Guide to Quality Indicators in Adult Trauma Care

Quality of Trauma Care

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Quality of Trauma in Adult Care

University of Calgary

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Preface

Health care services aspire to deliver high standards of care. It is for that reason that the quality of care provided to patients needs to be measured, otherwise how can high standards be maintained. In the trauma arena, professional trauma societies and provider organizations have advocated using quality indicators (QI) to measure and report quality of care as a critical step towards improving the care of injured patients.

The Quality of Trauma in Adult Care (QTAC) is a multi-disciplinary team in quality improvement research in Canada. QTAC investigators and collaborators have been involved individually and in collaboration in various sectors of health research, specifically the clinical, health services and population health sectors. QTAC is based at the University of Calgary, Institute of Public Health in Calgary, Alberta, Canada.

This guide includes 31 newly developed, evidence-informed quality indicators of adult trauma care by QTAC in 2012. These indicators could be used as quality performance measures to guide quality improvement practices in trauma care.

The proposed indicators do not represent a comprehensive catalogue of potential measures (others exist) and are intended to be dynamic tools that should be sequentially modified in response to the evolving evidence base in injury care as well as the quality improvement needs of healthcare organizations.

QTAC would like to hear from those who are using these indicators so we can develop a mechanism to keep the indicators updated through refinement and improvement of the developed measures. Please contact us via email at qtac@qualitytraumacare.com.

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- Alberta Innovates Health Solutions, AIHS
- Trauma Association of Canada, TAC
- Canadian Institute for Health Information, CIHI
- Alberta Health Services, AHS

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1 Introduction to Quality Indicators in Adult Trauma Care

Each year injuries affect 700 million people worldwide and result in more than five million deaths. In many countries injuries are the leading cause of death among those under the age of 45 years. The human and societal burden is even greater with many survivors never returning to school, work or their "regular" lives.

Health care services provide patients with treatment for what is a major cause of morbidity and death. Yet medical errors and substandard care threaten trauma care. Half of all patients with major traumatic injuries do not receive recommended care, medical errors are common in critically ill trauma patients and preventable trauma deaths in hospital are widely reported. The World Health Organization (WHO), professional trauma organizations (e.g. American College of Surgeons, Trauma Association of Canada and Royal Australasian College of Surgeons) and accreditation bodies have promoted efforts to improve the quality of care delivered to injured patients. However, before the quality of injury care can be improved, it needs to be measured using reliable and valid measures of health care quality.

1.1 What are Quality Indicators for Trauma Care?

Quality indicators are performance measures designed to compare actual care against ideal criteria for the purposes of quality measurement, benchmarking and identifying potential opportunities for improvement. Quality indicators for trauma care have previously been developed by the American College of Surgeons, researchers and local institutions. At present there are many different quality indicators of trauma care available, significant variation in the utilization of indicators by trauma centres and limited evidence to support the use of specific indicators over others.

1.2 Origins of the Quality Indicators for Trauma Care

The goal of the present document is to summarize the results of a consensus method to select and develop quality indicators of trauma care. Consensus methods have been demonstrated to be an effective tool for facilitating decision making where there is insufficient information and also where there is an overload of often contradictory information. We employed a modified version of the RAND/UCLA Appropriateness Method (RAM), a reproducible and valid nominal group technique used in health services research to gather feedback and information from relevant experts.

The Trauma Quality Indicator Consensus Panel, an international panel of injury and quality of care experts, reviewed existing quality indicators in adult trauma care, suggested revisions to these indicators, proposed new indicators and through three rounds of review selected the indicators that they believed were most promising. The indicators have been developed with the intent of complementing existing quality measurement and improvement efforts in injury care such as accreditation processes, national benchmarking projects (e.g. Trauma Quality Improvement Program) and regional or local programs (e.g. institutional trauma quality assurance programs).

The indicators are designed to provide tools for measurement of the quality of care for injured patients for whom full medical care is planned (i.e. some indicators may not be appropriate for patients with limitations on treatment) across the spectrum of injury care from the time of injury to the time of recovery (Figure 1).

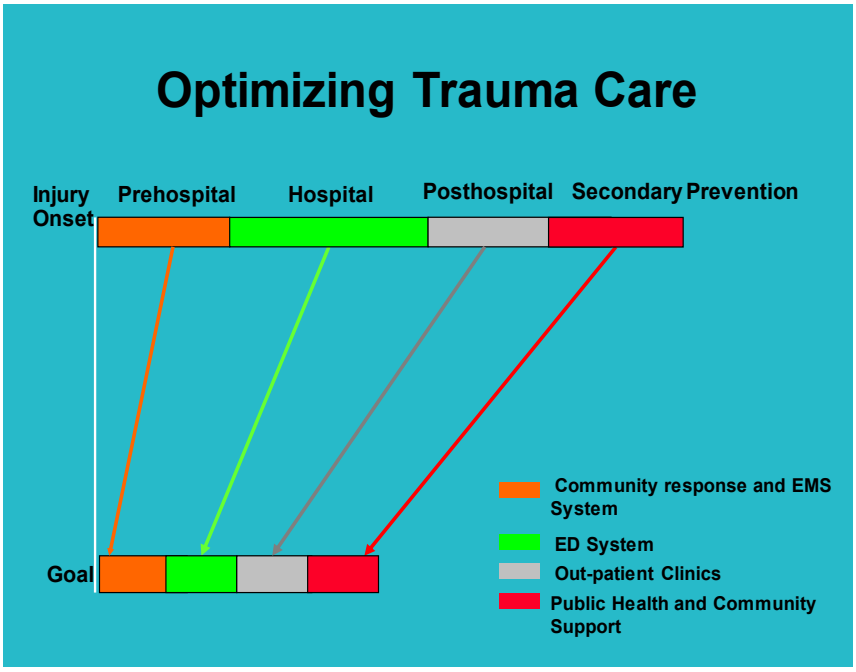

Figure 1. A potential framework for optimizing quality of trauma care

1.3 How can the Quality Indicators for Trauma Care be used?

These indicators can be used to assess patient safey, and to evaluate and improve quality of care by incorporating these measures into local, regional or national quality improvement efforts. Implementing a consistent approach to measurement (same indicators, same

definitions, same data elements, same reporting format) would provide institutions with reliable performance data that is necessary for surveillance (e.g. tertiary survey completion), to track local problems (e.g. adverse events – specifically missed injuries), evaluate the effects of interventions or program changes (e.g. tertiary survey protocol) and provide comparisons across centers (e.g. benchmarking adverse events using programs such as the American College of Surgeons' Trauma Quality Improvement Program). Well-designed, carefully evaluated and appropriately implemented QIs may be essential tools for guiding efforts to improve health and healthcare.

1.4 Definitions

Glasgow Coma Scale (GCS) score assesses the function of the central nervous system by observing motor and verbal response, and eye-opening. The score ranges from 3 to 15[1].

Injury Severity Score (ISS) is a tool to quantify the severity of injuries and the effects of multiple injuries upon mortality. ISS ranges from 1 to 75, with 1 representing minor and 75 representing uniformly fatal injuries [1]. Different thresholds have been employed to identify severely injured patients. Common thresholds employed in the literature include an ISS > 9 for penetrating injuries and ISS > 12 or ISS > 15 for non-penetrating injuries [2,3,].

Quality Indicators are performance measures that compare actual care against ideal criteria and are a tool for assessing the quality of care. The definition is derived from the Institute of Medicine's definition of quality of care, "*the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with professional knowledge*"[4].

[1] Rivara FP. Injury control: a guide to research and program evaluation. Cambridge; New York: Cambridge University Press; 2001.

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[3] Canadian Institute for Health Information. National Trauma Registry 2011 report: hospitalizations for major injury in Canada (includes 2008-2009 data). 2011; https://secure.cihi.ca/estore/productFamily.htm?pf=PFC1600&lang=en&media=0. Accessed September 26, 2011.

[4] Institute of Medicine Committee on Quality of Health Care in America. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington DC: National Academy Press; 2001.

1.5 Quality Indicator Evaluation

Face Validity: The ability of the quality indicator to capture aspects regarded as important by specialists in injury management.

Reliability: The ability of the quality indicator to consistently identify the events it was designed to identify across multiple providers (individual or institutional) over time.

Construct Validity: The extent to which the quality indicator has been shown to capture what it was intended to measure.

Risk Adjustment: The extent to which the influences of factors that differ among groups being compared can be controlled or taken into account.

Utilization: Percentage of trauma centers that used a specific quality indicator.

Severely Injured Patient is inconsistently defined in the medical literature and includes the following definitions: ISS > 15, GCS < 9, prehospital index (PHI) > 7, death within 24 hours of injury, intensive care unit (ICU) admission, and immediate surgical care[5,6,7,8].

For the purposes of developing simple and operational quality indicator definitions, we have derived two separate definitions for severely injured patients (major anatomic injury and physiological compromise) based on field triage criteria published by the Center for Disease Control and Prevention (CDC)[9,10].

[5] Brown JB, Stassen NA, Bankey PE, Sangosanya AT, Cheng JD, Gestring ML. Mechanism of injury and special consideration criteria still matter: an evaluation of the National Trauma Triage Protocol. J Trauma. 2011;70(1):38-44; discussion 44-45.

[6] Koehler JJ, Baer LJ, Malafa SA, Meindertsma MS, Navitskas NR, Huizenga JE. Prehospital Index: a scoring system for field triage of trauma victims. Ann Emerg Med. 1986;15(2):178-182.

[7] Baez AA, Lane PL, Sorondo B. System compliance with out-of-hospital trauma triage criteria. J Trauma. 2003;54(2):344-351.

[8] Carron PN, Taffe P, Ribordy V, Schoettker P, Fishman D, Yersin B. Accuracy of prehospital triage of trauma patients by emergency physicians: A retrospective study in western Switzerland. Eur J Emerg Med. 2011;18(2):86-93.

[9] Centers for Disease Control and Prevention (CDC). CDC - Injury Prevention and Control: Field Triage - Guidelines for the Field Triage of Injured Patients. 2011; http://www.cdc.gov/fieldtriage/index.html. Accessed July 8, 2012.

[10] Sasser SM, Hunt RC, Sullivent EE, et al. Guidelines for field triage of injured patients. Recommendations of the National Expert Panel on Field Triage. MMWR Recomm Rep. 2009;58(RR-1):1-35.

Major anatomic injury refers to specific anatomical injuries that can be diagnosed through inspection of the patient in the field and which may benefit from management at a Level 1 or Level 2 trauma center. The injury diagnoses were proposed by an expert panel on field triage published by the CDC[9,10]. They include: penetrating injury to head, neck, torso or extremities proximal to elbow or knee; flail chest; two or more proximal long-bone fractures; crush injury; degloved or mangled extremity; amputation proximal to wrist and ankle; pelvic fracture; open or depressed skull fracture; and paralysis.

Physiological compromise is defined as a respiratory rate (RR) < 10 or > 29 or intubation; GCS < 9 or; (SBP) < 90 mmHg. This definition is derived from recommendations from an expert panel on field triage published by the CDC[9,10].

Trauma Center Classification The American College of Surgeons categorizes trauma centers into four levels based on human and physical resources; Level 1 (regional resource), Level 2 (comprehensive care), Level 3 (initial management) and Level 4 (initial evaluation)[2].

Trauma and ISS (TRISS) is a method to assess a patient's individual probability of survival based on the Revised Trauma Score (RTS), ISS, mechanism of injury and age[1].

Weighted Trauma Score (W-RTS) includes GCS, SBP and RR. It is coded and weighted with values ranging from four (normal) to zero (poor)[11].

[1] Rivara FP. Injury control: a guide to research and program evaluation. Cambridge; New York: Cambridge University Press; 2001.

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[9] Centers for Disease Control and Prevention (CDC). CDC - Injury Prevention and Control: Field Triage - Guidelines for the Field Triage of Injured Patients. 2011; http://www.cdc.gov/fieldtriage/index.html. Accessed July 8, 2012.

[10] Sasser SM, Hunt RC, Sullivent EE, et al. Guidelines for field triage of injured patients. Recommendations of the National Expert Panel on Field Triage. MMWR Recomm Rep. 2009;58(RR-1):1-35.

[11] Champion HR, Sacco WJ, Copes MD, Gann DS, Gennarelli TA, Flanagan ME. A revision of the Trauma Score. J Trauma. 1989;29(5):623-629.

2 Prehospital Indicators

Prehospital Quality Indicators are designed to measure the quality of care provided to patients with major injuries from the time of first contact to arrival at the definitive treatment trauma center. The indicators are intended to examine select domains of injury care and to be applicable across geographical areas in high-income countries.

2.1 Time to First Medical Contact

Description of Indicator

Relationship to Quality	Medical care should be timely
Type of Indicator	Prehospital process, System level
Proposed Data Sources	Emergency Medical Services (EMS) Records, Emergency Department (ED) Record
Definition	Time from onset of injury to first medical contact*
Numerator	Time of first medical contact* with injured patient age 18 years and older – time of injury[‡†]
Denominator	Not applicable
Benchmark	Not specified at present
Risk Adjustment[β]	Geographic area (urban, suburban, rural), initial GCS, ISS, mechanism of injury, type of injuries

* First medical contact = time at which the injured patient had first contact with a medical provider. In the field this may include a medical first responder, paramedic or other emergency medical service provider, depending on the jurisdiction. For patients presenting directly to a healthcare facility (e.g. Hospital ED) first medical contact will be the time of arrival at the healthcare facility.

[‡] Time of injury may not be precisely known, but is likely to be accurately estimated by initial medical service providers. We believe that using time of injury as a starting point for prehospital time based measures is conceptually attractive from both physiological and quality improvement perspectives as it represents the onset of tissue injury. It is analogous to using time of symptom onset in patients with stroke or myocardial infarction.

[†] Time to first medical contact will be reported as an interval measure (mean or median) with a measure of variation (standard deviation or interquartile range).

Summary

This indicator is intended to reflect community system response, access to 911, dispatch of resources and actual time of first medical contact. The indicator consists of an amalgamation of four separate measures evaluated by the Quality Indicators in Trauma Care Consensus Panel; S*cene Time, Prehospital Time, Time of Decision to Transport Patient to Trauma Center* and *Patients Transferred to Another Health Facility after Spending >6h at the Initial Hospital.*

Panel Review

Panelists agreed that time is an important factor in patient care and expressed that measurement of multiple time metrics is possible, each with different implications. With limited evidence for the clinical importance of specific time thresholds, it was suggested that it may be simplest to report time[12]. In addition, panelists emphasized the importance of reporting and/or adjusting for geographic area and mechanism and type of injuries, and specifically the value of restricting the use of this indicator for severely injured patients.

Panelists discussed when time measurement should begin and outlined that time of EMS dispatch could likely be accurately recorded. Conversely, using time (or estimated time) of injury onset was suggested to be conceptually a better reference point despite potential measurement challenges.

Trauma Center Review

Comments from the trauma centers reflected the panel's discussion relating to the importance of this indicator, as well as the challenges of implementation. These challenges include difficulties of ascertaining, documenting and obtaining the time of injury and first medical contact. The trauma centers reported that current EMS practices do not consistently report the data required for this quality indicator and therefore changes in data reporting may be required to implement the indicator.

[12] Newgard CD, Schmicker RH, Hedges JR, et al. Emergency medical services intervals and survival in trauma: assessment of the "golden hour" in a North American prospective cohort. Ann Emerg Med. 2010;55(3):235-246.

Review of Literature & Evidence

Face Validity: In one study, 88% of Delphi panel participants ranked need for developing scene time limits and auditing violations as very important[13].

Construct Validity: Three studies have shown an association between scene time and increased ICU and hospital length of stay, but an inconsistent association with hospital mortality[14,15,16].

Reliability: No studies identified.

Risk Adjustment[β]: A list of potential variables for risk adjustment is available from studies examining this indicator[12].

Utilization: Measures of prehospital time are used as an indicator by a large number of trauma centers: USA 64% (127/200), Canada 17% (6/35), Australasia 50% (6/12).

There is evidence that prehospital times can be decreased through the use of global positioning systems[17,18], flashing light protocols[19] and different methods of transportation (helicopter versus ground ambulance)[20], but there is an inconsistent association of this time interval with mortality[14,15,16].

