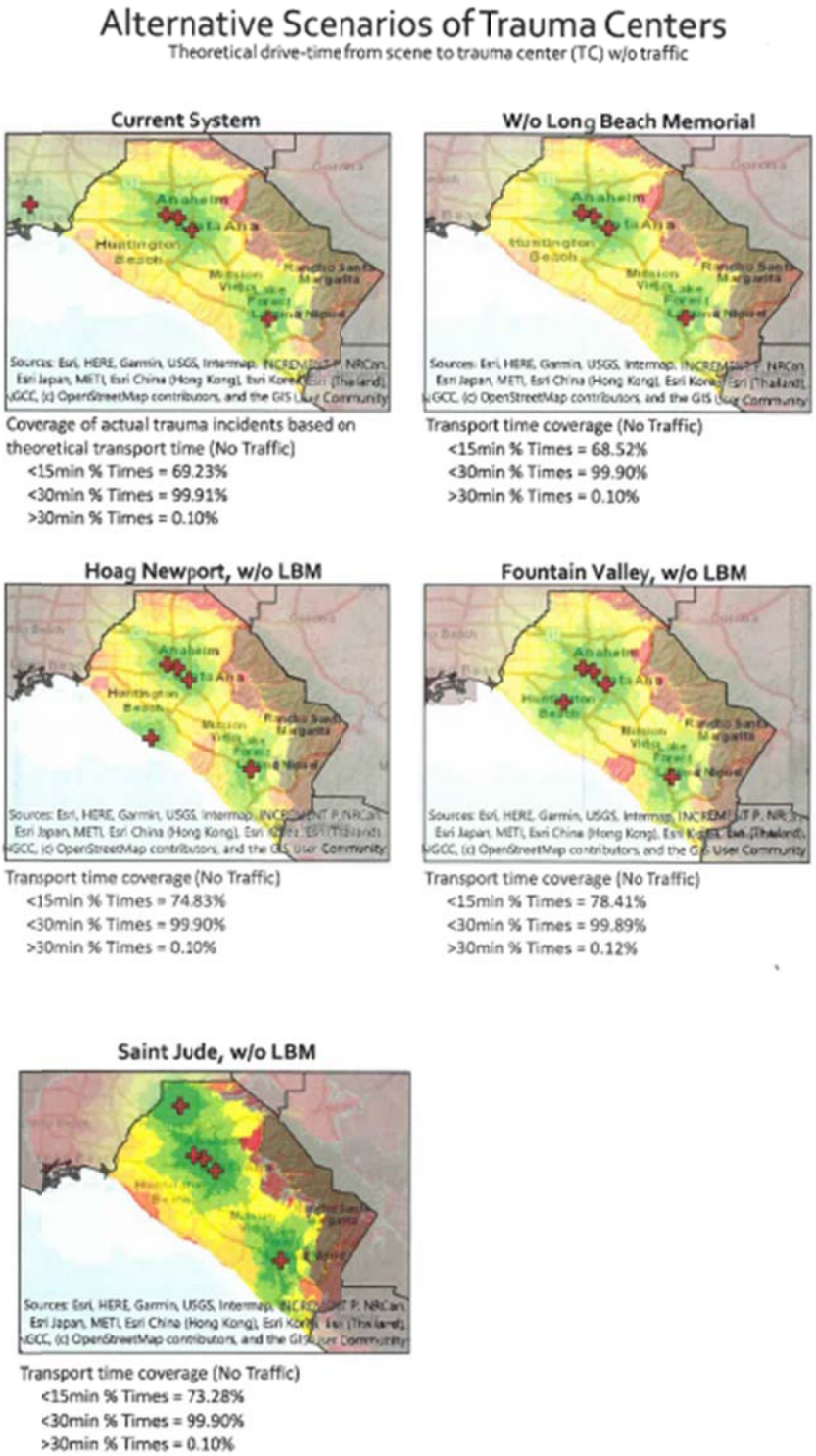

Table 2: Current volume distribution of all Orange County trauma patients with ISS > 15 and potential volume shifts with the addition of St. Jude, Hoag, or Fountain

Hospital	Injuries with ISS > 15 within OC with known location	Add. of St. Jude	# Inj. to St. Jude	Add. of Hoag	# Inj. to Hoag	Add. of Foun.	# Inj to Foun.
UC Irvine	**930**	729	201	768	162	629	301
		78%	22%	83%	17%	68%	32%
OC Global	**614**	585	29	425	189	377	237
		95%	5%	69%	31%	61%	39%
Mission	**563**	562	1	537	26	537	26
		100%	0%	95%	5%	95%	5%

System Coordination and Patient Flow

Purpose and Rationale

To achieve the best possible outcomes, the system must be designed so that the right patient is transported to the right facility at the right time. Although on the surface this objective seems relatively straightforward, patients, geography, and transportation systems often conspire to present significant challenges. The most critically injured trauma patient is often easy to identify at the scene by virtue of the presence of coma or hypotension. However, in some circumstances, the patients requiring the resources of a Level I or II center may not be immediately apparent to prehospital providers. Primary or field triage criteria aid providers in identifying which patients have the greatest likelihood of adverse outcomes and might benefit from the resources of a designated trauma center. Even if the need is identified, Regional geography or limited air medical (or land) transport services might not allow for direct transport to an appropriate facility.

Primary triage of a patient from the field to a center capable of providing definitive care is the goal of the trauma system. However, there are circumstances (for example, airway management, rural environments, inclement weather) when triaging a patient to a closer facility for stabilization and transfer is the best option for accessing definitive care. Patients sustaining severe injuries in rural environments might need immediate assessment and stabilization before a long-distance transport to a trauma center. In addition, evaluation of the patient might bring to light severe injuries for which needed care exceeds the resources of the initial receiving facility. Some patients might have specific needs that can be addressed at relatively few centers within a Region (for example, pediatric trauma, burns, severe TBI, SCI, and re-implantation). Finally, temporary resource limitations might necessitate the transfer of patients between acute care facilities.

Secondary triage at the initial receiving facility has several advantages in systems with a large rural or suburban component. The ability to assess patients at non-designated or Level III to V centers provides an opportunity to limit the transfer of only the most severely injured patients to Level I or II facilities, thus preserving a limited resource for patients most in need. It also provides patients with lesser injuries the possibility of being cared for within their community.

The decision to transfer a trauma patient should be based on objective, prospectively agreed-on criteria. Established transfer criteria and transfer agreements will minimize discussions about individual patient transfers, expedite the process, and ensure optimal patient care. Delays in transfer might increase mortality, complications, and length of stay. A system with an excess of transferred patients might tax the resources of the Regional trauma facility. Conversely, inappropriate retention of patients at centers without adequate facilities or expertise might increase the risk of adverse outcomes. Given the importance of timely, appropriate inter-facility transfers, the time to transfer, as well as the rates of primary and secondary over-triage basis, and corrective actions should be instituted when problems are identified. Data derived from tracking and monitoring the timeliness of access to a Level of trauma care commensurate with injury type and severity should be used to help define optimal system configuration.

A central communications center with real-time access to information on system resources greatly facilitates the transfer process. Ideally, this center identifies a receiving facility, facilitates dialogue between the transferring and receiving centers, and coordinates inter-facility transport.

To ensure that the system operates at the greatest efficiency, it is important that patients are repatriated back to community hospitals once the acute phase of trauma care is complete. The process of repatriation opens up the limited resources available to care for severely injured patients. In addition, it provides an opportunity to bring patients back into their local environment where their social network might help reintegrate patients into their community.

Optimal Elements

I. The trauma system is supported by an EMS system that includes communications, medical oversight, prehospital triage, and transportation; the trauma system, EMS system, and public health agency are well integrated. **(B-302)**

   a. There are mandatory system-wide prehospital triage criteria to ensure that trauma patients are transported to an appropriate facility based on their injuries. These triage criteria are regularly evaluated and updated to ensure acceptable and system-defined rates of sensitivity and specificity for appropriately identifying a major trauma patient. **(I-302.6)**

   b. There is a universal access number for citizens to access the EMS/trauma system, with dispatch of appropriate medical resources. There is a central communications system for the EMS/trauma system to ensure field-to- facility bidirectional communications, inter-facility dialogue, and all-hazards response communications among all system participants. **(I-302.7)**

   c. There is a procedure for communications among medical facilities when arranging for inter-facility transfers, including contingencies for radio or telephone system failure. **(I-302.9)**

II. Acute care facilities are integrated into a resource-efficient, inclusive network that meets required standards and that provides optimal care for all injured patients. **(B-303)**

   a. When injured patients arrive at a medical facility that cannot provide the appropriate Level of definitive care, there is an organized and regularly monitored system to ensure that the patients are expeditiously transferred to the appropriate system-defined trauma facility. **(I-303.4)**

Current Status

One dedicated pediatric trauma center and four adult trauma centers (including Long Beach Memorial) with pediatric capabilities manage the comprehensive spectrum of injury across the county. The OCEMS Agency (OCEMS) bases its trauma activation for EMS upon the CDC Field Triage Guidelines. Trauma field triage protocols direct EMS personnel to establish base hospital contact to determine the appropriate destination based upon injury acuity, center capability, and trauma center status. In addition, EMS personnel have protocol support for making base hospital contact for injuries that do not meet the threshold of established field triage criteria, but may need trauma or other special services as judged by paramedic intuition. OCEMS designates and contracts with base hospitals to provide online medical direction of prehospital emergency medical care personnel within its area of jurisdiction. All four Orange County trauma centers and three additional hospitals are designated as base hospitals.