[12] Newgard CD, Schmicker RH, Hedges JR, et al. Emergency medical services intervals and survival in trauma: assessment of the "golden hour" in a North American prospective cohort. Ann Emerg Med. 2010;55(3):235-246.
[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.
[14] Nayduch D, Moylan J, Snyder BL, Andrews L, Rutledge R, Cunningham P. American College of Surgeons trauma quality indicators: an analysis of outcome in a statewide trauma registry. J Trauma. 1994;37(4):565-573; discussion 573-565.
[15] Copes WS, Staz CF, Konvolinka CW, Sacco WJ. American College of Surgeons audit filters: associations with patient outcome and resource utilization. J Trauma. 1995;38(3):432-438.
[16] Di Bartolomeo S, Valent F, Sanson G, Nardi G, Gambale G, Barbone F. Are the ACSCOT filters associated with outcome? Examining morbidity and mortality in a European setting. Injury. 2008;39(9):1001-1006.
[17] Ota FS, Muramatsu RS, Yoshida BH, Yamamoto LG. GPS computer navigators to shorten EMS response and transport times. Am J Emerg Med. 2001;19(3):204-205.
[18] Ho J, Lindquist M. Time saved with the use of emergency warning lights and siren while responding to requests for emergency medical aid in a rural environment. Prehosp Emerg Care. 2001;5(2):159-162.
[19] Marques-Baptista A, Ohman-Strickland P, Baldino KT, Prasto M, Merlin MA. Utilization of warning lights and siren based on hospital time-critical interventions. Prehosp Disaster Med. 2010;25(4):335-339.

Source

The American College of Surgeons Committee on Trauma proposed ambulance scene time >20 minutes and patients transferred to another health facility after spending >6h at the initial hospital as audit filters[2]. Rosengart et al. proposed developing scene time limits using a Delphi panel of trauma experts[13]. Several variations of prehospital time indicators were identified by trauma centers.

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.

[14] Nayduch D, Moylan J, Snyder BL, Andrews L, Rutledge R, Cunningham P. American College of Surgeons trauma quality indicators: an analysis of outcome in a statewide trauma registry. J Trauma. 1994;37(4):565-573; discussion 573-565.

[15] Copes WS, Staz CF, Konvolinka CW, Sacco WJ. American College of Surgeons audit filters: associations with patient outcome and resource utilization. J Trauma. 1995;38(3):432-438.

[16] Di Bartolomeo S, Valent F, Sanson G, Nardi G, Gambale G, Barbone F. Are the ACSCOT filters associated with outcome? Examining morbidity and mortality in a European setting. Injury. 2008;39(9):1001-1006.

[20] Talving P, Teixeira PGR, Barmparas G, et al. Helicopter evacuation of trauma victims in los angeles: Does it improve survival? World J Surg. 2009;33(11):2469-2476.

2.2 Acute Pain Management

Description of Indicator

Relationship to Quality	Medical care should be timely, effective and patient-centered
Type of Indicator	Prehospital and Hospital process, Hospital level
Proposed Data Sources	EMS Records, ED Records
Definition	Documented pain assessment and a reassessment within 30 minutes of first medical contact with injured patient
Numerator	All injured patients age 18 years and older with documented pain assessment AND reassessment within 30 minutes of first medical contact
Denominator	All injured patients with first medical contact (EMS and/or ED)
Benchmark	Not applicable
Risk Adjustment	Not applicable

Summary

This indicator is intended to monitor the assessment and reassessment of acute pain for injured patients following first medical contact. The indicator originally included initiation of pain management, but given that there are many ways to manage pain (e.g. pharmacological, immobilization, changing physical position etc.) it was revised to include a reassessment of acute pain.

Panel Review

Panelists emphasized the importance of this key patient-centered indicator. From a patient perspective effective acute pain management was described as imperative. Panelists reported evidence that acute pain may be associated with long-term pain, and that if inadequately treated acute pain has measurable physiological and psychological sequelae.

Looking at implementation of this indicator, panelists agreed that evaluation needs to include both prehospital and ED care. Panelists reported that both assessment and management of acute pain needs to be measured and may be most practically performed using medical record documentation.

Trauma Center Review

The trauma centers highlighted that multiple pain assessment tools are employed in practice and questioned whether indicator performance would be impacted by the tool used. Reassessment of pain was noted to be difficult to determine as EMS providers may not quantify pain during reassessment. In addition, a question was raised about how the indicator would perform for patients transferred to ED care within 30 minutes of the initial pain assessment. Documentation of pain assessment was reported to be inconsistent and potentially challenging to obtain from prehospital records. It was suggested that a change in the culture of some EMS organizations may be necessary to develop comprehensive pain assessment and reassessment practices and consistent documentation of these procedures.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study showed that the implementation of a fentanyl-based pain management protocol resulted in a marked reduction in time to initial analgesia[21].

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: No data identified.

Different tools have been tested for measuring acute pain in the prehospital setting. Maio et al.[22] recommended the use of 2 verbal pain-rating scales for out-of-hospital evaluation of adults, adolescents, and older children: (1) the Adjective Response Scale, which includes the

[21] Curtis KM, Henriques HF, Fanciullo G, Reynolds CM, Suber F. A fentanyl-based pain management protocol provides early analgesia for adult trauma patients. J Trauma. 2007;63(4):819-826.

[22] Maio RF, Garrison HG, Spaite DW, et al. Emergency Medical Services Outcomes Project (EMSOP) IV: pain measurement in out-of-hospital outcomes research. Ann Emerg Med. 2002;40(2):172-179.

responses “none,” “slight,” “moderate,” “severe,” and “agonizing,” and (2) the Numeric Response Scale, which includes responses from 0 (no pain) to 100 (worst pain imaginable)[22]. Several studies have shown that providing injured patients with analgesia within the first 30 minutes of contact with EMS personnel is feasible[21,23,24,].

Source

This quality indicator was proposed by the Quality Indicators in Trauma Care Consensus Panel.

[21] Curtis KM, Henriques HF, Fanciullo G, Reynolds CM, Suber F. A fentanyl-based pain management protocol provides early analgesia for adult trauma patients. J Trauma. 2007;63(4):819-826.
[22] Maio RF, Garrison HG, Spaite DW, et al. Emergency Medical Services Outcomes Project (EMSOP) IV: pain measurement in out-of-hospital outcomes research. Ann Emerg Med. 2002;40(2):172-179.
[23] Chao A, Huang CH, Pryor JP, Reilly PM, Schwab CW. Analgesic use in intubated patients during acute resuscitation. J Trauma. 2006;60(3):579-582.
[24] Abbuhl FB, Reed DB. Time to analgesia for patients with painful extremity injuries transported to the emergency department by ambulance. Prehosp Emerg Care. 2003;7(4):445-447.

2.3 Protocol for Field Triage

Description of Indicator

Relationship to Quality	Medical care should be timely and efficient
Type of Indicator	Prehospital structure, System level
Proposed Data Source	Survey
Definition	Trauma systems with a protocol to guide patient field triage
Numerator	Trauma systems with a protocol directing transport of injured patients age 18 years and older to specific hospitals
Denominator	Not applicable
Benchmark	Not applicable
Risk Adjustment	Not applicable

Summary

This indicator is intended to identify trauma systems with protocols for patient field triage.

Panel Review

Panelists noted that appropriate field triage criteria are essential for effective population-based injury care and advocated that this indicator may help evaluate decisions surrounding patient transport. For smaller trauma centers and non-urban centers this indicator may support facilitating direct transport of patients to the appropriate trauma center. Finally, panelists discussed the possible limited value of this indicator for geographic areas with few trauma centers or where all centers have similar resources.

Trauma Center Review

The trauma centers emphasized the importance of this indicator as a means to encourage triage protocol adoption. Difficulties with this indicator that were noted include the challenges that trauma centers face in accessing information relating to triage protocols outside of their

own system and the ability of insurance companies to dictate transport decisions and overrule triage protocols in place. Additionally, it was noted that developing and implementing triage protocols for a large geographical area (i.e. State or Province) is challenging.

Review of Literature & Evidence

Face Validity: In one study, 88% of Delphi panel members ranked the need for criteria to match needs of injured patients with hospital resources as very important[13].

Construct Validity: No studies identified.

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: Measures of triage criteria are used as an indicator by a small number of trauma centers: USA 0.5% (1/200), Canada 0% (0/35), Australasia 0% (0/12).

Many field triage protocols exist, but none have been shown to be superior to others[16]. Protocols for field triage may include physiological and anatomical parameters and mechanism of injury[2,12,14]. Additional consideration should be given to special populations in triage protocols, such as elderly patients[2,15].

Source

Rosengart et al. developed the indicator using a Delphi panel of trauma experts[13].

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[12] Newgard CD, Schmicker RH, Hedges JR, et al. Emergency medical services intervals and survival in trauma: assessment of the "golden hour" in a North American prospective cohort. Ann Emerg Med. 2010;55(3):235-246.

[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.

[14] Nayduch D, Moylan J, Snyder BL, Andrews L, Rutledge R, Cunningham P. American College of Surgeons trauma quality indicators: an analysis of outcome in a statewide trauma registry. J Trauma. 1994;37(4):565-573; discussion 573-565.

[15] Copes WS, Staz CF, Konvolinka CW, Sacco WJ. American College of Surgeons audit filters: associations with patient outcome and resource utilization. J Trauma. 1995;38(3):432-438.

[16] Di Bartolomeo S, Valent F, Sanson G, Nardi G, Gambale G, Barbone F. Are the ACSCOT filters associated with outcome? Examining morbidity and mortality in a European setting. Injury. 2008;39(9):1001-1006.

2.4 Field Triage Rate

Description of Indicator

Relationship to Quality	Medical care should be efficient & effective
Type of Indicator	Prehospital and Hospital process, System level
Proposed Data Source	Trauma Registries OR Administrative Data
Definition	Patients with major anatomic injuries admitted to a hospital without the resources to manage the patient's injuries per 100 patients
Numerator	All patients* age 18 years and older diagnosed with major anatomic injuries AND admitted to a hospital within the trauma system[‡] that is not a Level 1 OR Level 2 trauma center
Denominator	All patients* age 18 years and older diagnosed with major anatomic injuries AND admitted to a hospital within the trauma system
Benchmark	Under triage rate ≤ 5%[†]
Risk Adjustment	Not applicable

* Field triage criteria for injured patients are evolving. We propose currently using recommendations from an expert panel on field triage published by the CDC[9,10], but restricting criteria to major anatomic injury diagnoses (excluding physiological variables, e.g. blood pressure) to facilitate the use of trauma registry or administrative data for measurement purposes.

[9] Centers for Disease Control and Prevention (CDC). CDC - Injury Prevention and Control: Field Triage - Guidelines for the Field Triage of Injured Patients. 2011; http://www.cdc.gov/fieldtriage/index.html. Accessed July 8, 2012.
[10] Sasser SM, Hunt RC, Sullivent EE, et al. Guidelines for field triage of injured patients. Recommendations of the National Expert Panel on Field Triage. MMWR Recomm Rep. 2009;58(RR-1):1-35.

Inclusion criteria for patients with major anatomic injuries likely to benefit from admission to a Level 1 OR Level 2 trauma center are (satisfying any criterion is sufficient):

Penetrating injury to head, neck, torso extremities (proximal to elbow or knee)
Flail chest
≥ 2 proximal long-bone fractures
Crush, degloved or mangled extremity
Amputation proximal to wrist and ankle
Pelvic fracture
Open or depressed skull fracture
Paralysis

‡ Includes all acute care hospitals within the geographical area and/or operational boundaries of an inclusive trauma system.

† American College of Surgeons Committee on Trauma has proposed that under triage rates can be as high as 5% and over triage rates range between 25% and 50%[2]. These benchmarks were proposed using different methods of calculation. We propose using the American College of Surgeons Committee on Trauma benchmark of ≤5% for under triage in order to make the measure sensitive for identifying patients with major anatomic injuries that may benefit from admission to a Level 1 or Level 2 trauma center.

Summary

Treatment of injured patients in the prehospital setting should include rapid transport to the closest appropriate facility. Under triage is defined as a triage decision that classifies patients as not needing trauma center care when in fact they are likely to benefit from this level of care (false negative triage)[2]. Over triage is the decision that incorrectly classifies a patient as needing trauma center care when in fact they are unlikely to benefit from this level of care (false positive triage)[2].

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

The indicator has been constructed to complement quality indicator #1 (*Protocol of Field Triage*) and quality indicator #7 (*Time to Definitive Trauma Center*). It is intended to monitor rates of patients with major anatomic injuries admitted to hospitals without the resources to manage the patients' injuries and not to evaluate the initial destination hospital of EMS transports. We selected this approach to allow prehospital transport algorithms to include initial transport of severely injured patients to the closest facility for the purposes of facilitating transport to a Level 1 or Level 2 trauma center.

Panel Review

Panelists emphasized that field triage is an important measure of the coordination of prehospital and hospital care and determines whether patients are receiving care in the most appropriate setting. Panelists suggested EMS, trauma registry and/or administrative data as possible data sources for this indicator.

Panelists discussed the challenges of data collection relating to this indicator as it may potentially involve multiple regions and data sources. In rural areas this indicator may be dependent on what type of hospital (trauma classification) is available, as Level 1 or 2 trauma centers may be a long distance away. Panelists noted that this indicator would work well in urban areas with multiple types of healthcare facilities.

Panelists indicated that ideally both under and over triage would be calculated and examined given the potential impact of both on patient care and trauma system efficiency. It was also noted that examining over triage may not be practical as it is likely dependent on local protocols, which depict what patients go to what hospitals.

Trauma Center Review

The trauma centers reported that this indicator was crucial for assessing system performance. Specifically, they indicated that it allows for evaluation of how well EMS personnel are performing in relation to the triage protocol and assesses global performance of the triage protocol. Concerns from the trauma centers reflected the panelists' discussion that data collection may be difficult. They noted that considerations for geographical area, anatomic and

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

physiological criteria and mechanism of injury need to be included. The trauma centers stressed the need for all centers to be compliant in documentation of both under and over triage. They highlighted that in order for the indicator to be accurate, information must be available for all injured patients transported to hospitals (trauma centers and non-trauma centers).

Review of Literature & Evidence

Face Validity: In one study, 95% of Delphi panel participants ranked monitoring under triage and identifying causes as very important[13].

Construct Validity: No studies identified.

Reliability: No studies identified.

Risk Adjustment: Eight variables for risk adjustment have been used in the literature to examine this indicator: gender, race, age, GCS at scene, ISS, mechanism of injury, type of injuries and provider level (type)[25,26,27,28,29,]. However, it is unclear that risk adjustment should be used when measuring processes of care.

Utilization: Measures of under triage rate are used as an indicator by a moderate number of trauma centers: USA 31% (61/200), Canada 3% (1/35), Australasia 0% (0/12).

[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.

[25] Caterino JM, Valasek T, Werman HA. Identification of an age cutoff for increased mortality in patients with elderly trauma. Am J Emerg Med. 2010;28(2):151-158.

[26] Chang DC, Bass RR, Cornwell EE, Mackenzie EJ. Undertriage of elderly trauma patients to state-designated trauma centers. Arch Surg. 2008;143(8):776-781.

[27] Lane P, Sorondo B, Kelly JJ. Geriatric trauma patients-are they receiving trauma center care? Acad Emerg Med. 2003;10(3):244-250.

[28] Meldon SW, Reilly M, Drew BL, Mancuso C, Fallon W, Jr. Trauma in the very elderly: a community-based study of outcomes at trauma and nontrauma centers. J Trauma. 2002;52(1):79-84.
[29] Haas B, Gomez D, Zagorski B, Stukel TA, Rubenfeld GD, Nathens AB. Survival of the fittest: the hidden cost of undertriage of major trauma. J Am Coll Surg. 2010;211(6):804-811.

Source

This indicator is a combination of two indicators evaluated by the Quality Indicators in Trauma Care Consensus Panel: *Under Triage* and *Severely Injured Patients Admitted to Non-Trauma Center*. Rosengart et al. developed the indicator using a Delphi panel of trauma experts[13]. A national expert panel convened by the CDC in the United States proposed a triage scheme[9,10].

[9] Centers for Disease Control and Prevention (CDC). CDC - Injury Prevention and Control: Field Triage - Guidelines for the Field Triage of Injured Patients. 2011; http://www.cdc.gov/fieldtriage/index.html. Accessed July 8, 2012.

[10] Sasser SM, Hunt RC, Sullivent EE, et al. Guidelines for field triage of injured patients. Recommendations of the National Expert Panel on Field Triage. MMWR Recomm Rep. 2009;58(RR-1):1-35.
[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.

2.5 Protocol for Inter-Facility Transfer

Description of Indicator

Relationship to Quality	Medical care should be timely, equitable and efficient
Type of Indicator	Prehospital and Hospital structure, System level
Proposed Data Source	Survey
Definition	Trauma systems with a protocol to guide the transfer of injured patients from a lower-level facility to a higher-level facility
Numerator	Trauma systems with protocol for transfer of injured patients age 18 years and older from a lower-level facility to a higher-level facility
Denominator	Not applicable
Benchmark	Not applicable
Risk Adjustment	Not applicable

Summary

This indicator is intended to identify trauma systems with protocols for guiding transfer of injured patients between healthcare facilities.

Panel Review

Panelists emphasized the importance of this indicator for rural regions where Level 1 centers are significant distances from the site of injury. It was noted that there is a need to evaluate both the application and effectiveness of the protocol in addition to simply having a protocol. Panelists reported that protocols may vary between centers and this could impact protocol effectiveness.

Trauma Center Review

The trauma centers emphasized the importance of protocols for both patient transfer and transfer agreements between centers. They noted that getting the patient to the most appropriate facility is important. The trauma centers highlighted that all centers, regardless of trauma center status, needed to be involved in documentation for this indicator.

Review of Literature & Evidence

Face Validity: In one study, 88% of Delphi panel participants ranked implementation of a protocol to ensure prompt transfer of trauma patients from a lower-level to a higher-level facility as very important[13].

Construct Validity: No studies identified.

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: Patient Transfer Protocol is used as an indicator by a moderate number of trauma centers: USA 38% (75/200), Canada 3% (1/35), Australasia 0% (0/12).

Protocols should specify the transfer of appropriate injured patients from rural areas to Level 1 trauma centers in a timely fashion in order to reduce mortality rates[30]. Two hours has been suggested as one possible time threshold for transfer[31]. There is some evidence to support the use of helicopter transfer to improve patient survival[32]. Pretransfer interventions such as CT scan and laparotomy have been shown to delay time of transportation and increase cost and not improve outcomes[33]. Protocols should include means to ensure the equitable transfer of patients and not be based on patients' ability to pay[34].

[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.

[30] Garwe T, Cowan LD, Neas BR, Sacra JC, Albrecht RM. Directness of transport of major trauma patients to a level i trauma center: A propensity-adjusted survival analysis of the impact on short-term mortality. J Trauma. 2011;70(5):1118-1127.

[31] Crandall ML, Esposito TJ, Reed RL, Gamelli RL, Luchette FA. Analysis of compliance and outcomes in a trauma system with a 2-hour transfer rule. Arch Surg. 2010;145(12):1171-1175.

[32] Brown JB, Stassen NA, Bankey PE, Sangosanya AT, Cheng JD, Gestring ML. Helicopters improve survival in seriously injured patients requiring interfacility transfer for definitive care. J Trauma. 2011;70(2):310-314.

[33] Mohan D, Barnato AE, Angus DC, Rosengart MR. Determinants of compliance with transfer guidelines for trauma patients: a retrospective analysis of CT scans acquired prior to transfer to a Level I trauma center. Ann Surg. 2010;251(5):946-951.

[34] Parks J, Gentilello LM, Shafi S. Financial triage in transfer of trauma patients: a myth or a reality? Am J Surg. 2009;198(3):e35-e38.

Source

Rosengart et al. developed the indicator using a Delphi panel of trauma experts[13]

[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.

2.6 Protocol for Monitoring Diversion from Trauma Center

Description of Indicator

Relationship to Quality	Medical care should be equitable and efficient
Type of Indicator	Prehospital structure, System level
Proposed Data Source	Survey
Definition	Trauma systems with a protocol to monitoring the frequency and reasons for EMS patient transports diverted away from a trauma center (patient declined by trauma center)
Numerator	Trauma systems with a protocol for monitoring the frequency and reason for EMS transports of injured patients age 18 years and older diverted away from a trauma center
Denominator	Not applicable
Benchmark	Not applicable
Risk Adjustment	Not applicable

Summary

This indicator is intended to identify trauma systems with protocols for monitoring the frequency and etiology of trauma centers diverting EMS patient transports to other facilities.

Panel Review

Panelists emphasized that this is a key indicator because the best trauma systems have a nodiversion policy for Level 1 trauma centers. Panelists indicated that protocols need to include a mechanism for capturing the reason for diversion. It was also noted that an integrated trauma system would likely be needed in order to capture the required data for this indicator.

Panelists expressed that the potential value of this indicator may vary according to the ownership status of hospitals (private for profit, private not for profit, government). It was also

suggested that it might be most valuable to focus on severely injured patients for this indicator. Panelists separately indicated that outcomes of diverted patients should be evaluated.

Trauma Center Review

Trauma centers strongly emphasized that trauma center diversion should not occur and suggested that centers should have a no divert policy for trauma, cardiac arrest or other unstable patients. While the importance of this indicator was evident, trauma centers had concerns regarding documentation. They noted that it would be important to monitor reasons for diversion but acknowledged that current documentation practices would need to be altered in order to obtain this data. It was suggested that EMS may be the best source of data for monitoring reasons for diversion.

Review of Literature & Evidence

Face Validity: In one study, 98% of Delphi panel participants ranked monitoring instances and causes of trauma center diversion as very important[13].

Construct Validity: No studies identified.

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: Protocol for Monitoring Diversion from Trauma Center is used as an indicator by a small number of trauma centers: USA 15% (30/200), Canada 3% (1/35), Australasia 0% (0/12).

Source

Rosengart et al. developed the indicator using a Delphi panel of trauma experts[13].

[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.

2.7 Time to Definitive Trauma Center

Description of Indicator

Relationship to Quality	Medical care should be timely
Type of Indicator	Prehospital process, System level
Proposed Data Sources	EMS Records, ED Records
Definition	Time from onset of injury* to arrival at definitive trauma center
Numerator	Time of arrival of injured patient age 18 years and older at definitive trauma center[‡] – time of injury*[†]
Denominator	Not applicable
Benchmark	Not specified at present
Risk Adjustment[β]	Geographic area (urban, rural), initial GCS, ISS, mechanism of injury, type of injuries, entrapment, provider level (type), mechanism of transport (ground, fixed wing, helicopter, combination)

* Time of injury may not be precisely known, but is likely to be accurately estimated by initial medical service providers. We believe that using time of injury as a starting point for prehospital time based measures is conceptually attractive from both physiological and quality improvement perspectives as it represents the onset of tissue injury. It is analogous to using time of symptom onset in patients with stroke or myocardial infarction.

[‡] Time of arrival at definitive trauma center = time the injured patient arrived at the final trauma center. This may represent the first hospital to which the patient was transported or a subsequent hospital.

[†] Time to Definitive Trauma Center will be reported as an interval measure (mean or median) with a measure of variation (standard deviation or interquartile range).

Summary

This indicator is intended to reflect the entire spectrum of first medical contact and the various routes by which patients may be brought to the definitive trauma center (e.g. ground versus air transport, direct transport from scene versus indirect transport via local hospital). The indicator consists of an amalgamation of four separate measures evaluated by the Quality Indicators in Trauma Care Consensus Panel: *Scene Time, Prehospital Time, Time of Decision to Transport Patient to Trauma Center* and *Patients Transferred to Another Health Facility after Spending >6h at the Initial Hospital.* The data recorded for indicator #1 (*Time to First Medical Contact*) and indicator #7 (*Time to Definitive Trauma Care*) provide opportunities for calculating multiple time metrics.

Panel Review

Panelists agreed that time is an important factor in patient care and that multiple time metrics can be measured, each with different implications. Similar to the panelists' comments for the indicator, *Time to First Medical Contact,* it was suggested that using time of EMS dispatch as the reference point for time measurements may be most practical but that time of injury onset is conceptually better. In addition they highlighted that reporting and/or adjustment for geographic area (urban versus rural, distance from destination), mechanism and type of injuries, complexity of scene (e.g. entrapment), type of provider and mechanism of transport (e.g. ground versus air) is likely to be important for this indicator.

Panelists also discussed implementation of this indicator and the importance of coordinating data collection with EMS.

Trauma Center Review

The trauma centers agreed on the importance of this indicator but were concerned that it is difficult to ensure that documentation is consistent and completed. They indicated that it may be valuable to obtain information relating to reasons for delay, but discussed that this may be difficult to implement and obtain. The difficulty in accurately ascertaining time of injury was noted and trauma centers emphasized the importance of risk adjustment (e.g. geographic area, resources, mode of transport) for this indicator.

Review of Literature & Evidence

Face Validity: In one study, 88% of Delphi panel participants ranked the need for developing scene time limits and auditing violations as very important[13].

Construct Validity: Three studies have shown an association between scene time and increased ICU and hospital length of stay, but an inconsistent association with hospital mortality[14,15,16].

Reliability: No studies identified.

Risk Adjustment[β]*:* A list of potential variables for risk adjustment is available from studies examining this indicator[12].

Utilization: Measures of prehospital time are used as an indicator by a large number of trauma centers: USA 64% (127/200), Canada 17% (6/35), Australasia 50% (6/12).

There is evidence that prehospital times can be decreased through the use of global positioning systems[17], flashing light protocols[18,19] and different methods of transportation (helicopter

[12] Newgard CD, Schmicker RH, Hedges JR, et al. Emergency medical services intervals and survival in trauma: assessment of the "golden hour" in a North American prospective cohort. Ann Emerg Med. 2010;55(3):235-246.
[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.
[14] Nayduch D, Moylan J, Snyder BL, Andrews L, Rutledge R, Cunningham P. American College of Surgeons trauma quality indicators: an analysis of outcome in a statewide trauma registry. J Trauma. 1994;37(4):565-573; discussion 573-565.
[15] Copes WS, Staz CF, Konvolinka CW, Sacco WJ. American College of Surgeons audit filters: associations with patient outcome and resource utilization. J Trauma. 1995;38(3):432-438.
[16] Di Bartolomeo S, Valent F, Sanson G, Nardi G, Gambale G, Barbone F. Are the ACSCOT filters associated with outcome? Examining morbidity and mortality in a European setting. Injury. 2008;39(9):1001-1006.
[17] Ota FS, Muramatsu RS, Yoshida BH, Yamamoto LG. GPS computer navigators to shorten EMS response and transport times. Am J Emerg Med. 2001;19(3):204-205.
[18] Ho J, Lindquist M. Time saved with the use of emergency warning lights and siren while responding to requests for emergency medical aid in a rural environment. Prehosp Emerg Care. 2001;5(2):159-162.
[19] Marques-Baptista A, Ohman-Strickland P, Baldino KT, Prasto M, Merlin MA. Utilization of warning lights and siren based on hospital time-critical interventions. Prehosp Disaster Med. 2010;25(4):335-339.

versus ground ambulance)[20], but there is an inconsistent association between this time interval and mortality[14,15,16].

Source

The American College of Surgeons Committee on Trauma proposed ambulance scene time >20 minutes and patients transferred to another health facility after spending >6h at the initial hospital as audit filters[2]. Rosengart et al. proposed developing scene time limits using a Delphi panel of trauma experts[13]. Several variations of prehospital time indicators were identified from trauma centers.

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.

[14] Nayduch D, Moylan J, Snyder BL, Andrews L, Rutledge R, Cunningham P. American College of Surgeons trauma quality indicators: an analysis of outcome in a statewide trauma registry. J Trauma. 1994;37(4):565-573; discussion 573-565.

[15] Copes WS, Staz CF, Konvolinka CW, Sacco WJ. American College of Surgeons audit filters: associations with patient outcome and resource utilization. J Trauma. 1995;38(3):432-438.

[16] Di Bartolomeo S, Valent F, Sanson G, Nardi G, Gambale G, Barbone F. Are the ACSCOT filters associated with outcome? Examining morbidity and mortality in a European setting. Injury. 2008;39(9):1001-1006.

[20] Talving P, Teixeira PGR, Barmparas G, et al. Helicopter evacuation of trauma victims in los angeles: Does it improve survival? World J Surg. 2009;33(11):2469-2476.

2.8 Invasive Prehospital Procedure Documentation Rate

Description of Indicator

Relationship to Quality	Medical care should be effective
Type of Indicator	Prehospital process and outcome, System level
Proposed Data Sources	EMS Records
Definition	Documentation of high-risk low-volume prehospital procedures* attempted, performed successfully and associated complications per 100 EMS contacts with injured patients
Numerator	All EMS records for patients 18 years and older with a) documentation of the following invasive procedures attempted prior to arrival in hospital, b) documentation of procedures successfully performed and c) documentation of any procedure dependent complications*: Intubation Cricothyroidotomy Needle decompression thoracostomy Defibrillation
Denominator	All EMS contacts for injured patients age 18 years and older
Benchmark	Not specified at present
Risk Adjustment	Not specified at present

* For each of the four procedures, three measures will be calculated: i) number of documented attempted procedures per 100 patients, ii) number of documented successful procedures per 100 patients and iii) number of documented complications per 100 patients.

Summary

This indicator is intended to monitor the rate of high-risk low-volume invasive prehospital procedures attempted, successfully performed and associated complications.

Panel Review

Panelists emphasized that the indicator is not designed to encourage the performance of invasive procedures, but rather charting compliance of procedures when performed. The indicator should reflect the decision-making that paramedics do, and have the capacity to be interrogated. Panelists noted that the ability of EMS organizations to provide high quality advanced life support procedures for severely injured patients will likely be associated with robust patient care records and corresponding quality improvement program.

In addition panelists noted that the types of EMS providers should be documented in order to allow for international comparison. Panelists also discussed the need to ensure consistent definitions for procedure success and complications. Panelists noted that similar indicators could be developed for other healthcare workers.

Trauma Center Review

The trauma centers emphasized the importance of this indicator because accurate and complete documentation of invasive procedures is necessary for ongoing patient management, assessment of quality of care, and, in some cases, research purposes. In order for the indicator to be effective, it would be essential to ensure there is documentation of all attempted procedures, time of procedures and success rates. The trauma centers had concerns that data collection is often difficult because of missing or incomplete medical records and it would be time consuming if the system does not have an electronic EMS medical record. The trauma centers questioned the value of this indicator for rural areas where prehospital providers may have more limited training to perform invasive procedures and may not be exposed to sufficiently large patient volumes to maintain these skills.

Review of Literature & Evidence

Face Validity: In one study, 100% of Delphi panel participants ranked documenting indications for select prehospital interventions as very important[13].

[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.

Construct Validity: One study showed inconclusive association between the quality indicator and mortality[13].

Reliability: No studies identified.

Risk Adjustment: No studies identified.

Utilization: Emergency medical service documentation guidelines are used as an indicator by a small number of trauma centers: USA 13% (25/200), Canada 0% (0/35), Australasia 0% (0/12).

Source

Rosengart et al. developed the indicator using a Delphi panel of trauma experts[13].

[13] Rosengart MR, Nathens AB, Schiff MA. The identification of criteria to evaluate prehospital trauma care using the Delphi technique. J Trauma. 2007;62(3):708-713.

3 Hospital Indicators

Hospital Quality Indicators are designed to measure the quality of care provided to patients with major injuries from the time of arrival at the definitive treatment trauma center to the time of discharge. The indicators are intended to examine select domains of injury care and be applicable across geographical areas in high-income countries.

3.1 Direct Admission to ED Shock Room

Description of Indicator

Relationship to Quality	Medical care should be timely
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	ED Records
Definition	Number of injured patients with physiological compromise* directly admitted to ED shock room (trauma/resuscitation) per 100 ED admissions
Numerator	All injured patients age 18 years and older with physiological compromise* AND admission to the ED shock room (trauma/resuscitation) in 10 minutes or less of ED arrival
Denominator	All injured patients age 18 years and older with physiological compromise* admitted to the ED
Benchmark	Not specified at present
Risk Adjustment	Not applicable

* Proposed parameters of physiological compromise (RR < 10 or >29 breaths per minute or intubated or GCS < 9 or SBP < 90 mmHg) are derived from the field triage published by the CDC[9,10]. They are designed to provide simple identification of patients with physiological compromise that may benefit from direct admission to the ED shock room, but can be replaced by local guidelines if available.

[9] Centers for Disease Control and Prevention (CDC). CDC - Injury Prevention and Control: Field Triage - Guidelines for the Field Triage of Injured Patients. 2011; http://www.cdc.gov/fieldtriage/index.html. Accessed July 8, 2012.
[10] Sasser SM, Hunt RC, Sullivent EE, et al. Guidelines for field triage of injured patients. Recommendations of the National Expert Panel on Field Triage. MMWR Recomm Rep. 2009;58(RR-1):1-35.

Summary

This indicator is intended to monitor whether injured patients with physiological compromise are directly admitted to ED shock rooms.