The trauma system has developed a highly functional retriage methodology for the inter-facility transfer of under-triaged patients delivered to Emergency Receiving Centers (ERCs) but subsequently discovered to require trauma center care. Those injured patients requiring immediate transfer to a higher level of care are transferred to a trauma center using the 911 system with paramedic support. Lower acuity patients meeting threshold criteria for activation may be transferred by an OCEMS approved ALS transport service that operates under Inter-facility Transfer (IFT) Standing Orders. The system does not have good visibility on the over- and under- triage rates for trauma patients within the system. Likewise, the number and acuity of injured patients seen and managed at the ERCs is unknown. The issues of triage and numbers of trauma patients seen at non-trauma centers would be immediately remediable by developing a comprehensive data source of all injured patients seen within the county.

No process currently exists to track a patient across the continuum of care from the prehospital environment through discharge to home or completion of rehabilitation.

Recommendations

- Conduct a comprehensive analysis of injury care across Orange County, specifically including non-designated centers managing injured patients in order to develop an objective perspective of the contribution of non-designated facilities in trauma care.

- Assess the compliance of non-designated acute care facilities with regionally established trauma transfer guidelines.

- Analyze over and under triage rates across the system of care.

- Perform an analysis of population access to specialty trauma services including pediatrics, burn, and reimplantation.

Rehabilitation

Purpose and Rationale

As an integral component of the trauma system, rehabilitation services in acute care and rehabilitation centers provide coordinated care for trauma patients who have sustained severe or catastrophic injuries, resulting in long-standing or permanent impairments. Patients with less severe injuries may also benefit from rehabilitative programs that enhance recovery and speed return to function and productivity. The goal of rehabilitative interventions is to allow the patient to return to the highest Level of function, reducing disability and avoiding handicap whenever possible. The rehabilitation process should begin in the acute care facility as soon as possible, ideally within the first 24 hours. Inpatient and outpatient rehabilitation services should be available. Rehabilitation centers should have CARF (Commission on Accreditation of Rehabilitation Facilities) accreditation for comprehensive inpatient rehabilitation programs, and accreditation of specialty centers (SCI and TBI) should be strongly encouraged.

The trauma system should conduct a rehabilitation needs assessment (including specialized programs in SCI, TBI, and for children) to identify the number of beds needed and available for rehabilitation in the geographic Region. Rehabilitation specialists should be integrated into the multidisciplinary advisory committee to ensure that rehabilitation issues are integrated into the trauma system plan. The trauma system should demonstrate strong linkages and transfer agreements between designated trauma centers and rehabilitation facilities located in its geographic Region (in or out of state). Plans for repatriation of patients, especially when rehabilitation centers across state lines are used, should be part of rehabilitation system planning. Feedback on functional outcomes after rehabilitation should be made available to the trauma centers.

Optimal Elements

I. The lead agency ensures that adequate rehabilitation facilities have been integrated into the trauma system and that these resources are made available to all populations requiring them. **(B-308)**

    a. The lead agency has incorporated, within the trauma system plan and the trauma center standards, requirements for rehabilitation services, including inter-facility transfer of trauma patients to rehabilitation centers. **(I-308.1)**

    b. Rehabilitation centers and outpatient rehabilitation services provide data on trauma patients to the central trauma system registry that include final disposition, functional outcome, and rehabilitation costs and also participate in performance improvement processes. **(I-308.2)**

II. A resource assessment for the trauma system has been completed and is regularly updated. **(B-103**)

    a. The trauma system has completed a comprehensive system status inventory that identifies the availability and distribution of current capabilities and resources. **(I-103.1)**

Current Status

The Orange County EMS Agency (OCEMS) reports having over 450 licensed rehabilitation beds, including both inpatient acute rehabilitation beds as well as transitional care beds within licensed acute care facilities. Several of these facilities are accredited by the Commission on Accreditation of Rehabilitation Facilities (CARF), although this distinction is not uniformly reported. This capacity does not include intermediate care facilities (e.g. skilled nursing facilities, long-term care facilities), which may also provide these services. Capacity relative to specialty services available within the trauma system's geographic region such as spinal cord injury (SCI), traumatic brain injury (TBI), and pediatrics is not known, although stakeholders report the need for additional pediatric rehab beds. OCEMS should perform a gap analysis to identify the number and type of rehabilitation beds that are needed, including specialty beds, versus the numbers available.

At the County level, there is no collection of data relative to wait times and barriers to access to rehabilitation. Similarly, transfer agreements and repatriation efforts are not assessed or monitored. This absence of data prevents the County from understanding patient flow within the trauma system. Stakeholders report difficulties placing unfunded, homeless, and young adults in rehabilitation programs. However, they identified a program, Recuperative Care, offered by the Illumination Foundation, which is a 501(c)(3) organization that provides medical stabilization as well as assistance with housing. The impact of this program as well as other potential resources for rehabilitation services may be clarified if a gap analysis were performed.

At the County level and trauma center level, there is a nascent understanding of the quality of rehabilitation care and the metrics from which to make systematic improvements. The collection of rehab metrics is severely limited and coordinated feedback from rehab specialists and specialized facilities does not exist. Physiatrists typically report metrics via the Uniform Data System for Medical Rehabilitation, which potentially may be leveraged by trauma centers and OCEMS for process improvement activities. Inadequate data on rehabilitation services and other post-discharge outcomes hampers an understanding of the magnitude of lost productivity, economic impact, and the consumption of social services occurring at the community level. OCEMS should link NEMSIS data with in-hospital data and rehabilitation data to establish a single record of the patient's continuum of care. This approach will allow for feedback and performance improvement.

Rehabilitation is not currently represented on any OCEMS advisory committees. This represents a lost opportunity to integrate this aspect of patient care into the fabric of the trauma system.

Recommendations

- Perform a comprehensive status inventory to identify the availability and distribution of current capabilities and resources in rehabilitation including specialty services such as:
    - SCI
    - TBI
    - Pediatric
    - Vent dependent

- Evaluate the rehabilitation wait times and denials to identify opportunities and optimize patient flow.

- Identify barriers to the repatriation of the injured patient to their home community.

- Integrate representatives from rehabilitation into existing multidisciplinary advisory committees.

- Develop linkages between rehabilitation data repositories and the trauma databases to allow for feedback and performance improvement.

Disaster Preparedness

Purpose and Rationale

As critically important resources for state, Regional, and local responses to MCIs, the trauma system and its trauma centers are central to disaster preparedness. Trauma system leaders need to be actively involved in public health preparedness planning to ensure that trauma system resources are integrated into the state, Regional, and local disaster response plans. Acute care facilities (sometimes including one or more trauma centers) within an affected community are the first line of response to an MCI. However, an MCI may result in more casualties than the local acute care facilities can handle, requiring the activation of a larger emergency response plan with support provided by state and Regional assets.

For this reason, the trauma system and its trauma centers must conduct a resource assessment of its surge capacity to respond to MCIs. The resource assessment should build on and be coupled to a hazard vulnerability analysis. An assessment of the trauma system's response to simulated incident or tabletop drills must be conducted to determine the trauma system's ability to respond to MCIs. Following these assessments, a gap analysis should be conducted to develop statewide MCI response resource standards. This information is essential for the development of an emergency management plan that includes the trauma system.

Planning and integration of the trauma system with plans of related systems (public health, EMS, and emergency management) are important because of the extensive impact disasters have on the trauma system and the value of the trauma system in providing care. Relationships and working cooperation between the trauma system and public health, EMS, and emergency management agencies support the provision of assets that enable a more rapid and organized disaster response when an event occurs. For example, the EMS emergency preparedness plan needs to include the distribution of severely injured patients to trauma centers, when possible, to make optimal use of trauma center resources. This plan could optimize triage through directing less severely injured patients to lower Level trauma centers or non-designated facilities, thus allowing resources in trauma centers to be spared for patients with the most severe injuries. In addition, the trauma system and its trauma centers will be targeted to receive additional resources (personnel, equipment, and supplies) during major MCIs.

Mass casualty events and disasters are chaotic, and only with planning and drills will a more organized response be possible. Simulation or tabletop drills provide an opportunity to test the emergency preparedness response plans for the trauma system and other systems and to train the teams that will respond. Exercises must be jointly conducted with other agencies to ensure that all aspects of the response plan have the trauma system integrated.