Panel Review

Panelists indicated that the decision to use the shock or trauma room is part of basic triage of a trauma patient and that the indicator could be used to ensure that the right patients get to the right place in the ED. It was suggested that physiological criteria could be used to identify patients that may benefit from early admission to the ED shock room. Panelists advocated that the indicator may be valuable to examine any association between ED 'overcrowding' and patient care as well as to assist in further defining which patients are most likely to benefit from direct trauma/shock room admission.

Concerns relating to feasibility and documentation were brought forward by the panelists. They noted that hospitals might have very different local guidelines that may significantly impact ED triage decisions.

Trauma Center Review

The trauma centers emphasized that having resources available and accessible for compromised patients is essential and compliance for this indicator should be 100%. The trauma centers noted that some organizations already use similar measures and therefore the definition should be consistent with previously established guidelines (e.g. ASCOT)[2]. The trauma centers indicated that "ED Shock Room" must be explicitly defined to ensure a consistent application of the indicator. The question was raised about how patients who receive appropriate treatment in another location in the ED other than the shock room should be handled. The trauma centers were concerned about reliability and validity of medical record documentation required for the indicator.

Review of Literature & Evidence

Face Validity: No studies identified.

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

Construct Validity: One study demonstrated that implementation of a trauma quality improvement program that included the quality indicator was associated with reduced hospital mortality[35].

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: The indicator does not appear to be currently used by trauma centers: USA 0% (0/200), Canada 0% (0/35), Australasia 0% (0/12).

Source

The quality indicator was proposed by Ruchholtz et al.[35].

[35] Ruchholtz S, Waydhas C, Lewan U, et al. A multidisciplinary quality management system for the early treatment of severely injured patients: implementation and results in two trauma centers. Intensive Care Med. 2002;28(10):1395-1404.

3.2 Trauma Team Activation (TTA)

Description of Indicator

Relationship to Quality	Medical care should be safe
Type of Indicator	Hospital process, Hospital Level
Proposed Data Sources	Hospital Medical Records
Definition	Number of injured patients admitted to ED who satisfy local TTA guidelines AND for whom there is a TTA per 100 patients*****
Numerator	All injured patients age 18 years and older admitted to the ED who satisfy local TTA guidelines AND for whom there is a TTA*****
Denominator	All injured patients age 18 years and older admitted to the ED who satisfy local TTA guidelines*
Benchmark	Not specified at present
Risk Adjustment	Not applicable

***** Ideally local TTA guidelines should be employed. Alternatively presence of physiological compromise (RR < 10 or > 29 breaths per minute or intubated or GCS < 9 or SBP < 90 mmHg) or a major anatomic injury (penetrating injury to head, neck, torso, extremities proximal to elbow or knee, flail chest, ≥ 2 proximal long-bone fractures, crush, degloved or mangled extremity, amputation proximal to wrist and ankle, pelvic fracture, open or depressed skull fracture, paralysis) derived from the field triage published by the CDC[9,10] may be employed.

[9] Centers for Disease Control and Prevention (CDC). CDC - Injury Prevention and Control: Field Triage - Guidelines for the Field Triage of Injured Patients. 2011; http://www.cdc.gov/fieldtriage/index.html. Accessed July 8, 2012.
[10] Sasser SM, Hunt RC, Sullivent EE, et al. Guidelines for field triage of injured patients. Recommendations of the National Expert Panel on Field Triage. MMWR Recomm Rep. 2009;58(RR-1):1-35.

Summary

This indicator is intended to monitor TTA and identify deviations from local guidelines that warrant individual patient review.

Panel Review

Panelists expressed that this indicator may allow for opportunities to review situations in which the trauma team is not activated for patients satisfying TTA criteria. They noted that there are some issues that will make implementation of this indicator difficult as it is unclear if there is a common trigger that could be used across centers. Panelists noted that each institution has their own scoring mechanism for activating a trauma team and often physicians and EMS simply use their own judgment. It was discussed that a common trigger could be based on physiological criteria (e.g. intubated, GCS < 9 or SBP < 90mmHg) or alternatively remain based on local guidelines. Panelists noted ISS to be an inappropriate trigger as it is calculated retrospectively.

Trauma Center Review

The trauma centers specified that this indicator helps to measure timeliness of trauma care, resuscitation and diagnostics. Like the previous indicator, the trauma centers noted that it is already in place in some systems and therefore the definition should be consistent with previously established guidelines (e.g. ASCOT)[2]. It was reported that this indicator must allow for local protocols to be used for TTA but recognized that this may complicate comparison between centers. Lastly, trauma centers noted there is a need to ensure that documentation is completed and consistent in order to evaluate this indicator.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study demonstrated that the quality indicator was associated with reduced risk of ICU admission, but was not associated with hospital mortality[36].

Reliability: No studies identified.

Risk Adjustment: Age, GCS, SBP, ISS and level of trauma care have been employed as variables for risk adjustment in studies examining this indicator for tiered TTA protocols[37].

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[36] Willis CD, Stoelwinder JU, Cameron PA. Interpreting process indicators in trauma care: construct validity versus confounding by indication. Int J Qual Health Care. 2008;20(5):331-338.

Utilization: Trauma Team Activation is as an indicator used by a large number of trauma centers: USA 49% (97/200), Canada 66% (23/35), Australasia 33% (4/12).

One study showed that GCS < 8 and SBP < 90 mmHg were predictors of mortality and should be taken into consideration for TTA in cases of adult blunt trauma[38]. Franklin et al. showed that prehospital hypotension (SBP < 90 mmHg) remains a valid indicator for TTA[39]. Sava et al. suggested the addition of truncal gunshot to TTA criteria[40]. One study described how a 3-tiered TTA protocol allowed for safe patient care with improved utilization of hospital resources[41]. Another study suggested that age $\geq$ 70 years alone should be a criterion for TTA[42]. Rainer et al. suggested that compliance with TTA protocols optimized process of care and improved survival[43]. For the most part, studies in the literature have evaluated criteria incorporated into the field triage decision scheme proposed by the CDC[9,10].

Source

The quality indicator was proposed by Ruchholtz et al.[35] and Willis et al.[36].

[9] Centers for Disease Control and Prevention (CDC). CDC - Injury Prevention and Control: Field Triage - Guidelines for the Field Triage of Injured Patients. 2011; http://www.cdc.gov/fieldtriage/index.html. Accessed July 8, 2012.

[10] Sasser SM, Hunt RC, Sullivent EE, et al. Guidelines for field triage of injured patients. Recommendations of the National Expert Panel on Field Triage. MMWR Recomm Rep. 2009;58(RR-1):1-35.

[35] Ruchholtz S, Waydhas C, Lewan U, et al. A multidisciplinary quality management system for the early treatment of severely injured patients: implementation and results in two trauma centers. Intensive Care Med. 2002;28(10):1395-1404.

[36] Willis CD, Stoelwinder JU, Cameron PA. Interpreting process indicators in trauma care: construct validity versus confounding by indication. Int J Qual Health Care. 2008;20(5):331-338.

[37] Davis T, Dinh M, Roncal S, et al. Prospective evaluation of a two-tiered trauma activation protocol in an Australian major trauma referral hospital. Injury. 2010;41(5):470-474.

[38] Cherry RA, King TS, Carney DE, Bryant P, Cooney RN. Trauma team activation and the impact on mortality. J Trauma. 2007;63(2):326-330.

[39] Franklin GA, Boaz PW, Spain DA, Lukan JK, Carrillo EH, Richardson JD. Prehospital hypotension as a valid indicator of trauma team activation. J Trauma. 2000;48(6):1034-1037; discussion 1037-1039.

[40] Sava J, Alo K, Velmahos GC, Demetriades D. All patients with truncal gunshot wounds deserve trauma team activation. J Trauma. 2002;52(2):276-279.

[41] Claridge JA, Golob JF, Jr., Leukhardt WH, et al. Trauma team activation can be tailored by prehospital criteria. Am Surg. 2010;76(12):1401-1407.

[42] Demetriades D, Chan LS, Velmahos G, et al. TRISS methodology in trauma: the need for alternatives. Br J Surg. 1998;85(3):379-384.

[43] Rainer TH, Cheung NK, Yeung JH, Graham CA. Do trauma teams make a difference? A single centre registry study. Resuscitation. 2007;73(3):374-381.

3.3 Tracheal Intubation

Description of Indicator

Relationship to Quality	Medical care should be safe
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	ED Records, Trauma Registry
Definition	All injured patients age 18 years and older with documented decreased level of consciousness (GCS < 9) in the ED AND with successful insertion of endotracheal tube in the ED
Numerator	All injured patients age 18 years and older with documented decreased level of consciousness (GCS < 9) in the ED AND with successful insertion of endotracheal tube in the ED
Denominator	Injured patients age 18 years and older with decreased level of consciousness (GCS < 9) in the ED
Benchmark	Not specified at present
Risk Adjustment	Not specified at present

Summary

This indicator is intended to monitor endotracheal intubation for injured patients with a decreased level of consciousness in the ED.

Panel Review

A key question panelists discussed was whether including this indicator would be beneficial given its current wide utilization, but limited supporting evidence.

As for implementation, panelists emphasized key issues that would need to be addressed. It was noted that setting a time period for this indicator (e.g. intubation within 10 minutes) may

not be clinically relevant or practical from a measurement perspective. Conversely, inclusion of severity of injuries and shock as indications for intubation are not practical. For successful implementation and effectiveness of this indicator, it was discussed that the indicator should address reduced level of consciousness at any time during the ED stay, not just on admission or discharge. In addition, panelists highlighted that accounting for prehospital intubation may be important.

Trauma Center Review

It was suggested that it may be important to collect the reason why intubation was not performed in patients where the indicator definition suggests it was indicated. The trauma centers expressed that this indicator may require additional resources in order to ensure compliance and to review information. Current practices may not capture the necessary information (e.g. Trauma Registry only records initial observations and may not capture patients who deteriorate during ED).

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: Three studies showed no association between the quality indicator and hospital mortality[14,15,36]. Two studies demonstrated that implementation of a trauma quality improvement program that included the quality indicator was associated with reduced hospital mortality[44,45].

Reliability: No studies identified.

Risk Adjustment: No studies identified.

[14] Nayduch D, Moylan J, Snyder BL, Andrews L, Rutledge R, Cunningham P. American College of Surgeons trauma quality indicators: an analysis of outcome in a statewide trauma registry. J Trauma. 1994;37(4):565-573; discussion 573-565.

[15] Copes WS, Staz CF, Konvolinka CW, Sacco WJ. American College of Surgeons audit filters: associations with patient outcome and resource utilization. J Trauma. 1995;38(3):432-438.

[36] Willis CD, Stoelwinder JU, Cameron PA. Interpreting process indicators in trauma care: construct validity versus confounding by indication. Int J Qual Health Care. 2008;20(5):331-338.

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

[45] Chadbunchachai W, Sriwiwat S, Kulleab S, Saranrittichai S, Chumsri J, Jaikwang P. The comparative study for quality of trauma treatment before and after the revision of trauma audit filter, Khon Kaen hospital 1998. J Med Assoc Thai. 2001;84(6):782-790.

Utilization: Endotracheal Intubation associated indicators are used by a large number of trauma centers: USA 74% (148/200), Canada 97% (34/35), Australasia 67% (8/12).

A 12-month prospective study was undertaken to observe current practice and to determine if a GCS of < 9 is a useful parameter to predict the need for airway protection in poisoning. An initial GCS of < 9 had a sensitivity of 90% and specificity of 95% for predicting the need for intubation[46].

Source

American College of Surgeons Committee on Trauma proposed the indicator Comatose Trauma Patient Leaving the ED before Mechanical Airway Established[2].

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[46] Chan B, Gaudry P, Grattan-Smith TM, McNeil R. The use of Glasgow Coma Scale in poisoning. J Emerg Med. 1993;11(5):579-582.

3.4 Time to CT Scan

Description of Indicator

Relationship to Quality	Medical care should be timely
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	ED Records, Trauma Registry
Definition	ED patients with blunt force injuries AND trauma team activation (TTA)* OR ED documented GCS < 9, receiving CT scan[‡] within 1 hour of ED arrival per 100 patients
Numerator	All ED patients age 18 years and older with blunt force injuries AND TTA* OR ED documented GCS < 9 AND CT scan performed within 1 hour of ED arrival[†β]
Denominator	All ED patients age 18 years and older with blunt force injuries AND TTA* OR ED documented GCS < 9[†]
Benchmark	Not specified at present
Risk Adjustment	Not applicable

* Ideal to use local TTA guidelines to make the indicator as relevant as possible to local practice. Alternatively physiological compromise (RR < 10 or > 29 breaths per minute or intubated or GCS < 9 or SBP < 90 mmHg) or presence of major anatomic injuries (penetrating injury to head, neck, torso, extremities proximal to elbow or knee, flail chest, ≥ 2 proximal long-bone fractures, crush, degloved or mangled extremity, amputation proximal to wrist and ankle, pelvic fracture,

open or depressed skull fracture, paralysis) derived from the field triage published by the CDC[9,10] may be employed.

[‡] Body region for CT scan is not specified. The indicator is designed to encourage early use of CT imaging and CT guided therapy for patients with injuries for whom this may be beneficial. It applies to patients at ANY trauma hospital or hospital of any level with CT scanner.

[†] Time period of interest = Time stamp for CT scan – Time of ED registration.

[β] Exclude patients with surgery or percutaneous therapy within 1 hour of ED arrival as these likely represent patients receiving interventions based on clinical examination.

Summary

This indicator is intended to monitor the proportion of patients with severe blunt force injuries (that do not proceed directly for surgical or percutaneous therapy) who receive CT imaging within 1 hour of ED arrival.

Panel Review

Panelists highlighted this as a very important system indicator that is designed to encourage early CT and CT guided therapy. They also indicated that it may be a surrogate measure of whether the trauma team is working well. They emphasized the importance of time for certain injuries (e.g. brain injury), but noted that it is unclear what time threshold is most appropriate other than the general criteria that earlier is better.

Panelists reported that it would be necessary to precisely define ED arrival and address the issue of CT image availability at the final treating hospital. In relation to this they indicated that it would be important to evaluate the impact of CT imaging at initial centers on the timeliness of patient transfer to a definitive care center and whether imaging was sent with the patient. Controversy between panelists existed as to whether body region of injury should be specified in the indicator as earlier imaging may be more important for certain injuries (e.g. head injury, abdominal injury).

[9] Centers for Disease Control and Prevention (CDC). CDC - Injury Prevention and Control: Field Triage - Guidelines for the Field Triage of Injured Patients. 2011; http://www.cdc.gov/fieldtriage/index.html. Accessed July 8, 2012.
[10] Sasser SM, Hunt RC, Sullivent EE, et al. Guidelines for field triage of injured patients. Recommendations of the National Expert Panel on Field Triage. MMWR Recomm Rep. 2009;58(RR-1):1-35.

Trauma Center Review

The trauma centers indicated that it would be important to capture the reasons for delays in getting a CT scan (e.g. may be unlikely for early imaging to influence care). It was suggested that in cases where a patient is transported from a lower to a higher-level center, CT imaging should be delayed until arrival at the higher-level center or there is a need to ensure that CT images are transported with the patient. In relation to the time threshold, the trauma centers indicated that 1 hour was too long and that both CT imaging and interpretation should be performed within this time frame. They also noted that it would be important to restrict the application of this indicator to appropriately selected patients (e.g. defined by injury body region) in order to prevent unnecessary use of resources and radiation exposure for the patient.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: Five studies demonstrated no significant association between timely CT head and hospital mortality[15,16,36,44,47]. Two studies demonstrated that implementation of a trauma quality improvement program that included time to CT was associated with reduced hospital mortality[44,45].

Reliability: No studies identified.

Risk Adjustment: Not applicable.

[15] Copes WS, Staz CF, Konvolinka CW, Sacco WJ. American College of Surgeons audit filters: associations with patient outcome and resource utilization. J Trauma. 1995;38(3):432-438.

[16] Di Bartolomeo S, Valent F, Sanson G, Nardi G, Gambale G, Barbone F. Are the ACSCOT filters associated with outcome? Examining morbidity and mortality in a European setting. Injury. 2008;39(9):1001-1006.

[36] Willis CD, Stoelwinder JU, Cameron PA. Interpreting process indicators in trauma care: construct validity versus confounding by indication. Int J Qual Health Care. 2008;20(5):331-338.

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

[45] Chadbunchachai W, Sriwiwat S, Kulleab S, Saranrittichai S, Chumsri J, Jaikwang P. The comparative study for quality of trauma treatment before and after the revision of trauma audit filter, Khon Kaen hospital 1998. J Med Assoc Thai. 2001;84(6):782-790.