Optimal Elements

I. An assessment of the trauma system's emergency preparedness has been completed, including coordination with the public health agency, EMS system, and the emergency management agency. **(B-104)**

    a. There is a resource assessment of the trauma system's ability to expand its capacity to respond to MCIs in an all-hazards approach. **(I-104.1)**

b. There has been a consultation by external experts to assist in identifying current status and needs of the trauma system to be able to respond to MCIs. **(I-104.2)**

c. The trauma system has completed a gap analysis based on the resource assessment for trauma emergency preparedness. **(I-104.3)**

II. The lead agency ensures that its trauma system plan is integrated with, and complementary to, the comprehensive mass casualty plan for natural and manmade incidents, including an all-hazards approach to planning and operations. **(B-305)**

a. The EMS, the trauma system, and the all-hazards medical response system have operational trauma and all-hazards response plans and have established an ongoing cooperative working relationship to ensure trauma system readiness for all-hazards events. **(I-305.1)**

b. All-hazards events routinely include situations involving natural (for example, earthquake), unintentional (for example, school bus crash), and intentional (for example, terrorist explosion) trauma-producing events that test the expanded response capabilities and surge capacity of the trauma system. **(I-305-2)**

c. The trauma system, through the lead agency, has access to additional equipment, materials, and personnel for large-scale traumatic events. **(I-305.3)**

Current Status

The Orange County Health Care Agency receives funding from the Centers for Disease Control and Prevention (CDC) to support disaster and preparedness planning. Additionally, Orange County collaborates with the California Department of Public Health (CDPH) and other state and local entities to support disaster preparedness efforts. The Health Emergency Management (HEM) section of the OCEMS Agency supports the all-hazards preparedness activities managed by Orange County, including coordination with municipal efforts within the jurisdiction. By state statute, California Health & Safety Code 1797.200, OCEMS is authorized to administer and provide oversight to disaster preparedness and response activities for the Orange County Healthcare Agency. During the contingency of a disaster, state code directs the local Health Officer and LEMSA Administrator to act as the Medical Health Operational Area Coordinator (MHOAC) in order to obtain and manage medical resources. Similarly, regulation charges the Regional Disaster Medical Health Coordinator (RDMHC) with the responsibility to initiate and coordinate regional mutual aid requests. Orange County is within Region I of the 6 California RDMHS mutual aid regions. Orange County has enlisted a Medical Reserve Corps (OCMRC) which is a troop of credentialed, organized medical volunteers who assist during disaster and public health emergencies. Though this group exists, stakeholder comment suggests that this capability has limited participation and functionality. The Orange County trauma centers have been proactive in developing a preparedness posture and solutions with the preparedness system.

The OCEMS Agency is responsible as the lead agency for coordination of the annual disaster preparation exercises. All trauma centers participate in Orange County and statewide disaster drills semiannually. In addition, all base hospitals within Orange County participate in frequent MCI drills internally and at the local and regional level to enhance their preparedness. The level of preparedness of the other acute care facilities was not specifically elicited at the time of the consultation. However, the PRQ suggests that all hospitals are engaged in the disaster

preparedness process. The system reportedly performs in depth exercise-based vulnerability analyses after each of these exercise events and subsequently develops salient remediation strategies. The most recent Orange County Hazard Vulnerability Assessment was published in November 2015, although most trauma system stakeholders do not appear to be familiar with the results of this analysis.

The emergency preparedness program has incorporated ReddiNet communications technology that provides real-time communications and resource management. This capability affords users the capability to track bed status and receive event-specific alerts. This is a vital resource in the event that radio signal communication is compromised.

Recommendations

- **Ensure that all acute care facilities, as participants in the inclusive trauma system, have appropriate resources and training to care for the injured patient in the event of a disaster or mass casualty event.**

- Integrate the utilization of ReddiNet system into preparedness exercises in order to optimize and track casualty flow.

- Enhance visibility of disaster gap analyses generated from exercises performed in the county and support development of remediation strategies.

- Integrate clinical representation from all trauma centers and emergency receiving centers in preparedness and response planning to support a comprehensive and inclusive response to disasters.

- Develop a Hazards Vulnerability Assessment (HVA) and disseminate to trauma system stakeholders.

System-wide Evaluation and Quality Assurance

Purpose and Rationale

The trauma lead agency has responsibility for instituting processes to evaluate the performance of all aspects of the trauma system. Key aspects of system-wide effectiveness include the outcomes of population based injury prevention initiatives, access to care, as well as the availability of services, the quality of services provided within the trauma care continuum from prehospital and acute care management phases through rehabilitation and community reintegration, and financial impact or cost. Intrinsic to this function is the delineation of valid, objective metrics for the ongoing quality audit of system performance and patient outcomes based on sound benchmarks and available clinical evidence. Trauma management information systems (MISs) must be available to support data collection and analysis.

The lead agency should establish forums that promote inclusive multidisciplinary and multiagency review of cases, events, concerns, regulatory issues, policies, procedures, and standards that pertain to the trauma system. The evaluation of system effectiveness must take into account the integration of these various components of the trauma care continuum and review how well personnel, agencies, and facilities perform together to achieve the desired goals and objectives. Results of customer satisfaction (patient, provider, and facility) appraisals and data indicative of community and population needs should be considered in strategic planning for system development. System improvements derived through evaluation and quality assurance activities may encompass enhancements in technology, legislative or regulatory infrastructure, clinical care, and critical resource availability.

To promote participation and sustainability, the lead agency should associate accountability for achieving defined goals and trauma system performance indicators with meaningful incentives that will act to cement the support of key constituents in the health care community and general population. For example, the costs and benefits of the trauma system as they relate to reducing mortality or decreasing years of productive life lost may make the value of promoting trauma system development more tangible. A facility that achieves trauma center verification/designation may be rewarded with monetary compensation (for example, ability to bill for trauma activation fees) and the ability to serve as a receiving center for trauma patients. The trauma lead agency should promote ongoing dialog with key stakeholders to ensure that incentives remain aligned with system needs.

Optimal Elements

I. The trauma MIS is used to facilitate ongoing assessment and assurance of system performance and outcomes and provides a basis for continuously improving the trauma system, including a cost-benefit analysis. **(B-301)**

   a. The lead trauma authority ensures that each member hospital of the trauma system collects and uses patient data, as well as provider data, to assess system performance and to improve quality of care. Assessment data are routinely submitted to the lead trauma authority. **(I-301.1)**

II. The jurisdictional lead agency, in cooperation with other agencies and organizations, uses analytic tools to monitor the performance of population based prevention and trauma care services. **(B-304)**

III. The financial aspects of the trauma system are integrated into the overall performance improvement system to ensure ongoing fine tuning and cost-effectiveness. **(B-309)**

    a. Financial data are combined with other cost, outcome, or surrogate measures, for example, years of potential life lost, quality-adjusted life years, and disability adjusted life years; length of stay; length of intensive care unit stay; number of ventilator days; and others, to estimate and track true system costs and cost- benefits. **(I-309.4)**

Current Status

The *2016 Orange County Emergency Medical Services Trauma System Plan* identified a system-wide continuous quality improvement program to monitor, review, evaluate, and improve the delivery of prehospital and trauma care services. There are ongoing county-wide efforts to define the system needs through regular data analysis reviews, committee based review, and system evaluation expectations. The standardized performance criteria review integrates the following elements:

- Internal quality improvement processes for each trauma center
- External quality improvement for regional trauma care
- Trauma center and system review

The internal quality improvement review is linked to the trauma center's performance improvement plan. The trauma center review focuses on evaluating the trauma center for compliance with verification standards and the contract with the Orange County EMS Agency (OCEMS). These reviews may be done periodically or on a three year cycle for trauma center verification and compliance with the California regulations and local requirements of the trauma system.

The external quality review process focuses on the regional activities in the 2016 report. The Regional Trauma Operations Advisory Committee (RTOC) leads these quality reviews. The mission of the Committee is to optimize the quality of care and outcomes for all EMS trauma patients with a focus on injury prevention and reducing injury severity and death. Each trauma center participates in the EMS regional trauma studies and audits. The performance improvement process initiatives identified in the 2016 report included high risk, high volume calls for the base hospitals, specific audit topics established through the Quality Assurance Board, specific topics established through the RTOC, and identified trends impacting quality of care in the system.

The data included in the current PRQ reflect RTOC's organizational structure and membership, which includes the current trauma program manager and trauma medical director from each Orange County trauma center, as well as a trauma program representative from Long Beach Memorial trauma center. The additional members are comprised of OCEMS staff. There is limited stakeholder participation in this committee. The responsibility of this committee is defined as the multidisciplinary forum to monitor, evaluate, and report on the operation and quality of trauma services in Orange County. Data routinely presented at the committee include trauma diversion reports, clinical practice information, selected PI cases for review, and trauma system policies and planning reports. Additionally, this committee is involved in the trauma center grant

fund (Emergency Medical Services Fund) and reviews grants to recommend distribution formulas and track outcomes.

The discussion with the stakeholders during the consultation identified a need for consistent data to facilitate reviews, establish priorities, and define outcomes. The trauma program managers have taken the lead to review more comprehensive data regarding trauma patient outcomes. The trauma program managers, along with injury prevention coordinators, have initiated an ad hoc injury prevention committee of the RTOC that is integrating stakeholders and resources from the community to develop stronger collaboration and partnerships. The processes in place focus on trauma center led performance reviews. System led performance reviews are lacking.

A second document, *The Orange County Trauma System: 2018*, was reviewed. This document is an assessment of the current system and the potential impact of an additional trauma center. The report evaluates projected population for Orange County, transport times, diversion times, and the current volume and acuity at the four trauma centers. EMS overload was also reviewed. This report reflects that an additional trauma center could negatively impact the trauma center volume at the current trauma centers.