[47] Cryer HG, Hiatt JR, Fleming AW, Gruen JP, Sterling J. Continuous use of standard process audit filters has limited value in an established trauma system. J Trauma. 1996;41(3):389-394; discussion 394-385.

Utilization: Measures of time to diagnostic imaging are used by a moderate number of trauma centers: USA 34% (68/200), Canada 37% (13/35), Australasia 42% (5/12).

In one study the introduction of an algorithm for early management of severely injured patients reduced time to CT scan completion and reduced mortality[48]. Similarly, in another study the inclusion of high resolution CT scanning within 8 minutes of arrival into the early diagnostic workup reduced length of stay in the trauma room[49].

Source

The indicator is an amalgamation of two indicators, *Time to Body CT and Time to Head CT,* previously proposed by Chadbunchachai et al.[44,45].

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.
[45] Chadbunchachai W, Sriwiwat S, Kulleab S, Saranrittichai S, Chumsri J, Jaikwang P. The comparative study for quality of trauma treatment before and after the revision of trauma audit filter, Khon Kaen hospital 1998. J Med Assoc Thai. 2001;84(6):782-790.
[48] Bernhard M, Becker TK, Nowe T, et al. Introduction of a treatment algorithm can improve the early management of emergency patients in the resuscitation room. Resuscitation. 2007;73(3):362-373.
[49] Hilbert P, zur NK, Hofmann GO, Hoeller I, Koch R, Stuttmann R. New aspects in the emergency room management of critically injured patients: a multi-slice CT-oriented care algorithm. Injury. 2007;38(5):552-558.

3.5 Antibiotics for Open Fracture

Description of Indicator

Relationship to Quality	Medical care should be timely
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	Hospital Medical Records
Definition	Number of patients with an open fracture* receiving an antimicrobial agent within 1 hour of hospital arrival per 100 patients
Numerator	All patients age 18 years and older admitted to hospital with a diagnosis of an open fracture* AND administered guideline recommended intravenous antimicrobial agent‡ within 1 hour of hospital arrival
Denominator	All patients age 18 years and older admitted to hospital with a diagnosis of an open fracture*
Benchmark	Not applicable
Risk Adjustment	Not specified at present

* Open fracture is defined as a fracture with an associated overlying cutaneous wound[50].

‡ Practice management guidelines for prophylactic antibiotic use in open fractures by the Eastern Association for the Surgery of Trauma is one potential source of guidelines for recommended intravenous antibiotics[50].

[50] Luchette F, Bone L, Born C, et al. EAST practice management guidelines for prophylactic antibiotic use in open fractures. 1998. http://www.east.org/research/treatment-guidelines/open-fractures-prophylactic-antibiotics. Accessed Sep 26 2011.

Summary

This indicator is intended to monitor the timely administration of antibiotics for patients with open fractures.

Panel Review

Panelists were in agreement that this indicator is well supported by the evidence and should apply to all grades of fractures. Specification of antibiotics was deemed to be inappropriate by the panel and should instead be determined according to clinical practice guidelines. The panel indicated that because time from injury to initiation of antimicrobial agent is associated with risk of infection, administration of an antimicrobial agent should be performed as soon as possible and therefore proposed a 1 hour time frame for this indicator.

Trauma Center Review

The trauma centers had concerns regarding the limited evidence to support the proposed time threshold for antibiotic administration. They suggested that administration of antibiotics within the one-hour time frame may be difficult, particularly for patients with multiple injuries requiring emergent procedures and imaging.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study found no association between timing of antibiotic administration during acute phase and infection rates[51].

Reliability: No studies identified.

Risk Adjustment: No studies identified.

Utilization: Antibiotics for Open Fracture related indicators are used by a small number of trauma centers: USA 2% (3/200), Canada 0% (0/35), Australasia 0% (0/12).

[51] Al-Arabi YB, Nader M, Hamidian-Jahromi AR, Woods DA. The effect of the timing of antibiotics and surgical treatment on infection rates in open long-bone fractures: a 9-year prospective study from a district general hospital.[Erratum appears in Injury. 2008;39(3):381 Note: Nader, Michael [corrected to Nader, Maher]]. Injury. 2007;38(8):900-905.

When a fracture is associated with an overlying cutaneous wound, prevention of wound infection remains the primary objective in the management of the soft tissue. There is universal agreement that these wounds require emergency treatment to minimize infectious complications. Multiple studies have documented the reduction in wound infections with the use of prophylactic antibiotics in the care of patients with open fractures[52]. Dellinger suggested that reduction in wound infection was best achieved by early, parenteral, short term (for less than or equal to 24 hours) administration of large dose antimicrobials[53].

Source

The indicator was proposed by the Quality Indicator Consensus Panel.

[52] Eastern Association for the Surgery of Trauma. EAST - The Eastern Association for the Surgery of Trauma. 2011; http://www.east.org. Accessed September 26, 2011.
[53] Dellinger EP. Antibiotic prophylaxis in trauma: penetrating abdominal injuries and open fractures. Rev Infect Dis. 1991;13 Suppl 10:S847-857.

3.6 Massive Transfusion Protocol

Description of Indicator

Relationship to Quality	Medical care should be effective
Type of Indicator	Hospital structure, Hospital level
Proposed Data Source	Survey
Definition	Hospitals with a protocol to guide massive transfusions*
Numerator	Hospitals with a protocol to guide management of injured patients age 18 years and older requiring massive transfusion*
Denominator	Not applicable
Benchmark	Not applicable
Risk Adjustment	Not applicable

* We propose defining massive transfusion as the transfusion of more than 4 units of packed red blood cells in a 4-hour period for the purposes of this indicator. Multiple definitions of massive transfusion exist and the proposed definition is designed to encourage early coordination of resuscitation in injured patients with bleeding.

Summary

This indicator is intended to identify trauma centers with a protocol to guide the management of massive transfusions.

Panel Review

Panelists indicated that the goal of the indicator was to encourage early initiation of protocol-based coordinated resuscitation of the severely injured patient. They highlighted that there is limited data to support the definition of a massive transfusion.

The panel emphasized the importance of pairing the indicator with the subsequent indicator "*Massive Transfusion Protocol Activation*".

Trauma Center Review

It was noted that a massive transfusion protocol is standard in some trauma centers and therefore assessment of protocol utilization was important. Some of the trauma centers questioned the proposed massive transfusion definition and suggested that the number (majority of suggestions were for more units over the four hour time period) and type of blood products (suggestions to include plasma and platelets) could be revised.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study demonstrated a possible association between the quality indicator *Time to Blood Transfusion in Hemorrhagic Shock* and mortality[54]. Two studies demonstrated that implementation of a trauma quality improvement program that included the indicators *Transfusion for Anemia*[44], *Resuscitation without Blood*[44] and *Time to Blood Transfusion in Hemorrhagic Shock*[35] was associated with reduced hospital mortality.

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: Transfusion associated indicators are used by a small number of trauma centers: USA 2% (3/200), Canada 0% (0/35), Australasia 25% (3/12).

Three studies recommended that transfusion of 0.5 to 1 unit of packed red blood cells per hour

[35] Ruchholtz S, Waydhas C, Lewan U, et al. A multidisciplinary quality management system for the early treatment of severely injured patients: implementation and results in two trauma centers. Intensive Care Med. 2002;28(10):1395-1404.

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

[54] Al-Naami MY, Al-Faki AA, Sadik AA. Quality improvement data analysis of a mass casualty event. Injury. 2003;34(11):857-861.

over 12 to 24 hours be defined as a massive transfusion[55,56,57]. One study showed an association between a massive transfusion protocol and a reduction in multi-organ failure and infectious complications as well as an increase in ventilator free days[58,].

Source

The indicator is an amalgamation of three indicators: Transfusion for Anemia, Time to Blood Transfusion in Hemorrhagic Shock Patients and Resuscitation without Blood, previously proposed by Al-Naami et al.[54], Chadbunchachai et al.[44] and Ruchholtz et al.[35].

[35] Ruchholtz S, Waydhas C, Lewan U, et al. A multidisciplinary quality management system for the early treatment of severely injured patients: implementation and results in two trauma centers. Intensive Care Med. 2002;28(10):1395-1404.

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

[54] Al-Naami MY, Al-Faki AA, Sadik AA. Quality improvement data analysis of a mass casualty event. Injury. 2003;34(11):857-861.

[55] Gonzalez EA, Moore FA, Holcomb JB, et al. Fresh frozen plasma should be given earlier to patients requiring massive transfusion. J Trauma. 2007;62(1):112-119.

[56] Inaba K, Branco BC, Rhee P, et al. Impact of plasma transfusion in trauma patients who do not require massive transfusion. J Am Coll Surg. 2010;210(6):957-965.

[57] Inaba K, Lustenberger T, Rhee P, et al. The impact of platelet transfusion in massively transfused trauma patients. J Am Coll Surg. 2010;211(5):573-579.

[58] Cotton BA, Au BK, Nunez TC, Gunter OL, Robertson AM, Young PP. Predefined massive transfusion protocols are associated with a reduction in organ failure and postinjury complications. J Trauma. 2009;66(1):41-48.

3.7 Massive Transfusion Protocol Activation

Description of Indicator

Relationship to Quality	Medical care should be timely and effective
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	Trauma Registry, Blood Services
Definition	Activations of massive transfusion***** protocol per 100 patients
Numerator	All injured patients age 18 years and older prescribed a massive transfusion***** AND with massive transfusion* protocol activation
Denominator	All injured patients age 18 years and older prescribed a massive transfusion*****
Benchmark	Not specified at present
Risk Adjustment[†]	Age, gender, ISS, TRISS, mechanism of injury, W-RTS

***** We propose defining massive transfusion as the transfusion of more than 4 units of packed red blood cells in a 4-hour period for the purposes of this indicator. Multiple definitions of massive transfusion exist and the proposed definition is designed to encourage early coordination of resuscitation in injured patients with bleeding. To operationalize this definition we propose that prescription of massive transfusion be satisfied when a 5th unit of packed red blood cells is prescribed within a 4-hour time period.

Summary

This indicator is a corollary to the preceding quality indicator, *Massive Transfusion Protocol*. It is intended to monitor the utilization of protocols for management of massive transfusions.

Panel Review

Similar to the previous indicator, the panel discussed the challenges of establishing a definition for massive transfusion (number, type and timeframe of blood products transfused). The panel reiterated that the proposed definition was designed to ensure timely and coordinated resuscitation in injured bleeding patients.

Trauma Center Review

Similar to the previous indicator, the trauma centers expressed concern about the proposed definition. Some centers noted that the proposed definition was not consistent with local protocols for massive transfusion. In addition, centers suggested that the indicator definition be revised to evaluate the "administration" rather than the "prescription" of blood.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study demonstrated a possible association between the quality indicator *Time to Blood Transfusion in Hemorrhagic Shock* and mortality[55]. Two studies demonstrated that implementation of a trauma quality improvement program that included the indicators *Transfusion for Anemia*[44]*, Resuscitation without Blood*[44] and *Time to Blood Transfusion in Hemorrhagic Shock*[35] was associated with reduced hospital mortality.

Reliability: No studies identified.

Risk Adjustment[†]*:* A list of potential variables for risk adjustment are available from studies examining massive transfusion[58].

Utilization: Transfusion associated indicators are used by a small number of trauma centers: USA 2% (3/200), Canada 0% (0/35), Australasia 25% (3/12).

[35] Ruchholtz S, Waydhas C, Lewan U, et al. A multidisciplinary quality management system for the early treatment of severely injured patients: implementation and results in two trauma centers. Intensive Care Med. 2002;28(10):1395-1404.

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

[55] Gonzalez EA, Moore FA, Holcomb JB, et al. Fresh frozen plasma should be given earlier to patients requiring massive transfusion. J Trauma. 2007;62(1):112-119.

[58] Cotton BA, Au BK, Nunez TC, Gunter OL, Robertson AM, Young PP. Predefined massive transfusion protocols are associated with a reduction in organ failure and postinjury complications. J Trauma. 2009;66(1):41-48.

Source

The indicator is an amalgamation of three indicators: *Transfusion for Anemia, Time to Blood Transfusion in Hemorrhagic Shock Patients and Resuscitation without Blood*, previously proposed by Al-Naami et al.[54], Chadbunchachai et al.[44] and Ruchholtz et al.[35].

[35] Ruchholtz S, Waydhas C, Lewan U, et al. A multidisciplinary quality management system for the early treatment of severely injured patients: implementation and results in two trauma centers. Intensive Care Med. 2002;28(10):1395-1404.

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

[54] Al-Naami MY, Al-Faki AA, Sadik AA. Quality improvement data analysis of a mass casualty event. Injury. 2003;34(11):857-861.

3.8 Definitive Bleeding Control

Description of Indicator

Relationship to Quality	Medical care should be timely
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	Trauma Registry, Blood Services, Administrative Data
Definition	Attempted definitive (laparotomy, thoracotomy or percutaneous therapy) bleeding control within 30 minutes of massive transfusion* per 100 patients
Numerator	All patients age 18 years and older with an injury diagnosis AND prescribed a massive transfusion who receive attempted definitive bleeding control (laparotomy, thoracotomy, percutaneous therapy) within 30 minutes of the massive transfusion prescription*‡†
Denominator	All patients age 18 years and older with an injury diagnosis AND prescribed a massive transfusion*
Benchmark	Proposed threshold: 30 minutes
Risk Adjustment	Not applicable

* We propose defining massive transfusion as the transfusion of more than 4 units of packed red blood cells in a 4-hour period for the purposes of this indicator. Multiple definitions of massive transfusion exist and the proposed definition is designed to encourage early coordination of resuscitation in injured patients with bleeding. To operationalize this definition we propose that prescription for massive transfusion be satisfied when a 5th unit of packed red blood cells is prescribed within a 4-hour time period.

‡ If definitive bleeding control is attempted prior to massive transfusion criteria being satisfied in a patient who eventually satisfies the criteria then the numerator is satisfied.

[†] Time frame for definitive bleeding control satisfying numerator definition = Time procedure starts (skin incision for laparotomy or thoracotomy AND percutaneous needle insertion for percutaneous therapy) – Time 5th unit of packed red blood cells prescribed within a 4 hour time period.

Summary

This indicator is intended to monitor the timeliness of attempted bleeding control in bleeding patients.

Panel Review

Panelists indicated that the goal of the indicator was measuring timely access to definitive bleeding control in patients with hemorrhagic shock. The panel was unable to agree on a definition for sustained hemorrhagic shock and therefore proposed to use massive transfusion as the indication for bleeding control. The panel also advocated that the time threshold for this indicator should be as short as possible (30 to 60 minutes).

Trauma Center Review

The trauma centers noted the importance of timely bleeding control, but highlighted the potential challenges of identifying the need for bleeding control in a given patient (i.e. when to establish that initial resuscitation is insufficient).

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: Three studies showed no association between the quality indicator and mortality[15,36,54]. Two studies demonstrated that implementation of a trauma quality

[15] Copes WS, Staz CF, Konvolinka CW, Sacco WJ. American College of Surgeons audit filters: associations with patient outcome and resource utilization. J Trauma. 1995;38(3):432-438.

[36] Willis CD, Stoelwinder JU, Cameron PA. Interpreting process indicators in trauma care: construct validity versus confounding by indication. Int J Qual Health Care. 2008;20(5):331-338.

[54] Al-Naami MY, Al-Faki AA, Sadik AA. Quality improvement data analysis of a mass casualty event. Injury. 2003;34(11):857-861.

improvement program that included the quality indicator was associated with reduced hospital mortality[44,45].

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: Measures of time to attempted bleeding control are used by a moderate number of trauma centers: USA 15% (30/200), Canada 40% (14/35), Australasia 0% (0/12).

One study showed that the probability of death increased by 1% for every 3 minutes that hypotensive patients with abdominal bleeding were in the ED[59].

Source

The indicator is a combination of the indicators *Laparo-/Thoracotomy in Hemorrhagic Shock and Angiography in Hemorrhagic Shock*. The American College of Surgeons Committee on Trauma proposed the indicator *Laparo-/Thoracotomy in Hemorrhagic Shock*[2]. The Quality Indicator Consensus Panel proposed the indicator *Angiography in Hemorrhagic Shock.*

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

[45] Chadbunchachai W, Sriwiwat S, Kulleab S, Saranrittichai S, Chumsri J, Jaikwang P. The comparative study for quality of trauma treatment before and after the revision of trauma audit filter, Khon Kaen hospital 1998. J Med Assoc Thai. 2001;84(6):782-790.