A trauma system performance improvement plan is not developed. A written trauma system performance plan provides the structure and processes to focus actions and discussion that promote outcome reviews, data-driven decisions, and the development of outcome measures defined by the stakeholders. The plan needs clearly set definitions and terminology that ensure data reliability and integrity. It should encompass the prehospital setting and decisions, trauma center care, access to rehabilitation, financial outcomes such as length of stay and associated costs, injury prevention outcomes, and disaster response outcomes.

Outcomes should be selected based on evidence-based practice and should be monitored through the performance improvement plan. The plan should include compliance of data submission to the County registries, including both the completeness and quality of the data submitted. Standard reports from this registry should support the system trauma performance improvement plan. The RTOC needs to establish a system performance improvement sub-committee to be responsible for the plan development, implementation, and ongoing monitoring. The Orange County EMS Agency and the stakeholders need to evaluate the current statutes that protect the performance improvement reviews from disclosure and discoverability. A dashboard that reflects the reviews and outcomes of the trauma system performance improvement plan should be presented and shared at the RTOC and the Emergency Medical Care Committee, and be included in a trauma system annual report. This ensures all stakeholders have access to aggregate outcome data.

Orange County EMS proposed the two focus questions related to systems PI addressed below.

Does the Trauma System Consultation Committee feel the performance improvement program has identified adequate PI initiatives as a system and has adequate loop closure? How important is post-mortem exam in performance improvement?

The Trauma System Consultation Team did not identify an adequate system performance improvement program with targeted performance improvement initiatives or adequate event resolution. The performance improvement process is lacking several critical elements including system data, a process for identifying opportunities and recommended action plans, and tracking through to event closure. The trauma program manager ad hoc data committee

demonstrates the most dedication to the performance improvement initiatives. Please see the above paragraph for additional information.

The post-mortem exam provides the opportunity to identify missed injuries and opportunities for trauma system integration. Complete autopsies shared within a defined trauma performance improvement committee can assist in identifying potential prevention strategies, education regarding injury patterns, and defined opportunities for the system. An example is the child fatality reviews. Information from autopsies may explain deaths and provide additional information the system stakeholders may act on for improvements.

What method would ACS recommend for effectively monitoring and managing over-triage and under-triage of the critically injured patients within the county?

The Matrix Method included in the 2014 *Resources for Optimal Care of the Injured Patient*[1] is the most common method for evaluating over-and-under triage of the trauma patient. This is a simple process that assists in defining over-triage and under-triage. Once this is defined, the system (trauma center or trauma system) should identify those patients that were considered over-triaged and those under-triaged to identify trends. Those patients under-triaged have the greater risk, but over-triage can impact the system's ability to meet the needs of the critically injured patient as well.

Another method is to review all trauma patients by their activation level. Patients that meet the second level of activation who have an ISS of 25 or greater should be reviewed. In addition, any patient who has an ISS of 16 or greater in the lowest level of activation should be reviewed. The key is the actual review of these patients to define trends such as ICU admission, operative intervention, blood utilization, and outcomes. A common trend is the older adult on anticoagulation therapy. The trauma activation for these older adults expedites their care, diagnostics, and disposition. These are trauma center specific considerations. Davis, Dirks, Sue, and Kaups[2] completed a study to review over-triage and under-triage, which serves as a good resource. Additionally, there are emerging computer programs that can assist with the assessment of over-and-under triage. OCEMS, in collaboration with stakeholders, can complete an assessment of the various tools to define consistent practice for the region.

Recommendations

- **Develop, implement, and monitor a trauma system performance improvement plan.**
- Provide data definitions and targeted goals for the indicators to review in the plan.
- Integrate evidence-based practice into the standard performance measures.
- Ensure timely submission of all trauma system data and penalize non-compliance.
- Develop standardized reports for review at the Emergency Medical Care Committee and Regional Trauma Operations Advisory Committee to assist in evaluating trauma system performance.

- Establish a performance improvement subcommittee of the Regional Trauma Operations Advisory Committee.

- Evaluate the statutory regulations to protect performance improvement activities.

References for System-wide Evaluation and Quality Assurance Section

1. Committee on Trauma, American College of Surgeons. Resources for Optimal Care of the Injured Patient: 2006:28. Chicago, IL: ACS-COT; 2006.

2. Davis JW, Dirks RC, Sue LP, Kaups KL. Attempting to validate the overtriage/undertriage matrix at a Level I trauma center. The journal of trauma and acute care surgery. 2017;83(6):1173-1178, doi: 10.1097/TA.0000000000001623.

Trauma Management Information Systems

Purpose and Rationale

Hospital-based trauma registries developed from the idea that aggregating data from similar cases may reveal variations in care and ultimately result in a better understanding of the underlying injury and its treatment. Hospital-based registries have proven very effective in improving trauma care within an institution but provide limited information regarding how interactions with other phases of health care influence the outcome of an injured patient. To address this limitation, data from hospital-based registries should be collated into a Regional registry and linked such that data from all phases of care (prehospital, hospital, and rehabilitation) are accessible in 1 data set. When possible, these data should be further linked to law enforcement, crash incident reports, ED records, administrative discharge data, medical examiner records, vital statistics data (death certificates), and financial data. The information system should be designed to provide system-wide data that allow and facilitate evaluation of the structure, process, and outcomes of the entire system; all phases of care; and their interactions. This information should be used to develop, implement, and influence public policy.

The lead agency should maintain oversight of the information system. In doing so, it must define the roles and responsibilities for agencies and institutions regarding data collection and outline processes to evaluate the quality, timeliness, and completeness of data. There must be some means to ensure patient and provider confidentiality is in keeping with federal regulations. The agency must also develop policies and procedures to facilitate and encourage injury surveillance and trauma care research using data derived from the trauma MIS. There are key features of Regional trauma MISs that enhance their usefulness as a means to evaluate the quality of care provided within a system. Patient information collected within the management system must be standardized to ensure that noted variations in care can be characterized in a similar manner across differing geographic Regions, facilities, and EMS agencies. The composition of patients and injuries included in local registries (inclusion criteria) should be consistent across centers, allowing for the evaluation of processes and outcomes among similar patient groups. Many Regions limit their information systems to trauma centers. However, the optimal approach is to collect data from all acute care facilities within the Region. Limiting required data submission to hospitals designated as trauma centers allows one to evaluate systems issues only among patients transported to appropriate facilities. It is also important to have protocols in place to ensure a uniform approach to data abstraction and collection. Research suggests that if the process of case abstraction is not routinely calibrated, practices used by abstractors begin to drift.

Finally, every effort should be made to conform to national standards defining processes for case acquisition, case definition (that is, inclusion criteria), and registry coding conventions. Two such national standards include the National Highway Traffic Safety Administration's (NHTSA) National Emergency Medical Services Information System (NEMSIS), which standardizes EMS data collection, and the American College of Surgeons National Trauma Data Standard (NTDS), which addresses the standardization of hospital registry data collection. Strictly adhering to national standards markedly increases the value of state trauma MISs by providing national benchmarks and allowing for the use of software solutions that link data sets to enable a review of the entire injury and health care event for an injured patient.

To derive value from the tremendous amount of effort that goes into data collection, it is important that a similar focus address the process of data reporting. Dedicated staff and resources should be available to ensure rapid and consistent reporting of information to vested parties with the authority and vision to prevent injuries and improve the care of patients with injuries. An optimal information reporting process will include standardized reporting tools that allow for the assessment of temporal and/or system changes and a dynamic reporting tool, permitting anyone to tailor specific "views" of the information.

Optimal Elements

I. There is an established trauma MIS for ongoing injury surveillance and system performance assessment. **(B-102)**

   a. There is an established injury surveillance process that can, in part, be used as an MIS performance measure. **(I-102.1)**

   b. Injury surveillance is coordinated with statewide and local community health surveillance. **(I-102.2)**

   c. There is a process to evaluate the quality, timeliness, completeness, and confidentiality of data. **(I-102.4)**

   d. There is an established method of collecting trauma financial data from all health care facilities and trauma agencies, including patient charges and administrative and system costs. **(I-102.5)**

II. The trauma MIS is used to facilitate ongoing assessment and assurance of system performance and outcomes and provides a basis for continuously improving the trauma system, including a cost-benefit analysis. **(B-301)**

   a. The lead trauma authority ensures that each member hospital of the trauma system collects and uses patient data, as well as provider data, to assess system performance and to improve quality of care. Assessment data are routinely submitted to the lead trauma authority. **(I-301.1)**

   b. Prehospital care providers collect patient care and administrative data for each episode of care and not only provide these data to the hospital, but also have a mechanism to evaluate the data within their own agency, including monitoring trends and identifying outliers. **(I-301.2)**

   c. Trauma registry, ED, prehospital, rehabilitation, and other databases are linked or combined to create a trauma system registry. **(I-301.3)**

   d. The lead agency has available for use the latest in computer/technology advances and analytic tools for monitoring injury prevention and control components of the trauma system. There is reporting on the outcome of implemented strategies for injury prevention and control programs within the trauma system. **(I-301.4)**

Current Status

The Orange County EMS Agency (OCEMS) leads data collection and maintenance of a trauma registry. All trauma centers within the county are required to submit the National Trauma Data Bank (NTDB) dataset from their individual center in a timely fashion. It is clear from discussion

that all centers are compliant with this mandate. There is no current method to validate the quality of data the County is collecting. Additionally, all centers participate in TQIP.