[59] Clarke JR, Trooskin SZ, Doshi PJ, Greenwald L, Mode CJ. Time to laparotomy for intra-abdominal bleeding from trauma does affect survival for delays up to 90 minutes. J Trauma. 2002;52(3):420-424.

3.9 Time to Acute Subdural Hematoma Evacuation

Description of Indicator

Relationship to Quality	Medical care should be timely
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	EMS Records, Trauma Registry
Definition	Time from onset of injury to acute subdural hematoma (ASDH) evacuation*‡
Numerator	Time of ASDH evacuation‡ for patients age 18 years and older diagnosed with an ASDH AND who undergo surgical treatment† - time of injury*β
Denominator	Not applicable
Benchmark	Not applicable
Risk Adjustment	Geographic area (urban, rural), initial GCS, mechanism of injury, type of injuries

* Time of injury may not be precisely known, but can likely be accurately estimated. We believe that using time of injury as a starting point for a time based measure of ASDH evacuation is conceptually attractive from both a physiological and quality improvement perspective as it represents the onset of tissue injury. It is analogous to using time of symptom onset in patients with stroke or myocardial infarction.

‡ Time of ASDH evacuation = Time of skin incision for the procedure.

† The indicator inclusion criteria are patients who are diagnosed with an ASDH (≤ 48 hours from time of injury) and undergo evacuation. Evacuation may not be offered to all patients with an ASDH depending on perceived potential for therapeutic benefit.

[β] Time to ASDH Evacuation will be reported as an interval measure (mean or median) with a measure of variation (standard deviation or interquartile range).

Summary

This indicator is intended to monitor the timeliness of treatment of patients with an ASDH. The data recorded from indicator #2.1 (T*ime to First Medical Contact*), indicator #2.7 (T*ime to Definitive Trauma Care*) and indicator #3.9 (T*ime to Acute Subdural Hematoma Evacuation*) may provide opportunities for calculating other metrics that can inform trauma system performance.

Panel Review

Panelists specified the purpose of this indicator was to identify whether a trauma program had a dedicated neurosurgical trauma team and whether it functioned efficiently. It was noted that the Brain Trauma Foundation provides an excellent synthesis of evidence based practices for traumatic brain injury and that consideration should be given to using the Foundation's guidelines as a basis for additional quality indicator development[60].

Panelists reported that the indicator was important as it captured the necessity of timely access to neurosurgery, but had concerns that there is currently no expectation of an acceptable time to evacuation. Panelists debated whether adjustment for ASDH severity (e.g. size, mass effect, midline shift) would be helpful, but decided that if decision is made to evacuate an ASDH (panelists noted that not all ASDH require evacuation), it should be done in a timely fashion. Panelists noted that while the indicator addresses timeliness, it does not address the appropriateness of the surgery.

Trauma Center Review

The trauma centers highlighted the challenges of measuring quality ASDH care, which can consist of both surgical and non-surgical interventions. Centers suggested that differentiation between appropriate and inappropriate surgical intervention could be a helpful measure.

The trauma centers had concerns regarding using time of injury as the reference point for the indicator. They noted that it is difficult to accurately and consistently ascertain time of injury and suggested that time of EMS arrival may be more suitable. In addition they noted that factors such as inappropriate triage, geographic area and limited resources may influence the results of this indicator for some trauma centers.

[60] Brain Trauma Foundation. Guidelines for the management of severe traumatic brain injury: 3rd edition. J Neurotrauma. 2007;24(S1):S1-S106.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: Four studies showed that timing from injury to evacuation of an ASDH was not associated with decreased mortality[14,16,36,61,62]. One study showed that length of stay was significantly longer for the patients receiving a craniotomy > 4 hours after injury[14].

Reliability: No studies identified.

Risk Adjustment: Age, GCS, CT findings of intracranial hemorrhage or herniation and prehospital time are variables that have been used for risk adjustment in studies examining time to ASDH evacuation[63]. Factors that could be considered to impact the measure that may warrant adjustment include geographic area (urban, rural), initial GCS, mechanism of injury and type of anatomical injuries.

Utilization: Time to Acute Subdural Hematoma Evacuation related indicators are used by a few trauma centers: USA 0.5% (1/200), Canada 0% (0/35), Australasia 0% (0/12).

Fung Kon Jin et al. described that having CT scanner in the trauma room reduces the time to surgical intervention in patients with severe traumatic brain injury[64]. Different time thresholds

[14] Nayduch D, Moylan J, Snyder BL, Andrews L, Rutledge R, Cunningham P. American College of Surgeons trauma quality indicators: an analysis of outcome in a statewide trauma registry. J Trauma. 1994;37(4):565-573; discussion 573-565.

[16] Di Bartolomeo S, Valent F, Sanson G, Nardi G, Gambale G, Barbone F. Are the ACSCOT filters associated with outcome? Examining morbidity and mortality in a European setting. Injury. 2008;39(9):1001-1006.

[36] Willis CD, Stoelwinder JU, Cameron PA. Interpreting process indicators in trauma care: construct validity versus confounding by indication. Int J Qual Health Care. 2008;20(5):331-338.

[61] Wilberger JE, Harris M, Diamond DL. Acute subdural hematoma: morbidity and mortality related to timing of operative intervention. J Trauma. 1990;30(6):733-736.

[62] Schwartz ML, Sharkey PW, Andersen JA. Quality assurance for patients with head injuries admitted to a regional trauma unit. J Trauma. 1991;31(7):962-967.

[63] Tien HCN, Jung V, Pinto R, Mainprize T, Scales DC, Rizoli SB. Reducing time-to-treatment decreases mortality of trauma patients with acute subdural hematoma. Ann Surg. 2011;253(6):1178-1183.

[64] Fung Kon Jin PH, Goslings JC, Ponsen KJ, van KC, Hoogerwerf N, Luitse JS. Assessment of a new trauma workflow concept implementing a sliding CT scanner in the trauma room: the effect on workup times. J Trauma. 2008;64(5):1320-1326.

for ASDH evacuation have been proposed including 1 hour, 2 hours and 4 hours[2,14,16,47,61,62].

Source

The American College of Surgeons Committee on Trauma proposed the indicator Patients with Epidural Hematoma or Subdural Hematoma Receiving Craniotomy more than 4 hours after Arrival at ED[32].

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[14] Nayduch D, Moylan J, Snyder BL, Andrews L, Rutledge R, Cunningham P. American College of Surgeons trauma quality indicators: an analysis of outcome in a statewide trauma registry. J Trauma. 1994;37(4):565-573; discussion 573-565.

[16] Di Bartolomeo S, Valent F, Sanson G, Nardi G, Gambale G, Barbone F. Are the ACSCOT filters associated with outcome? Examining morbidity and mortality in a European setting. Injury. 2008;39(9):1001-1006.

[32] Brown JB, Stassen NA, Bankey PE, Sangosanya AT, Cheng JD, Gestring ML. Helicopters improve survival in seriously injured patients requiring interfacility transfer for definitive care. J Trauma. 2011;70(2):310-314.

[47] Cryer HG, Hiatt JR, Fleming AW, Gruen JP, Sterling J. Continuous use of standard process audit filters has limited value in an established trauma system. J Trauma. 1996;41(3):389-394; discussion 394-385.

[61] Wilberger JE, Harris M, Diamond DL. Acute subdural hematoma: morbidity and mortality related to timing of operative intervention. J Trauma. 1990;30(6):733-736.

[62] Schwartz ML, Sharkey PW, Andersen JA. Quality assurance for patients with head injuries admitted to a regional trauma unit. J Trauma. 1991;31(7):962-967.

3.10 Time to Ischemic Limb Treatment

Description of Indicator

Relationship to Quality	Medical care should be timely
Type of Indicator	Prehospital and Hospital process, System level
Proposed Data Sources	EMS Records, Trauma Registry
Definition	Time from onset of injury to treatment (surgery or percutaneous therapy) for an ischemic limb*
Numerator	Time of initiation of treatment[‡] for patients age 18 years and older diagnosed with an ischemic limb* - time of injury[†β]
Denominator	Not applicable
Benchmark	Not specified at present
Risk Adjustment	Geographic area of injury (urban, rural)

* Ischemic limb diagnoses will be restricted for the purpose of operationalizing the indicator to include major arterial injuries of the extremities. Limb ischemia secondary to compartment syndrome will not be included as part of the proposed indicator.

[‡] Time of initiation of treatment = Time procedure starts (skin incision for surgical therapy or needle insertion for percutaneous therapy).

[†] Time of injury may not be precisely known, but can likely to be accurately estimated. We believe that using time of injury as a starting point for a time based measure of treatment of an ischemic limb is conceptually attractive from both a physiological and quality improvement perspective as it represents the onset of tissue injury. It is analogous to using time of symptom onset in patients with stroke or myocardial infarction.

[β] Time to ischemic limb treatment will be reported as an interval measure (mean or median) with a measure of variation (standard deviation or interquartile range).

Summary

This indicator is intended to monitor the timeliness of treatment for patients with an ischemic limb.

Panel Review

Panelists noted this to be an important indicator that reflects the effectiveness of triage, prehospital time management and hospital care. Concerns regarding the challenge of identifying time of ischemic injury diagnosis were reported. Discussions relating to implementation of this indicator suggested that acceptable intervention would be within 6 hours of time of injury or 4 hours of ED arrival. In addition, panelists emphasized the need to adjust the measure for geographic area.

Trauma Center Review

The trauma centers suggested that the indicator would benefit from greater specificity of interventions that should be used for treatment of an ischemic limb. Similar to previous indicators, trauma centers questioned the appropriateness of using time of injury as a reference point and suggested that time of EMS arrival may be more suitable.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study demonstrated that implementation of a trauma quality improvement program that included the quality indicator was associated with reduced hospital mortality[44].

Reliability: No studies identified.

Risk Adjustment: No studies identified.

Utilization: Time to Ischemic Limb Treatment is used by a small number of trauma centers: USA 0% (0/200), Canada 9% (3/35), Australasia 8% (1/12).

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

Prompt diagnosis of acute limb ischemia and rapid restoration of perfusion has been demonstrated to be associated with lower rates of amputation and shorter length of hospital stay. It remains unclear if major improvements in these key time segments (e.g. diagnosis and revascularization) would further improve short-term and long-term outcomes[65].

Source

The indicator was initially proposed by Chadbunchachai et al.[44].

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.
[65] Keo H, Baumgartner I, Oldenburg N, et al. Effect of time delays on outcomes of acute limb ischemia. J Am Coll Cardiol. 2010;55(10A):A213.E2019.

3.11 Treatment of Joint Dislocation

Description of Indicator

Relationship to Quality	Medical care should be timely
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	ED Medical Record
Definition	Time from onset of injury to attempted reduction* for a joint dislocation
Numerator	Time of attempted reduction for patients age 18 years and older diagnosed with a joint dislocation* - time of injury[‡†]
Denominator	Not applicable
Benchmark	Not specified at present
Risk Adjustment	Not specified at present

* Time of attempted reduction = Time of first attempt to reduce a dislocated joint (non-surgical reduction or surgical reduction).

[‡] Time of injury may not be precisely known, but can likely to be accurately estimated. We believe that using time of injury as a starting point for a time based measure of treatment of joint dislocation is conceptually attractive from both physiological and quality improvement perspectives as it represents the onset of tissue injury. It is analogous to using time of symptom onset in patients with stroke or myocardial infarction.

[†] Treatment of joint dislocation will be reported as an interval measure (mean or median) with a measure of variation (standard deviation or interquartile range).

Summary

This indicator is intended to monitor timeliness of attempted joint reduction in patients diagnosed with a dislocated joint admitted to the ED.

Panel Review

Panelists extensively discussed the most appropriate reference time point for this indicator (e.g. from time of injury, first medical contact or arrival in ED) and whether a time threshold should be proposed (it was not proposed in the end). Panelists agreed that all joints should be included. Additional questions regarding the need for radiographic documentation and management of dislocations requiring surgery were brought forward. In the end the panel suggested that the indicator focus on "attempted reduction" leaving the decision of mechanism of reduction to the treating clinicians. Panelists noted the difficulties of including patients transported from one facility to another without attempted joint reduction.

Trauma Center Review

Comments from the trauma centers largely reflected the panelists' discussion and emphasized the need to include all joints in the indicator. It was noted that current documentation practices would make it difficult to evaluate isolated joint dislocations in patients that do not meet criteria for inclusion in a trauma registry. In addition, centers outlined that times of procedures are not consistently documented.

Similar to several other indicators, trauma centers expressed concerns about using time of injury as a reference point due to difficulties with time ascertainment and potential factors confounding prehospital care. Finally, some trauma centers suggested that evaluation of a functional outcome could be used to determine whether early reduction improved patient outcomes.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study demonstrated that implementation of a trauma quality improvement program that included the quality indicator was associated with reduced hospital mortality[44].

Reliability: No studies identified.

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

Risk Adjustment: No studies identified.

Utilization: Treatment of Joint Dislocation is used as an indicator by a small number of trauma centers: USA 1% (2/200), Canada 9% (3/35), Australasia 25% (3/12).

There is some evidence for the use of an algorithm to guide treatment decisions regarding joint dislocation to decrease radiological load in the ED and the time that the patient spends in the ED[66].

Source

The indicator was initially proposed by Chadbunchachai et al.[44].

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.
[66] Hendey GW, Chally MK, Stewart VB. Selective radiography in 100 patients with suspected shoulder dislocation. J Emerg Med. 2006;31(1):23-28.

3.12 Non-Trauma/Surgical Service Admissions

Description of Indicator

Relationship to Quality	Medical care should be efficient and effective
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	Administrative Data
Definition	Number of patients with major anatomic injuries* admitted under care of a non-trauma/surgical service‡ per 100 admissions*
Numerator	All patients age 18 years and older admitted to hospital with a major anatomic injury diagnosis* under the care of a non-trauma/surgical service‡
Denominator	All patients age 18 years and older admitted to hospital with a major anatomic injury* diagnosis
Benchmark	Not specified at present
Risk Adjustment	Not applicable

* Patient inclusion criteria for the indicator is based on major anatomic injuries derived from an expert panel on field triage published by the CDC[9,10]. The criteria were selected to make the indicator specific for identifying patients with major anatomic injuries that may benefit from admission to a trauma/surgical service.

[9] Centers for Disease Control and Prevention (CDC). CDC - Injury Prevention and Control: Field Triage - Guidelines for the Field Triage of Injured Patients. 2011; http://www.cdc.gov/fieldtriage/index.html. Accessed July 8, 2012.
[10] Sasser SM, Hunt RC, Sullivent EE, et al. Guidelines for field triage of injured patients. Recommendations of the National Expert Panel on Field Triage. MMWR Recomm Rep. 2009;58(RR-1):1-35.

Penetrating injury to head, neck, torso, extremities (proximal to elbow or knee)

Should severe blunt traumatic brain injury added to selection criteria?

Flail chest

≥ 2 proximal long-bone fractures

Crush, degloved or mangled extremity

Amputation proximal to wrist and ankle

Pelvic fracture

Open or depressed skull fracture

Paralysis

‡ ICUs that provide care for trauma or surgical patients are considered a trauma/surgical service for the purposes of this indicator.

Summary

This indicator is intended to monitor the clinical team to which injured patients are admitted.

Panel Review

Panelists noted that the goal of the indicator was to capture the admission of patients to services that are not used to dealing with severely injured patients. They reported that consideration should be given to co-admissions for patients with specific comorbidities and/or advanced age.

Trauma Center Review

The trauma centers noted that the defined criteria might be difficult to adhere to as many trauma centers have local admitting practices. They also agreed with the panelists' suggestions of incorporating considerations for patients with specific comorbidities and/or advanced age.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study showed that the quality indicator was associated with hospital mortality[14]. One study showed no significant association between the quality indicator and hospital mortality[15].

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: Non-Trauma/Surgical Service Admissions is used as an indicator by a small number of trauma centers: USA 2% (3/200), Canada 0% (0/35), Australasia 0% (0/12).

A multicenter study suggested that acute trauma patients received better nursing care when admitted to a trauma ward[67].

Source

The American College of Surgeons Committee on Trauma proposed the audit filter Trauma Patient Admitted to Hospital under Care of Admitting or Attending Physician who is not a Surgeon[2].

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[14] Nayduch D, Moylan J, Snyder BL, Andrews L, Rutledge R, Cunningham P. American College of Surgeons trauma quality indicators: an analysis of outcome in a statewide trauma registry. J Trauma. 1994;37(4):565-573; discussion 573-565.