EMS field data is also collected from the patient care report (PCR). While the county has multiple fire and EMS agencies, a common PCR is used and can be passed from one providing agency to another.

Base hospital contact is made by the ALS provider on scene in order to determine trauma patient destination. These records are also kept by the County in a standardized report.

There is clear collaboration among the trauma centers regarding data sharing. The trauma program managers and registrars have developed a data committee in order to standardize certain elements across the system. An important project that was recently completed was the Trauma Registry Inclusion Criteria for the county. While supported by OCEMS, this was not led by the County.

The Hospital Discharge Data Set (HDDS) is not consistently being collected from the Emergency Receiving Centers (ERCs). Some centers may submit while others do not, and the data is not collected in any usable format. Without this data, it is impossible to develop a true picture of all trauma patients being treated in the county. Injured patients definitively treated at non-designated centers are not represented in any currently usable system.

While there is a tremendous amount of data collected, the use of that data is extremely limited. The majority of County efforts go to the collection of data rather than the creation of useful reports to guide the development of the trauma system. This appears to be secondary to a lack of human resources, and the system would benefit from a dedicated Trauma Data Analyst. Regular reports are not shared with the Regional Trauma Operations Committee; however, if specific data is requested, then it can be acquired, although the process is cumbersome. At this time, if the trauma program managers have a system wide question, they often bring each center's individual data to collate rather than requesting a system-wide report from the County. Even before the County registry can start to be used for report writing, the data must be validated to ensure accuracy and consistency across the multiple centers.

There are no data use agreements with OCEMS. Each entity (trauma center, fire department, EMS agency) owns their individual data even after submission to the County. If research is performed, it is a requirement to gain individual permission from each agency to use their data.

Recommendations

- **Dedicate a full time equivalent position for a Trauma Data Analyst within the Orange County EMS Agency to manage the trauma registry, and other data sources, both from data quality and data usage perspectives.**

- **Validate the quality of registry data and implement solutions for improvement.**

- **Mandate submission of a minimal data set to the trauma registry for all hospitals caring for injured patients.**

- Establish trauma leadership at the Orange County EMS Agency level to provide dedicated oversight of the registry and data sources to optimize information management and utilization beyond data collection.

- Ensure that trauma registry data are systematically used for system development, evaluation, and performance improvement.

- Establish data use agreements among all agencies in the county to ease access and use of data across the continuum of care

Research

Purpose and Rationale

Overview of Research Activity

Trauma systems are remarkably diverse. This diversity is simply a reflection of authorities tailoring the system to meet the needs of the Region based on the unique combination of geographic, economic, and population characteristics within their jurisdiction. In addition, trauma systems are not fixed in their organization or operation. The system evolves over years in response to lessons learned, critical review, and changes in population demographics. Given the diversity of organization and the dynamic nature of any particular system, it is valuable when research can be conducted that evaluates the effectiveness of the Regional or statewide system. Research drives the system and will provide the foundation for system development and performance improvement. Research findings provide value in defining best practices and might alter system development. Thus, the system should facilitate and encourage trauma-related research through processes designed to make data available to investigators. Competitive grants or contracts made available through lead authorities or constituencies should provide funds to support research activities. All system components should contribute to the research agenda. The extent to which research activities are required should be clearly outlined in the trauma system plan and/or the criteria for trauma center designation.

The sources of data used for research might be institutional and Regional trauma registries. As an alternative, population-based research might provide a broader view of trauma care within the Region. Primary data collection, although desirable, is expensive but might provide insights into system performance that might not be otherwise available.

Trauma Registry–based Research

Investigators examining trauma systems can use the information recorded in trauma registries to great advantage to determine the prevalence and annual incidence rate of injuries, patterns of care that occur to injured patients in the system's Region, and outcomes for the patients. These data can be compared with standards available from other trauma registries, such as the NTDB. Such comparisons can then enable investigators to determine if care within their Region is within standards and can allow for benchmarking. Initiating and sustaining injury prevention initiatives is a vital goal in mature trauma systems. Investigators can take a leadership role in performing research using trauma registry data that identify emerging threats and instituting public health measures to mitigate the threats. For example, a recent surge in death and disability related to off -road vehicles can be identified and the scope of the problem defined in terms of who, where, and how riders are injured, and then, through presentations and publications, the public can be informed of a new threat.

Trauma system administrators have a responsibility to control investigators' access to the registry. The integrity and reliability of data in a trauma systems registry are essential if accurate research and valid conclusions are to be reached using the data. Trauma system administrators should have a process that screens data entered into the system's composite registry from individual institutions. There should be a mechanism that ensures that the information is stored in a secure manner. Investigators who seek access to the trauma registry must follow a written policy and procedure that includes approval by an authorized institutional review board (IRB).

Trauma registry data may include unique identifiers, and system administrators must ensure that patient confidentiality is respected, consistent with state and federal regulations.

Population-based Trauma System Research

A major disadvantage of using only trauma registry data to conduct research that evaluates injured patients in a Region is the bias resulting from missing data on patients not treated at trauma centers. Specifically, most registry data are restricted to information from hospitals that participate in the trauma system. Although ideally all facilities participate in the form of an inclusive system, many systems do not attain this goal. Thus, a population-based data set provides investigators with the full spectrum of patients, irrespective of whether they have been treated in trauma centers or non-designated centers or were never admitted to the hospital owing to death at the scene of incident or because their injuries were insufficiently severe to require admission. The state and national hospital discharge databases are examples of population-based data. These discharge databases contain information that was abstracted from medical records for billing purposes by hospital employees who enter these data into an electronic database. For investigators seeking a wider perspective on the care of injured patients in their Region, these more inclusive data sets, compared with registries, are essential tools. Other population-based data that may be of help include mortality vital statistics data recorded in death certificates. Selected Regions might have outpatient data to capture patients who are assessed in the ED and then released.

Investigators can use these population-based data to study the influence of a Regional trauma system on the entire spectrum of patients within its catchment area.

Participation in Research Projects and Primary Data Collection

Multi-institutional research projects are important mechanisms for learning new knowledge that can guide the care of injured patients. Investigators within trauma systems can participate as coinvestigators in these projects. Investigators can participate by recruiting patients into prospective studies, being leaders in the design and administration of grants, and preparing manuscripts and reports. Evidence of this collaboration is that investigators within a trauma system are recognized in announcements of grants or awards. Lead agency personnel should identify and reach out to resources within the system with research expertise. These include academic centers and public health agencies.

Measures of Research Activity

Research can be broadly defined as hypothesis-driven data analysis. This analysis leads the investigators to a conclusion, which might become a recommendation for system change. Full manuscripts published in peer reviewed research journals are an exemplary form of research activity. Research reported in annual reviews or in public information formats intended to inform the trauma system’s constituency can also be considered legitimate research activity.

Optimal Elements

I. The trauma MIS is used to facilitate ongoing assessment and assurance of system performance and outcomes and provides a basis for continuously improving the trauma system, including a cost-benefit analysis. **(B-301)**

a. The lead agency has available for use the latest in computer/technology advances and analytic tools for monitoring injury prevention and control components of the trauma system. There is reporting on the outcome of implemented strategies for injury prevention and control programs within the trauma system. **(I-301.4)**

II. The lead agency ensures that the trauma system demonstrates prevention and medical outreach activities within its defined service area. **(B-306)**

a. The trauma system has developed mechanisms to engage the general medical community and other system participants in their research findings and performance improvement efforts. **(I-306.1)**

b. The effect or impact of outreach programs (medical community training/support and prevention activities) is evaluated as part of a system performance improvement process. **(I-306.3)**

III. To maintain its state, Regional, or local designation, each hospital will continually work to improve the trauma care as measured by patient outcomes. **(B-307)**

a. The trauma system implements and regularly reviews a standardized report on patient care outcomes as measured against national norms. **(I-307.2)**

Current Status

The most fundamental restriction to performing system-based research in Orange County is the lack of a comprehensive, uniform, and validated data source. Potential investigators are hesitant to use the OCEMS dataset due to access challenges and quality concerns. The data that has been collated at the system level is limited to injury data from EMS and the trauma centers. As such, this data repository does not appear to be truly representative of the inclusive trauma system within the county. The OCEMS Agency (OCEMS) serves as a repository for the trauma system registry as well as a number of other datasets, but the defined method to access this data for research projects appears cumbersome. Though multiple data sources exist, there does not appear to be the human resource support or analysis expertise at the OCEMS level to functionally link data for research. OCEMS lacks substantive investment in data management and analysis required to support more robust research efforts within the county trauma system.

The trauma centers have conducted trauma system research in the past by combining registry data from individual centers, rather than accessing the trauma system registry. The system research to date has been conducted primarily by individual investigators and the projects do not always involve the lead agency. Likewise, OCEMS, with independent access to research compliance and regulatory authority, has produced research work product to support the evolution of the regional trauma system including the *Analysis of Pediatric Utilization of OCEMS and Secondary Health Impact Analysis of Pediatric Trauma* and the white paper entitled *The Orange County Trauma System: 2018*.

Several potential opportunities to perform salient trauma system research on cost effectiveness, injury outcomes, injury prevention and control, and quality of life after injury exist within the region. However, OCEMS and trauma system stakeholders have not currently established research as a priority in the evolution of their trauma system. The lack of concentration on a relevant research agenda aligned with current system goals limits system development progress.