[15] Copes WS, Staz CF, Konvolinka CW, Sacco WJ. American College of Surgeons audit filters: associations with patient outcome and resource utilization. J Trauma. 1995;38(3):432-438.

[67] Lloyd JM, Elsayed S, Majeed A, et al. The practice of out-lying patients is dangerous: a multicentre comparison study of nursing care provided for trauma patients. Injury. 2005;36(6):710-713.

3.13 Deep Vein Thrombosis Prophylaxis

Description of Indicator

Relationship to Quality	Medical care should be timely and effective
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	Trauma Registry
Definition	Deep vein thrombosis (DVT) prophylaxis (pharmacological OR mechanical) prescribed within 24 hours of hospital admission per 100 patients
Numerator	All patients age 18 years and older admitted to hospital with an injury diagnosis AND DVT prophylaxis (pharmacological OR mechanical) prescribed within 24 hours of hospital admission
Denominator	All patients age 18 years and older admitted to hospital with an injury diagnosis
Benchmark	Not specified at present
Risk Adjustment	Not applicable

Summary

This indicator is intended to monitor DVT prophylaxis.

Panel Review

Panelists identified this as an important indicator. They suggested that focusing on a specific patient population may improve the measurement properties of this indicator, but could then unintentionally imply that DVT prophylaxis is of lower priority for patients not specified in the indicator. Panelists debated what would be the optimal patient population for evaluation of this indicator and highlighted evidence suggesting that DVT is common in injured patients and may be associated with spinal cord injuries, spinal fractures, older age, increasing ISS, blood

transfusion, long bone fractures, pelvic fractures and head injuries[68]. Panelists also noted that an alternative approach would be to modify the indicator to capture both DVT prophylaxis as well as documentation of reasons for not prescribing prophylaxis. This approach was not adopted due to concerns that it would make the indicator more complex to implement.

The panel noted that evidence is strongest for pharmacological prophylaxis, but decided to include mechanical prophylaxis given unknown risk of hemorrhage in select patient populations (e.g. head injured) and its perceived widespread use in patients considered at risk of bleeding.

Trauma Center Review

Comments from the trauma centers emphasized the importance of this indicator. They noted that the indicator may be most beneficial if it focused on patients at highest risk of DVT. Centers also suggested that consideration be given to address both contraindications to DVT prophylaxis and for cases where DVT prophylaxis may not be warranted.

Some trauma centers also suggested that the proposed 24 hour time frame was too long and indicated that time frames of 8 or 12 hours may be more appropriate.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: A systematic review by the EAST Practice Parameter Workgroup for DVT Prophylaxis in 2002 summarized that venous thromboembolism is common in severely injured patients and that the optimal mode of prophylaxis is unknown. The best current evidence is for the use of low molecular weight heparin, but evidence exists for the effectiveness of unfractionated heparin and various mechanical devices[68].

[68] Rogers FB, Cipolle MD, Velmahos G, Rozycki G, Luchette FA. Practice management guidelines for the prevention of venous thromboembolism in trauma patients: the EAST practice management guidelines work group. J Trauma. 2002;53(1):142-164.

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: DVT Prophylaxis is used as a quality indicator by a small number of trauma centers: USA 3% (5/200), Canada 9% (3/35), Australasia 8% (1/12).

Source

DVT prophylaxis has been proposed by several patient advocacy groups as a quality indicator for hospitalized patients[69].

[69] Canadian Patient Safety Institute. Safer Healthcare Now! Preventing venous thromboembolism - updated resources now available! 2012; http://www.saferhealthcarenow.ca/EN/shnNewsletter/Pages/Preventing-Venous-Thromboembolism-%E2%80%93-Updated-resources-now-available!.aspx. Accessed July 8, 2012.

3.14 Tertiary Survey

Description of Indicator

Relationship to Quality	Medical care should be safe and effective
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	Trauma Registry
Definition	Tertiary survey completed within 24 hours of hospital admission
Numerator	All patients age 18 years and older admitted to hospital with an injury diagnosis AND a tertiary survey documented in the medical record within 24 hours of hospital admission
Denominator	All patients age 18 years and older admitted to hospital with an injury diagnosis
Benchmark	Not specified at present
Risk Adjustment	Not applicable

Summary

This indicator is intended to monitor the use of tertiary surveys to identify injuries not diagnosed upon patient admission.

Panel Review

The indicator was derived from another indicator that was designed to evaluate the occurrence of missed injuries. However, panelists had concerns that identifying missed injuries was challenging and suggested that focusing on a key process to minimize the risk of missed injuries, such as the tertiary survey, may be more effective.

There was debate among panelists as to what time frame would be most appropriate for this indicator. It was suggested that a time frame of 24 hours would be reasonable, but other

panelists argued that the time frame should be extended to 36 to 48 hours to accommodate the practicalities of coordinating other patient investigations and interventions as well as patient handoffs post call. Panelists highlighted the importance of establishing who is responsible for conducting the survey (e.g. trauma service versus ICU service).

Trauma Center Review

Trauma centers noted the importance of this indicator and suggested that it may be beneficial to document the number of injuries identified by tertiary surveys. As in the panel review, there were discordant responses from trauma centers as to what time frame is most appropriate with the majority of centers suggesting 24 hours as a reasonable time frame. In addition, trauma centers questioned what documentation would be required for evaluation of the indicator.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study demonstrated a 36% overall reduction in missed injuries with the completion of a tertiary survey within 24 hours of admission in a Level 1 trauma center[70]. One study demonstrated that implementation of a tertiary survey within 24 hours of admission in a Level 2 trauma center identified 14% of patients that had a missed injury[71].

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: No data identified.

Enderson et al.[72] proposed the implementation of a tertiary survey after completing a prospective study looking into injuries missed in the primary and secondary evaluations of patients[72]. The tertiary survey should include a structured and comprehensive evaluation of the patient including review of diagnostic studies by both a physician familiar with and a physician

[70] Biffl WL, Harrington DT, Cioffi WG, Enderson BL, Mackersie RC, Tinkoff G. Implementation of a tertiary trauma survey decreases missed injuries. J Trauma. 2003;54(1):38-44.
[71] Howard J, Sundararajan R, Thomas SG, Walsh M, Sundararajan M. Reducing missed injuries at a level II trauma center. J Trauma Nurs. 2006;13(3):89-95.
[72] Enderson BL, Reath DB, Meadors J, Dallas W, DeBoo JM, Maull KI. The tertiary trauma survey: a prospective study of missed injury. J Trauma. 1990;30(6):666-669; discussion 669-670.

unfamiliar (fresh set of eyes) with the patient[73]. Guidelines for completion of the tertiary survey vary in the literature[73] with the majority of articles suggesting within 24 hours of admission[70,71,74].

Source

The indicator was developed from the American College of Surgeons Committee on Trauma audit filters, *Missed Injuries* and *Injuries Diagnosed >24 hours Post Presentation*[2].

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[70] Biffl WL, Harrington DT, Cioffi WG, Enderson BL, Mackersie RC, Tinkoff G. Implementation of a tertiary trauma survey decreases missed injuries. J Trauma. 2003;54(1):38-44.

[71] Howard J, Sundararajan R, Thomas SG, Walsh M, Sundararajan M. Reducing missed injuries at a level II trauma center. J Trauma Nurs. 2006;13(3):89-95.

[73] Thomson CB, Greaves I. Missed injury and the tertiary trauma survey. Injury. 2008;39(1):107-114.

[74] Brooks A, Holroyd B, Riley B. Missed injury in major trauma patients. Injury. 2004;35(4):407-410.

3.15 Spine Evaluation

Description of Indicator

Relationship to Quality	Medical care should be safe, timely and effective
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	Hospital Medical Record
Definition	Number of patients with evaluations and decisions regarding immobilization of the spine within 36 hours of hospital admission per 100 patients
Numerator	All patients age 18 years and older admitted to hospital with an injury diagnosis from a blunt force mechanism AND documented assessment of the cervical, thoracic and lumbar spine AND decision to continue OR discontinue spine immobilization within 36 hours of admission to hospital*
Denominator	All patients age 18 years and older admitted to hospital with an injury diagnosis from a blunt force mechanism
Benchmark	Not specified at present
Risk Adjustment	Not applicable

***** Documented decision making regarding spine immobilization within 36 hours could include any of the following: 1) decision to discontinue all precautions, 2) decision to continue all precautions or 3) decision to discontinue some precautions, but continue others (e.g. discontinue thoracic and lumbar spine precautions, but continue cervical spine immobilization with a collar).

Summary

This indicator is intended to monitor whether spine evaluation and decision making regarding immobilization is performed in a timely fashion. The indicator does not prescribe the mechanism of spine evaluation given evolving scientific evidence. The indicator does not pertain to assessment and decision-making regarding the use of spine boards, which is a separate process.

Panel Review

Panelists noted the evolving nature of evidence for spine immobilization. They discussed that the systems should evaluate and make decisions regarding spine immobilization in an efficient manner.

Panelists debated the most appropriate time threshold for the indicator and suggested one of 24, 36 or 48 hours as potentially acceptable for the indicator to be clinically relevant. In addition, panelists emphasized the importance that documentation of both spine evaluation and immobilization decisions be included in the indicator due to a perception that written communication is often poorly done (i.e. clinical team evaluates and decides on whether to continue or discontinue immobilization but this is not clearly documented in the medical record and other health care providers are unclear about the care plan). As controversy exists regarding the best mechanisms for spine evaluation, the panelists suggested that the most practical measure may be to leave the precise method (clinical and/or radiographic) of spine evaluation to local practice.

Trauma Center Review

The trauma centers noted that the indicator may be challenging to implement and interpret given the multidimensional nature of the definition and data elements. It was noted that current practices and documentation tools might need to be altered in order for this information to be consistently documented and accessible.

In relation to the time frame, the majority of trauma centers reported that a 24 hour time frame would be most appropriate. It was noted by several trauma centers that the indicator incorporates evaluation of multiple components of trauma care (i.e. timeliness of imaging, timeliness of radiology reports, timeliness of decision making).

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: Two studies demonstrated that the implementation of a trauma quality improvement program that included the quality indicator was associated with reduced hospital mortality[44,45].

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: Indicators to evaluate spine evaluation are used by a moderate number of trauma centers: USA 39% (77/200), Canada 63% (22/35), Australasia 33% (4/12).

The majority of the studies recommended that clearance be performed within 72 hours of admission to minimize immobilization associated complications[75,76], although mortality wasn't reduced[77,78]. Some studies recommended the use of helical CT scan of the cervical spine[79,80].

Source

The Quality Indicator Consensus Panel proposed the indicator *Time to Cervical Spine Clearance* and subsequently revised it to *Spine Evaluation*.

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.
[45] Chadbunchachai W, Sriwiwat S, Kulleab S, Saranrittichai S, Chumsri J, Jaikwang P. The comparative study for quality of trauma treatment before and after the revision of trauma audit filter, Khon Kaen hospital 1998. J Med Assoc Thai. 2001;84(6):782-790.
[75] Orlando Regional Medical Center Department of Surgical Education. Cervical spine clearance. 2009; http://www.surgicalcriticalcare.net/guidelines.php. Accessed September 26, 2011.
[76] Albrecht RM, Kingsley D, Schermer CR, Demarest GB, Benzel EC, Hart BL. Evaluation of cervical spine in intensive care patients following blunt trauma. World J Surg. 2001;25(8):1089-1096.
[77] Griffen MM, Frykberg ER, Kerwin AJ, et al. Radiographic clearance of blunt cervical spine injury: plain radiograph or computed tomography scan? J Trauma. 2003;55(2):222-226.
[78] Schinkel C, Frangen TM, Kmetic A, Andress HJ, Muhr G, Registry GT. Timing of thoracic spine stabilization in trauma patients: impact on clinical course and outcome. J Trauma. 2006;61(1):156-160; discussion 160.
[79] Barba CA, Taggert J, Morgan AS, et al. A new cervical spine clearance protocol using computed tomography. J Trauma. 2001;51(4):652-656.
[80] Brown CV, Antevil JL, Sise MJ, Sack DI. Spiral computed tomography for the diagnosis of cervical, thoracic, and lumbar spine fractures: its time has come. J Trauma. 2005;58(5):890-895; discussion 895-896.

3.16 Unplanned Intensive Care Unit Admission

Description of Indicator

Relationship to Quality	Medical care should be effective, efficient and safe
Type of Indicator	Hospital outcome, Hospital level
Proposed Data Sources	Trauma Registry, Administrative Data
Definition	Number of patients with a primary injury diagnosis admitted to ICU from the ward per 100 patients*
Numerator	All patients age 18 years and older with a primary injury diagnosis admitted to ICU from the ward[‡†]
Denominator	All patients age 18 years and older with a primary injury diagnosis admitted to a hospital ward[†]
Benchmark	Not specified at present[β]
Risk Adjustment	Age, sex, pre-existing conditions and a validated ISS [e.g. abbreviated ISS (AIS) or International Classification of Diseases–based ISS (ICISS)]

* How to calculate Risk-Adjusted Unplanned ICU Admission:
Risk-adjusted Unplanned ICU Admission = [Observed Unplanned ICU Admission Rate/Risk-adjusted Unplanned ICU Admission Rate (X100)] x Overall Unplanned ICU Admission Rate in the standard population.

Note: Standard population refers to a population of institutions under evaluation (e.g. institutions contributing data to a national trauma registry or centrally collected administrative data bank).

Alternatively Risk-adjusted Unplanned ICU Admission can be calculated directly from parameter estimates from a multivariable risk adjusted model examining data from individual institutions or from multiple institutions.

[‡] A small number of injured patients may have "planned" admissions from the ward to the ICU. However, this number is likely to be small compared to the number of patients with transfers from the ward to the ICU that are "unplanned". To make the indicator easy to implement, a small amount of misclassification will likely need to be tolerated.

[†] Excludes patients admitted to ICU from the ED, operating room or post-operative care unit.

[β] Mean unplanned ICU admission across all centers excluding the center under evaluation is one possible benchmark that can be considered.

Summary

The indicator is intended to monitor unplanned admissions to the ICU.

Panel Review

Panelists noted that distinguishing unplanned versus planned ICU admissions is challenging and that either the definition could be operationalized to facilitate measurement (approach selected by panel) or that medical record level data may be needed. It was noted that the indicator may help identify opportunities or interventions to improve patient safety.

Trauma Center Review

The trauma centers similarly highlighted the challenges of distinguishing unplanned versus planned ICU admission as well the potential value of also capturing the reason for transfers from ward to the ICU.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study demonstrated that implementation of a trauma quality improvement program that included the quality indicator was associated with reduced hospital mortality[44].

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

Reliability: No studies identified.

Risk Adjustment: No studies identified.

Utilization: Unplanned ICU admission is used as a quality indicator by a moderate number of trauma centers: USA 9% (17/200), Canada 23% (8/35), Australasia 33% (4/12).

There is limited literature exploring unplanned admissions to the ICU for trauma patients.

Source

This indicator consists of an amalgamation of two separate measures evaluated by the Quality Indicators in Trauma Care Consensus Panel; *Unplanned Return to ICU* and *Unplanned ICU Admission /Readmission*, previously proposed by Chadbunchachai et al.[44].

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

3.17 Adverse Event Rate

Description of Indicator

Relationship to Quality	Medical care should be safe
Type of Indicator	Hospital outcome, Hospital level
Proposed Data Sources	Trauma Registry, Administrative Data
Definition	Number of adverse events per 100 patient discharges with a primary injury diagnosis*
Numerator	All discharges of patients age 18 years and older with a primary injury diagnosis AND the one of the following secondary diagnoses: Decubitus ulcer Hospital acquired infection (any - pneumonia, blood stream, wound etc.) Iatrogenic pneumothorax Foreign body left during procedure Myocardial infarction Acute renal failure
Denominator	All discharges of patients age 18 years and older with a primary injury diagnosis
Benchmark	Not specified at present‡
Risk Adjustment†	Age, sex, pre-existing conditions and a validated ISS [e.g. abbreviated ISS (AIS) or International, Classification of Disease–based ISS (ICISS)

* How to calculate Risk-Adjusted Adverse Event Rate:
Risk-Adjusted Adverse Event Rate = [Observed Adverse Event Rate/Risk-adjusted Expected Adverse Event Rate (x100)] x Overall Adverse Event Rate in the standard population.

Note: Standard population refers to a population of institutions under evaluation (e.g. institutions contributing data to a national trauma registry or centrally collected administrative data bank).