Recommendations

- Improve collaboration between the trauma system stakeholders and the Orange County EMS Agency for system level research projects.

- The trauma system should facilitate and encourage a research agenda tailored to the specific injury care needs of the community.

- Create a research subcommittee of the Regional Trauma Operations Committee.

APPENDIX A: Methodology

The Orange County Emergency Medical Services (OCEMS) Agency requested this consultative review of the Orange County EMS and Trauma System, which was conducted under the auspices of the Trauma Systems Consultation (TSC) Program of the American College of Surgeons (ACS) Committee on Trauma (COT). The multidisciplinary TSC Review Team consisted of 2 ACS staff and 6 nationally recognized trauma experts, including: three trauma surgeons, an emergency medicine physician, a state emergency medical services director, and a trauma program manager. Biographical information about the 8 ACS TSC Review Team Members is provided in Appendix F.

The primary objective of the ACS TSC for the Orange County EMS and Trauma System was to guide and promote a sustainable effort in the graduated development of an inclusive and integrated system of care within the County. The format of this TSC Report correlates with the public health framework of assessment, policy development, and assurance outlined in the ACS *Regional Trauma Systems Optimal Elements, Integration, and Assessment: System Consultation Guide*[1]. Prior to the Site Visit, the TSC Review Team studied the ACS Pre-Review Questionnaire (PRQ) and additional supporting documents, submitted by the OCEMS Agency. Other information publicly available on government and official websites was also assessed.

The ACS TSC Review Team convened a Site Visit from July 15 to July 18, 2019, in Santa Ana, CA. The four-day site visit consisted of several plenary sessions during which the ACS TSC Review Team engaged with a broad range of representatives from the Orange County EMS and Trauma System, with the opportunity for more informal discussions to take place in between. The ACS TSC Review Team also sequestered in private Team Meetings for more detailed reviews of the Orange County EMS and Trauma System data, to establish consensus on essential elements regarding the Trauma System, develop recommendations for system improvement, and to prepare the TSC Report.

The conceptual framework of the ACS *Regional Trauma Systems Optimal Elements, Integration, and Assessment: System Consultation Guide* was based on the Health Resources and Services Administration (HRSA) *Model Trauma System Planning and Evaluation (MTSPE)* [2] document, released in 2006. The public health approach to trauma systems described within the HRSA MTSPE document informed the Purpose and Rationale for each of the 18 trauma system components, or sections, within the ACS *System Consultation Guide*. The Benchmarks from the HRSA *MTSPE* were adapted directly into the ACS *System Consultation Guide*, but categorized under the appropriate and relevant trauma system components, under the Optimal Elements heading. For reference, each Benchmark under the Optimal Elements includes its numerical designation from the HRSA *MTSPE* document. According to the HRSA *MTSPE* document's description, "Benchmarks are global overarching goals, expectations, or outcomes. In the context of the trauma system, a benchmark identifies a broad system attribute."

The Trauma System Consultation (TSC) Report for Orange County EMS and Trauma System presents the same Purpose and Rationale and Optimal Elements, as those within the *System Consultation Guide* for each of the 18 trauma system components.

Methodology References:

1. American College of Surgeons Committee on Trauma. *Regional Trauma Systems Optimal Elements, Integration, and Assessment: System Consultation Guide.* Chicago, IL: American College of Surgeons: 2008.

2. Health Resources and Services Administration. *Model Trauma System Planning and Evaluation*. Rockville, MD: Health Resources and Services Administration; 2006.

APPENDIX B: OCEMS Agency submitted Focus Questions

Orange County EMS Agency asked the following set of questions that concerned their unique EMS and Trauma System. The ACS TSC Review Team, however, determined that many of these questions would naturally be answered within the Current Status analysis narrative and Recommendations section of one of the 18 trauma system components, or sections, of the ACS *System Consultation Guide*.

The crosswalk below depicts which of the 18 trauma system components, or sections, includes the ACS TSC Review Team responses to these Focus Questions.

OCEMS Agency submitted Focus Questions	Trauma System Section of the ACS *System Consultation Guide*
What would be the appropriate amount of epidemiological support to address research, data management, and reporting for our trauma system?	• INJURY EPIDEMIOLOGY
What is the value and significance of conducting a Benchmark Indicator Scoring (BIS) self-assessment?	• INDICATORS AS A TOOL FOR SYSTEM ASSESSMENT
What would the recommended amount of support be in regards to assigned staffing by the lead agency to support the trauma program within our county?	• LEAD AGENCY AND HUMAN RESOURCES WITHIN THE LEAD AGENCY
We have a new collaborative Trauma Injury Prevention Committee, what recommendations or guidance could you provide for them to be successful?	• PREVENTION AND OUTREACH
Describe the impact of changes to trauma center configuration on various system components such as access, volume, and transport times.	• DEFINITIVE CARE FACILITIES
What recommendations can be made for disaster healthcare system sustainment that includes health care and response organizations/system partners to prepare for and respond to emergencies, natural disasters, and other crises?	• DISASTER PREPAREDNESS
Does the Trauma System Consultation Committee feel the performance improvement program has identified adequate PI initiatives as a system and has adequate loop closure? How important is a post-mortem exam in performance improvement?	• SYSTEM-WIDE EVALUATION AND QUALITY ASSURANCE
What methods would ACS recommend for effectively monitoring and managing over-triage and under-triage of the critically injured patients within the county?	• SYSTEM-WIDE EVALUATION AND QUALITY ASSURANCE
How important is receiving non-trauma hospital outcomes data from the Hospital Discharge Data System (HDDS)?	• DEFINITIVE CARE • TRAUMA MANAGEMENT INFORMATION SYSTEMS • SYSTEM COORDINATION AND PATIENT FLOW

APPENDIX C: Acronyms

ACEP – American College of Emergency Physicians
ACS – American College of Surgeons
ALS – Advanced Life Support
AMS – Air Medical Service
ATLS – Advanced Trauma Life Support

BH – Base Hospital
BHS – Behavioral Health Services
BIS – Benchmarks, Indicators and Scoring
BLS – Basic Life Support

CAAHEP – Commission on Accreditation of Allied Health Education Programs
CARF – Commission on Accreditation of Rehabilitation Facilities
CDC – Centers for Disease Control and Prevention
CDPH – California Department of Public Health
CEMSIS – California Emergency Medical Services Information System
CEU – Continuing Education Unit
CHOC – Children's Hospital of Orange County
COT – Committee on Trauma
CQI – Clinical Quality Improvement

DUA – Data Use Agreement

E-911 – Enhanced 911
ED – Emergency Department
EMCC – Emergency Medical Care Committee
EMD – Emergency Medical Dispatch
EMS – Emergency Medical Services
EMSF – Emergency Medical Services Fund
EMT – Emergency Medical Technician
EOC – Emergency Operations Center
EPCRS – Electronic Patient Care Reporting System
ERC – Emergency Receiving Centers
ETSE – Essential Trauma System Elements

FACEP – Fellow of the American College of Emergency Physicians
FACS – Fellow of the American College of Surgeons
FC – Facilities Coordinator
FTE – Full-time Equivalent
FY – Fiscal Year

GIS – Geographic Information Systems

HDDS – Hospital Discharge Data Set
HCA – Health Care Agency
HEM – Health Emergency Management
HIP – Health Improvement Partnership
HRSA – Health Resources and Services Administration

IFT – Inter-facility Transfers
IPC – Injury Prevention Coordinator
IRB – Institutional Review Board
ISS – Injury Severity Score

LA – Los Angeles, California
LEMSA – Local EMS Authority

MCI – Mass Casualty Incident
MHOAC – Medical Health Operational Area Coordinator
MICN – Mobile Intensive Care Nurse
MIS – Management Information Systems

NBATS – Needs Based Assessment of Trauma Systems
NEMSIS – National Emergency Medical Services Information System
NHTSA – National Highway Traffic and Safety Administration
NREMT – National Registry of Emergency Medical Technicians
NTDB – National Trauma Data Bank
NTDS – National Trauma Data Standards

OCEMS Agency – Orange County Emergency Medical Services Agency
OCGMC – Orange County Global Medical Center
OC-MEDS – Orange County Medical Emergency Data System
OCMRC – Orange County Medical Reserve Corps
OLMC – On-Line Medical Control

PCR – Patient Care Report
PHTLS – Pre-Hospital Trauma Life Support
PI – Performance Improvement
PRQ – Pre-Review Questionnaire
PSAP – Public Safety Answering Points

QA – Quality Assurance
QAB – Quality Assurance Board
QI – Quality Improvement

RDMHC – Regional Disaster Medical Health Coordinator
REAC – Regional Emergency Advisory Committee
RTOC – Regional Trauma Operations Committee

SCI – Spinal Cord Injury
SKOC – Safe Kids Orange County
STEMI – ST-Elevation Myocardial Infarction
STSAC – State Trauma System Advisory Committee

TBI – Traumatic Brain Injury
TDD - Telecommunication Device for the Deaf
TPM – Trauma Program Manager
TQIP – Trauma Quality Improvement Program
TSC – Trauma System Consultation
TTY – Text Telephone

UC – University of California
UCI – University of California, Irvine

ZIP – USPS Zone Improvement Plan

APPENDIX D: ACS TSC Review Team Biographies

BARBARA A. GAINES, MD FACS
Role: Trauma Surgeon, Team Lead

Dr. Gaines is a Professor of Surgery at the University of Pittsburgh School of Medicine and an attending surgeon at the Children's Hospital of Pittsburgh of UPMC, a level 1 pediatric trauma center. She serves as the Director of the Benedum Pediatric Trauma and Injury Prevention Programs, Clinical Director of Pediatric General and Thoracic Surgery, and the Program Director of the Pediatric Surgery Training Program. She is triple board certified in pediatric surgery, general surgery and surgical critical care.

Dr. Gaines is currently serving as the Chair of the American Association for the Surgery of Trauma (AAST) Pediatric Committee, a member of the American College of Surgeons Committee on Trauma (ACS-COT), and the Secretary/Treasurer of the Association of Pediatric Surgery Training Directors (APSTD). She is a past president and founding member of the Pediatric Trauma Society (PTS) and a past board president of the Injury Free Coalition for Kids. Her current research interests include the role of post-traumatic coagulopathy in pediatric trauma, as well as outcomes and quality of life after pediatric injury and the prevention of childhood injury.

COL. BRIAN J. EASTRIDGE, MD FACS
Role: Trauma Surgeon

Dr. Brian Eastridge received his BS in biochemistry from Virginia Tech in 1985 and his MD from the University of Maryland School of Medicine in 1989. He entered the US Army Reserve as a second lieutenant Medical Service Corps officer in 1988. Dr. Eastridge did his residency in general surgery at the University of Maryland Medical System and then pursued fellowship training in surgical critical care at the University of Texas Southwestern Medical Center in Dallas, TX. During his tenure on the academic faculty at UTSW, Dr. Eastridge was deployed three times in support of combat operations Operation Enduring Freedom and Operation Iraqi Freedom as a U.S Army Reserve surgeon in 2002, 2003, and 2004. During his deployment in 2004, he was appointed as the first Joint Theater Trauma System Director.

Dr. Eastridge matriculated to active duty U.S Army in 2005 and served as Trauma Medical Director for the Brooke Army Medical Center, Surgical Critical Care Program Director for SAUSHEC, Director of the Joint Trauma System (U.S. Army Institute of Surgical Research of the U.S. Army's Medical Research and Material Command (MRMC), and Trauma Consultant to the US Army Surgeon General. During his active duty service, he was deployed two more times to combat in Southwest Asia during which time he lead the development and implementation of the military trauma system.

During his career, Dr. Eastridge has published extensively in the peer reviewed literature and edited three books focused upon improving the military trauma system and improving combat casualty care outcomes for our Wounded Warriors. Dr. Eastridge left active service and returned to the active US Army Reserves in late 2012 and is currently the DCCS of the 228th Combat Support Hospital. His military awards and decorations include the Combat Medical Badge, Combat Action Badge, Legion of Merit, Bronze Star Medal, Defense Meritorious Service Medal, and the Joint Service Commendation Medal. He is a member of Order of Military Medical Merit. For his military service, he has been awarded the American Association for the Surgery of Trauma Honorary Medal for Combat Surgical Care in 2004 and the US Army Medical Research and Materiel Command Combat Casualty Care Program Award for Excellence in 2011.

Currently, he is Professor of Surgery at the University of Texas Health Science Center and was appointed as the Trauma Medical Director of the University Health System in San Antonio, TX. He holds the Jocelyn and Joe Straus Endowed Chair in Trauma Research. His current research interests are focused on trauma system development, including development of the regional trauma system performance improvement initiatives, predictive modeling of injury outcomes, and improved pre-hospital resuscitation strategies for casualties. Dr. Eastridge also serves as an active member on the American College of

Surgeons Committee on Trauma, and is the current Chair of the Trauma Systems Evaluation and Planning Committee, and the Trauma Systems Pillar.

PETER E. FISCHER, MD MS FACS
Role: Trauma Surgeon, Specialty Reviewer (Needs Assessment)

Dr. Fischer is an Associate Professor of Surgery at the University of Tennessee Health Science Center in Memphis, TN. He completed his residency in general surgery at the University of Tennessee at Memphis and subsequently a surgical critical care fellowship at Oregon Health and Science University in Portland, OR.

He was previously at Carolinas Medical Center in Charlotte, NC before returning to Memphis in 2016.

He has been an active member in the fire service as a firefighter & paramedic since 1998, and thus his main areas of interest include trauma systems and prehospital care.

KATHY J. RINNERT, MD MPH FACEP
Role: Emergency Medicine Physician

Dr. Rinnert began her career in emergency medicine and emergency medical services (EMS) in the early 1980's as a Nationally Registered Paramedic in a five-county, rural EMS agency in the Allegheny Mountains of Southeast Ohio. She completed medical school at the Ohio State University, followed by an internship in Internal Medicine at Loyola University, and residency training in Emergency Medicine at the University of Chicago. Following residency, Dr. Rinnert completed a two-year fellowship in Emergency Medical Services (EMS) at the University of Pittsburgh. She simultaneously obtained a Master's in Public Health at the Graduate School during her tenure in Pittsburgh.

Dr. Rinnert is currently a Professor of the Department of Emergency Medicine at the University of Texas Southwestern Medical Center at Dallas (UTSWMC). Additionally, she is the Director of the EMS Fellowship Program and the EMS Medical Director. She was previously the Associate Medical Director for the UTSW/BioTel EMS system, encompassing sixteen municipalities and their fire-based EMS and Public Safety agencies. In this capacity, she oversaw the out-of-hospital practice of over 1700 paramedics operating in urban, suburban, and rural environments. Dr. Rinnert directs the Center for Government Emergency Medical Security Services (GEMSS) at the UTSWMC, which provides academic and clinical tactical support to government agencies. At the Center, she directs both the EMS and GEMSS fellowship programs, which provide post-doctoral training in these subspecialty areas of emergency medicine.

Dr. Rinnert has special interest and expertise in trauma, injury prevention and control, air medical transport, tactical EMS, urban search and rescue, and domestic preparedness for weapons of mass effect (WME) and counterterrorism. She is a member of the Board of Directors for the Commission on Accreditation of Ambulance Services (CAAS), the national body for accreditation of EMS agencies in the United States and Canada. Dr. Rinnert is an active grant reviewer for the Centers for Disease Control and Prevention-National Institute for Occupational Safety and Health (CDC-NIOSH) and trauma systems consultant to the American College of Surgeons Committee on Trauma (ACS-COT).

FERGUS LAUGHRIDGE, Captain ASM CPM CACO
Role: State EMS Director

Mr. Laughridge is currently employed by Humboldt General Hospital EMS Rescue in Winnemucca, Nevada. Mr. Laughridge has the responsibility of assuring regulatory compliance for a high performance and dynamic emergency medical system. Mr. Laughridge is also responsible for coordination of public health preparedness for Humboldt General Hospital and surrounding county.

Mr. Laughridge has a diverse professional background as a police officer, firefighter, paramedic, disaster response coordinator, and manager of EMS systems and operations. Mr. Laughridge has served as the Director of Nevada State Health Division, Emergency Medical Systems and Trauma program where he

was responsible for assuring the quality of out of hospital emergency medical and trauma services throughout Nevada. As State Director, he was involved with numerous federal, state, and community activities relating to emergency preparedness and response.
Mr. Laughridge is continually engaged on various committees and workgroups centered on quality patient care, trauma systems, public health preparedness, and credentialing of EMS systems.

JORIE D. KLEIN, BSN RN
Role: Trauma Program Manager

Ms. Klein is the current director of nursing for the trauma program at the Rees-Jones Trauma Center at Parkland. In this role she is responsible for the oversight and authority for the trauma nurse clinician program, trauma registry, trauma performance improvement process, injury prevention and outreach education in conjunction with the trauma medical director.

She is the past director of disaster management at Parkland. Ms. Klein is the current chair of the Governor's EMS, Trauma Advisory Council's Trauma System Committee. In addition, Ms. Klein is the vice-chair of the North Central Texas Trauma Advisory Council. Ms. Klein is a past president of the Society of Trauma Nurses and is a current member of the STN TOPIC committee and ATCN committee. Ms. Klein is also an instructor for the TOPIC Course and the ATCN course and regional VI chair for STN. In addition, she is an instructor for the Disaster Management Emergency Preparedness Course sponsored by the American College of Surgeons. Additionally, Ms. Klein is the course director for the Trauma Center Leadership Course and the Trauma System Leadership Course, which she developed. She is the founding member of the Texas Trauma Coordinators Forum.

Ms. Klein was recently appointed to the ACS Committee on Trauma's Performance Improvement Patient Safety Committee as a STN Nurse Liaison. In this capacity she is working in collaboration with the Best Practice Workgroup.

HOLLY MICHAELS, MPH
Role: ACS Trauma Program Staff (TSC Review Team Discussion Facilitator and TSC Report Editor)

Ms. Michaels joined the American College of Surgeons (ACS) in January 2007, and has served in several key areas of the Trauma Quality Programs during her tenure at the ACS. As the Program Administrator for the Trauma Systems Consultation Program, Ms. Michaels managed over 30 state and regional system reviews, bringing together multidisciplinary teams of industry experts to assess, evaluate, and recommend strategic improvements for state and regional trauma systems.
Following several years facilitating the growth and development of this program, she transitioned into a Program Manager role, leading the development of new programs including piloting the Level III Trauma Quality Improvement Program (TQIP) and expanding the TQIP Collaborative Program. In her role as Program Manager, her responsibilities continued to evolve to match the growth of programs and needs of stakeholders. Ms. Michaels was recently promoted to the role of Manager of Trauma Systems Programs, and through this role, heads the Trauma Systems Pillar which also includes Injury Prevention, Firearm Injury Prevention, Rural and Military activities.

Having received her Bachelor of Arts in English from the University of South Florida in 2001, Ms. Michaels began her career in public health at the non-profit organization, 2-1-1 Tampa Bay Cares, providing the Clearwater, FL community with access to critical resources, such as health and social services. In August 2014, Ms. Michaels earned a Master of Public Health from the University of Illinois at Chicago.

MARIA ALVI, MHA
Role: ACS Trauma Program Staff (TSC Logistics Manager and TSC Report Editor)

Ms. Maria Alvi joined the American College of Surgeons (ACS) Trauma Department as the Trauma Systems and Quality Programs Manager in May 2015. In this role, Ms. Alvi provides administrative support to the COT subcommittees within the Trauma Systems Pillar, and is the point of contact for the Trauma Systems Evaluation and Planning Committee. She also serves as the manager for the Trauma

Systems Consultation Program, the BIS Facilitation Program, and other Trauma Systems and Quality initiatives.

Prior to joining the ACS, Ms. Alvi worked as a healthcare consultant at the IBM Watson Health Truven Health Analytics company for 2 years, providing data reporting support to US clients, through the company's trademarked financial, marketing and clinical outcomes assessment programs. Her focus at Truven also allowed her to assist with critical analysis and validation of client data towards improving health outcomes in their patients, and better management of their healthcare programs.

In December 2013, Ms. Alvi earned her Masters of Healthcare Administration (MHA) from the University of Illinois at Chicago, School of Public Health, Division of Health Policy and Administration. As part of her curriculum, she also completed a Graduate Preceptorship at Cook County Health and Hospitals System (CCHHS). Through this opportunity, Ms. Alvi employed strategic planning, process improvement, and operations management skills to clinical service-lines and non-clinical initiatives at John H. Stroger Hospital of Cook County and CCHHS.

Although interested in clinical sciences (pre-med curriculum), and licensed as an EMT-B for the State of Illinois until June 2012, Ms. Alvi found her passions truly lay within business management for healthcare services. She is passionate about helping clinical care providers as much as patients, in order to ensure quality and accessible care. Ms. Alvi serves as a volunteer member on the ACHE CHEF Communications Committee, is a Young Professional member for the Chicago Council on Global Affairs, and partakes in various early careerist, networking and charitable events throughout the greater Chicago area. Through her work at the ACS, Ms. Alvi also volunteers as a Bleeding Control (B-Con) Course Instructor which teaches life-saving skills to lay persons at the scene of an injury, and members of the public.

APPENDIX E: Orange County EMS and Trauma System Participants List

Facility, Agency or Department		Position	Name
TRAUMA GROUP	Childrens Hospital Orange County	Trauma Program Manager	Amy Waunch
		Trauma Medical Director/EMCC	David Gibbs
		ED Director	Frank Maas
	Mission Hospital MV	Adult Trauma Program Manager	Anabella Anderson
		Ped Trauma Program Manager	Amanda Pringle
		Trauma Medical Director	Eric Kuncir
		Asst. Trauma Medical Director	Tetsuya Takeuchi
	Orange County Global MC	Trauma Program Director	Julia Schroefer
		Trauma Program Manager	Jennifer Gonzales
		Trauma Medical Director	Humberto Sauri
		General Surgeon	Frank Nastanski
	University California Irvine	Adult Trauma Program Manager	Stephanie Lush
		Ped Trauma Program Manager	Christy Carroll
		Trauma Medical Director/Chair	Michael Lekawa
		Trauma Program RN	Mary Slattery
	Long Beach Memorial MC	Trauma Program Manager	Desiree Thomas
		Trauma Medical Director	Reginald Jones
		Trauma Nurse Clinician	Stephanie Aparicio
		Chief Medical Officer Millers Childrens	Graham Tse
		Chief Medical Officer Long Beach Memorial	Eric Ramos
		VP Advocacy/Govt Relations	Kristen Pugh
BURN UNITS	Burn Unit (OC Global)	Burn Unit Coordinator	Stephanie Garcia
		Burn Medical Director	Andrea Dunkelman
	Burn Unit (UCIMC)	Burn Unit Director	Jennifer Cash
		Burn Medical Director	Victor Joe
BASE HOSPITAL GROUP	CHOC	Base Hospital Coordinator	Kim Zaky
		Base Hospital Medical Director	Ted Heyming
	HOAG	Base Hospital Coordinator	Cyndie Strader
		Base Hospital Medical Director	Matt Hunt
	Huntington Beach	Base Hospital Coordinator	Chris Waddell
	MISSION	Base Hospital Coordinator	Laura Cross
	OC GLOBAL	Base Hospital Coordinator	Ruth Clark

Facility, Agency or Department		Position	Name
	ST JUDE	Base Hospital Coordinator	Melanie Golda
	UCIMC	Base Hospital Coordinator	Maryle Olivier
		ED Physician	Robert Katzer
		Base Hospital Medical Director	Eric McCoy
FIRE	OCFA	FIRE EMS	Scott Wiedensholer Claus Hecht, MD
HCA ADMINISTRATION	EMS	EMS Medical Director	Carl Schultz
		EMS Administrator	Tammi McConnell
		EMS Associate Medical Director	Gagandeep Grewal
	Epidemiology	EMS Physician Researcher	Sam Stratton
	Health Emergency Management/HEM Disaster	Assistant EMS Administrator	Mike DeLaby
		System & Standards Chief	Danielle Ogaz
		EMS Facilities Coordinator	David Johnson
		EMS QI Coordinator	Vicki Sweet
	Trauma Management Information Systems	EMS Info Systems Chief	Laurent Repass
OUT OF COUNTY	LA County EMS	EMS Administrator	Cathy Chidester
		Trauma Program Manager	Christy Preston
	Riverside EMS	EMS Administrator	Trevor Douville
		Asst. Nurse Manager (EM Dept)	Shanna Kissel
	EMSA	Chief EMS Systems Division	Tom McGinnis
		Trauma Coordinator	Elizabeth Winward
ERC GROUP	Foothill Regional	ED Director/CNO	Kim Dyer
		ED Medical Director	David Thomas
	Fountain Valley	ED Medical Director	Tim Korber
		General, Robotics, Laparoscopic	Richard Guerrero
	Hoag Newport	ED Director	Chris Childress
		ED Medical Director	Raymond Ricci
	Los Alamitos	ED Director	Titus Ynares
	Mission Hospital MV	ED Director	Mary Birkle
		ED Medical Director	Matthew Kaplan
	Orange Coast Memorial	ED Director	Efren Grospe
	Orange County Global	ED Director	Julia Schrofer
		ED Medical Director	Vu Huynh
	Placentia Linda Hospital	ED Director	Kim Nichols

Facility, Agency or Department		Position	Name
	Saddleback Memorial	ED Director/EMCC	Karen Sharp
		Assistant Medical Director	Josh Bobko
	St. Jude Medical Center	ED Director	Troy Gideon
		ED Medical Director	Tim Greco
	UCI Medical Center	ED Director	Colette Baez
ADMINISTRATIVE	Orange County Global	CEO	Ann Abe
		COO	Scott Rifkin
		CNO	Ellen Kuhnert
	Venture Strategic	CEO/President	Jeff Corless
		Disaster Coordinator	Kyle Houraney
	Fountain Valley Regional	CEO	Kenn McFarland
		CNO	Kristin Christophersen
		Trauma Program Manager	Janet Hewson
		Executive Assistant	Rebecca Woody
	Tenet Healthcare	Government Relations	Sam Roth
	Hoag Memorial	General Surgery Chief of Staff	Michael Hurwitz
		Executive Medical Director Neuroscience Institute	Michael Brant-Zawadzki
		Exec VP & COO	Michael Ricks
		Strategy & Business Development	Chris Plender
		Neurosurgery	Vivek Mehta
	Mission Hospital	Chief Executive	Eileen Haubl
		Chief Medical Officer	Linda Sieglen
		Director Rehabilitatoin Services	Janie McComb
		Admin/CNO CHOC Children's @ Mission Hospital	Emma Sandhu
		Dir Pt Care Services, CHOC Children's @ Mission Hosp	Bronwyn Stackleather
	Childrens Hospital Orange County	Chief Government Relations Officer	Jenna Jensen
		Manager, Business Continuity	Chris Riccardi
		Manager, EOC Workplace Violence	Harving Parra
	St. Jude Hospital	Administration	Matt Bader
		Administration	Brian Helleland
		Finance/Administration	Katie Gonzalez
		CNO	Laura Ramos
		Medical Director Rehab/Physical Medicine	Natalia Covarrubias

Facility, Agency or Department		Position	Name
		ED Nurse Manager	Sandy Martinez
	UCIMC	CEO	Rick Gannotta
		COO	Chad Lefteris
	Chapman Global	CNO	Ada Yeh