Alternatively Risk Adjusted Adverse Event rates can be calculated directly from parameter estimates from a multivariable risk adjusted model examining data from individual institutions or from multiple institutions.

‡ Mean adverse event rates across all centers excluding the center under evaluation is one possible benchmark that can be considered.

Summary

This indicator is intended to monitor adverse events among hospitalized patients.

Panel Review

Panelists indicated that this was a valuable indicator, but noted that it is difficult to measure. Because of challenges with documentation and classification, panelists suggested that the indicator be restricted to those adverse events that can be objectively documented. Panelists debated the best way to report the measure (composite measure versus individual adverse events).

Trauma Center Review

The trauma centers noted that many systems already have policies for measuring adverse events, but emphasized the importance of standardizing measurement. It was highlighted that reliable identification of adverse events through non-clinical registrar abstraction of inconsistently documented medical records is challenging.

Like the panelists, the trauma centers presented conflicting responses on how to best report the measure with the majority of centers preferring to report each adverse event individually. The importance of risk adjustment was highlighted by multiple centers.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: Four studies demonstrated an association between the quality indicator and hospital mortality[14,15,36,81]. Two studies demonstrated no association between the quality indicator and hospital mortality[54,62]. Two studies demonstrated that implementation of a trauma quality improvement program that included the quality indicator was associated with reduced hospital mortality[44,45]. One study demonstrated an association between the quality indicator and length of stay[82].

Reliability: No studies identified.

Risk Adjustment[†]: A list of potential variables for risk adjustment is available from studies examining this indicator[83,84].

[14] Nayduch D, Moylan J, Snyder BL, Andrews L, Rutledge R, Cunningham P. American College of Surgeons trauma quality indicators: an analysis of outcome in a statewide trauma registry. J Trauma. 1994;37(4):565-573; discussion 573-565.

[15] Copes WS, Staz CF, Konvolinka CW, Sacco WJ. American College of Surgeons audit filters: associations with patient outcome and resource utilization. J Trauma. 1995;38(3):432-438.

[36] Willis CD, Stoelwinder JU, Cameron PA. Interpreting process indicators in trauma care: construct validity versus confounding by indication. Int J Qual Health Care. 2008;20(5):331-338.

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

[45] Chadbunchachai W, Sriwiwat S, Kulleab S, Saranrittichai S, Chumsri J, Jaikwang P. The comparative study for quality of trauma treatment before and after the revision of trauma audit filter, Khon Kaen hospital 1998. J Med Assoc Thai. 2001;84(6):782-790.

[54] Al-Naami MY, Al-Faki AA, Sadik AA. Quality improvement data analysis of a mass casualty event. Injury. 2003;34(11):857-861.

[62] Schwartz ML, Sharkey PW, Andersen JA. Quality assurance for patients with head injuries admitted to a regional trauma unit. J Trauma. 1991;31(7):962-967.

[81] Miller PR, Johnson JC, III, Karchmer T, Hoth JJ, Meredith JW, Chang MC. National nosocomial infection surveillance system: from benchmark to bedside in trauma patients. J Trauma. 2006;60(1):98-103.

[82] Shafi S, Barnes S, Nicewander D, et al. Health care reform at trauma centers--mortality, complications, and length of stay. J Trauma. 2010;69(6):1367-1371.

[83] Baker GR, Norton PG, Flintoft V, et al. The Canadian Adverse Events Study: the incidence of adverse events among hospital patients in Canada. CMAJ. 2004;170(11):1678-1686.

[84] Ang DN, Rivara FP, Nathens A, et al. Complication rates among trauma centres. J Am Coll Surg. 2009;20(5):595-602.

Utilization: Adverse Events is used as a quality indicator by a large number of trauma centers: USA 100% (200/200), Canada 43% (15/35), Australasia 100% (12/12).

Shafi et al.[82] suggested that Trauma Quality Improvement Programs should promote activities to review process of care that reduce adverse events and therefore reduce length of stay and associated costs.

Ang et al.[84] examined the association between patient complications and admission to Level 1 trauma center compared to non-trauma center. Trauma center patients had a higher risk of developing three or more complications. It is possible that injured patients admitted to a trauma center are intrinsically different than those admitted to a non-trauma center.

Source

Risk adjusted adverse event rates has been proposed as a quality indicator by professional trauma societies, patient advocacy groups and researchers[52,85,86,87].

[52] Eastern Association for the Surgery of Trauma. EAST - The Eastern Association for the Surgery of Trauma. 2011; http://www.east.org. Accessed September 26, 2011.

[82] Shafi S, Barnes S, Nicewander D, et al. Health care reform at trauma centers--mortality, complications, and length of stay. J Trauma. 2010;69(6):1367-1371.

[84] Ang DN, Rivara FP, Nathens A, et al. Complication rates among trauma centres. J Am Coll Surg. 2009;20(5):595-602.

[85] American College of Surgeons. American College of Surgeons. 2011; http://www.facs.org. Accessed September 26, 2011.

[86] International Society for Quality in Health Care (ISQua). The International Society for Quality in Health Care. 2011; http://www.isqua.org. Accessed September 26, 2011.

[87] Empowered Patient Coalition. Patient Safety Advocates for Health Care Issues: Empowered Patient Coalition. 2011; http://www.empoweredpatientcoalition.org. Accessed September 26, 2011.

3.18 Mortality Rate

Description of Indicator

Relationship to Quality	Medical care should be effective
Type of Indicator	Hospital outcome, Hospital level
Proposed Data Sources	Trauma Registry, Administrative Data
Definition	Number of patients admitted to hospital* with an injury diagnosis who die[‡] per 100 patients[†]
Numerator	All patients age 18 years and older admitted to hospital with an injury diagnosis who die[‡]
Denominator	All patients age 18 years and older admitted to hospital with an injury diagnosis
Benchmark	Not specified at present[β]
Risk Adjustment[α]	Age, sex, pre-existing conditions and a validated ISS [e.g. abbreviated ISS (AIS) or International Classification of Diseases–based ISS (ICISS)]

* Indicator is restricted to patients admitted to hospital. Patients who die prior to hospital arrival or who die in the ED prior to being admitted to hospital are excluded.

[‡] We propose calculating two risk adjusted mortality rates:

1) One for deaths during initial hospital stay = in hospital mortality.

2) One for deaths during the first 12 months following injury = mortality rate 12 months following injury.

Although data for in hospital mortality is easier to obtain than data for 12 month mortality, both measures provide potentially important and slightly different evaluations of patient care outcome.

† How to calculate Risk-Adjusted Mortality Rate:

Risk-adjusted Mortality = [Observed Mortality Rate/Risk-adjusted Expected Mortality Rate (x100)] x Overall Mortality Rate in the standard population.

Note: Standard population refers to a population of institutions under evaluation (e.g. institutions contributing data to a national trauma registry or centrally collected administrative data bank).

Alternatively risk adjusted mortality can be calculated directly from parameter estimates from a multivariable risk adjusted model examining data from individual institutions or from multiple institutions[88].

β Mean mortality across all centers excluding the center under evaluation is one possible benchmark that can be considered[88].

Summary

This indicator is intended to monitor risk-adjusted mortality in hospital and 12 months from injury and allow comparisons across institutions.

Panel Review

Panelists agreed that this is a key measure as it addresses a widely accepted outcome. The panel discussed the challenges related to data collection, analysis, risk adjustment and interpretation. They highlighted that multiple approaches for risk adjustment for this indicator exist, each with their respective strengths and limitations. These include using a Standardized Mortality Ratio (SMR) or direct estimation from parameters derived from multivariable regression models. If SMR is used then particular attention needs to be paid to the external standard applied to ensure that it accurately reflects a standard population. It was suggested that risk adjustment may be most effective and best accepted if applied using a validated and published instrument.

[88] Moore L, Hanley JA, Turgeon AF, Lavoie A, Eric B. A new method for evaluating trauma centre outcome performance: TRAM-adjusted mortality estimates. Ann Surg. 2010;251(5):952-958.

Trauma Center Review

The trauma centers suggested that the definition of this indicator could be refined so that it does not capture patients with what are expected to be fatal injuries. Centers emphasized the importance of the indicator, but highlighted challenges of implementation including data linkages (e.g. trauma registries and death records) to provide 12 month follow up.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: Most studies show no correlation with individual measures of process but some correlation with composite measures of process[47]. Two studies showed poor agreement between risk adjustment using TRISS and ASCOT[89,90].

Reliability: No studies identified.

Risk Adjustment[α]*:* Several variables have been evaluated in studies of risk adjustment of patient mortality[90,91].

Utilization: Measures of hospital mortality are used by a large number of trauma centers: USA 52% (105/200), Canada 71% (25/35), Australasia 8% (1/12).

Nakahara et al.[92] developed a simplified method to predict survival probability with the objective of risk adjustment. The model included only three predictors: age, anatomical injury severity described in the *Injury Surveillance Guidelines, and a physiological status parameter*[90].

[47] Cryer HG, Hiatt JR, Fleming AW, Gruen JP, Sterling J. Continuous use of standard process audit filters has limited value in an established trauma system. J Trauma. 1996;41(3):389-394; discussion 394-385.

[89] Glance LG, Osler TM, Dick A, Mukamel D. The relation between trauma center outcome and volume in the National Trauma Databank. J Trauma. 2004;56(3):682-690.

[90] Glance LG, Osler TM, Dick AW. Evaluating trauma center quality: does the choice of the severity-adjustment model make a difference? J Trauma. 2005;58(6):1265-1271.

[91] Osler T, Rutledge R, Deis J, Bedrick E. ICSS: an international classification of disease-9 based injury severity score. J Trauma. 1996;41(3):380-386, discussion 386-388.

[92] Nakahara S, Ichikawa M, Kimura A. Simplified alternative to the TRISS method for resource-constrained settings. World J Surg. 2011;35(3):512-519.

The simplified model may allow for efficiencies in data collection by enabling the use of injury surveillance data for both injury prevention and risk adjustment in quality evaluation[88].

Source

Risk adjusted mortality has been proposed as a quality indicator by professional trauma societies, patient advocacy groups and researchers[2,89,90].

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[88] Moore L, Hanley JA, Turgeon AF, Lavoie A, Eric B. A new method for evaluating trauma centre outcome performance: TRAM-adjusted mortality estimates. Ann Surg. 2010;251(5):952-958.

[89] Glance LG, Osler TM, Dick A, Mukamel D. The relation between trauma center outcome and volume in the National Trauma Databank. J Trauma. 2004;56(3):682-690.

[90] Glance LG, Osler TM, Dick AW. Evaluating trauma center quality: does the choice of the severity-adjustment model make a difference? J Trauma. 2005;58(6):1265-1271.

3.19 Protocol for Peer Review & Reporting of Quality of Injury Care

Description of Indicator

Relationship to Quality	Medical care should be safe and effective
Type of Indicator	Hospital structure, Hospital level
Proposed Data Sources	Survey
Definition	Hospitals with multidisciplinary peer review of the quality of care provided to injured patients and reporting of quality improvement actions
Numerator	Hospitals with regular*, structured[‡] and multidisciplinary[†] peer review of the quality of care provided to injured patients age 18 years and older that includes review of adverse events and deaths AND reporting[β] of resultant quality improvement actions
Denominator	Not applicable
Benchmark	Not applicable
Risk Adjustment	Not applicable

* Regular indicates scheduled recurrent meetings more than once a year (e.g. monthly).

[‡] Structured indicates an organized and systematic process that is standardized (i.e. same process each meeting).

[†] Multidisciplinary indicates participation of experts from the multiple patient care domains pertinent to injury management.

[β] Reporting indicates that results of the multidisciplinary peer review process are summarized and resulting quality improvement actions documented and periodically reported (e.g. annual peer review report outlining improvement opportunities identified and actions taken).

Summary

This indicator is intended to identify trauma centers with regular, structured and multidisciplinary peer review and reporting of the quality of care provided to patients with injuries.

Panel Review

Panelists indicated that the indicator was designed to encourage learning opportunities for healthcare teams regarding their performance. Panelists highlighted the importance that the peer review process is multidisciplinary and incorporates relevant stakeholders (healthcare providers across the spectrum of care – paramedics, nurses, physicians of different specialties, rehabilitation experts, administrators and patient advocates). They also noted the importance of the peer review being structured to ensure that the process is somewhat standardized. In addition panelists felt that it was important to have a reporting process that summarizes the peer reviews and links them to data, so that associations between quality improvement measures/activities and patient outcomes can be evaluated.

Trauma Center Review

The trauma centers emphasized that a protocol for peer review and reporting of quality of care exemplifies a commitment to quality. Some trauma systems centers indicated that such protocols are already place while others centers had concerns that defining the peer review process may unnecessarily complicate the indicator.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study demonstrated good agreement between peer review for preventable deaths and autopsy review[93]. One study demonstrated that implementation of a trauma quality improvement program that included this quality indicator was associated with reduced hospital mortality[45].

[45] Chadbunchachai W, Sriwiwat S, Kulleab S, Saranrittichai S, Chumsri J, Jaikwang P. The comparative study for quality of trauma treatment before and after the revision of trauma audit filter, Khon Kaen hospital 1998. J Med Assoc Thai. 2001;84(6):782-790.

[93] West JG. Validation of autopsy method for evaluating trauma care. Arch Surg. 1982;117(8):1033-1035.

Reliability: Eight studies demonstrated good intra-rater and inter-rater reliability for peer review of medical errors and preventable death[94,95,96,97,98,99,100,101]. One study demonstrated poor agreement between peer-review and TRISS (mortality prediction model)[102].

Risk Adjustment: Not applicable.

Utilization: Peer review based measures of quality of injury care are used by a moderate number of trauma centers: USA 20% (40/200), Canada 20% (7/35), Australasia 0% (0/12).

Source

The American College of Surgeons Committee on Trauma has promoted using a multidisciplinary peer review committee to improve care by reviewing sentinel events, complications and deaths[2].

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[94] Draaisma JM, de Haan AF, Goris RJ. Preventable trauma deaths in The Netherlands--a prospective multicenter study. J Trauma. 1989;29(11):1552-1557.

[95] McDermott FT, Cordner SM, Tremayne AB. Reproducibility of preventable death judgments and problem identification in 60 consecutive road trauma fatalities in Victoria, Australia. Consultative Committee on Road Traffic Fatalities in Victoria. J Trauma. 1997;43(5):831-839.

[96] Esposito TJ, Sanddal ND, Hansen JD, Reynolds S. Analysis of preventable trauma deaths and inappropriate trauma care in a rural state. J Trauma. 1995;39(5):955-962.

[97] Hill DA, Lennox AF, Neil MJ, Sheehy JP. Evaluation of TRISS as a means of selecting trauma deaths for clinical peer review. Aust N Z J Surg. 1992;62(3):204-208.

[98] Demetriades D, Sava J, Alo K, et al. Old age as a criterion for trauma team activation. J Trauma. 2001;51(4):754-756.

[99] Kelly AM, Nicholl J, Turner J. Determining the most effective level of TRISS-derived probability of survival for use as an audit filter. Emerg Med (Fremantle). 2002;14(2):146-152.

[100] Pories SE, Gamelli RL, Pilcher DB, et al. Practical evaluation of trauma deaths. J Trauma. 1989;29(12):1607-1610.

[101] Karmy-Jones R, Copes WS, Champion HR, et al. Results of a multi-institutional outcome assessment: results of a structured peer review of TRISS-designated unexpected outcomes. J Trauma. 1992;32(2):196-203.

[102] Fallon WF, Barnoski AL, Mancuso CL, Tinnell CA, Malangoni MA. Benchmarking the quality-monitoring process: a comparison of outcomes analysis by trauma and injury severity score (TRISS) methodology with the peer-review process. J Trauma. 1997;42(5):810-815; discussion 815-817.

4 Posthospital Indicators

Posthospital Quality Indicators are designed to measure the quality of care provided to patients with major injuries after discharge from an acute care hospital. The indicators are intended to examine select domains of injury care and be applicable across geographical areas in high-income countries.

4.1 Evaluation of Patient Functional Status

Description of Indicator

Relationship to Quality	Medical care should be effective
Type of Indicator	Hospital process, Hospital level
Proposed Data Sources	Trauma Registry
Definition	Number of patients with assessments for disability and decisions regarding prescriptions for post-acute care therapy per 100 patients
Numerator	All patients age 18 years and older admitted to hospital with an injury diagnosis AND documented to have an assessment for disability* AND a decision to prescribe OR not prescribe post-acute care therapy‡
Denominator	All patients age 18 years and older admitted to hospital with an injury diagnosis
Benchmark	Not specified at present
Risk Adjustment	Not applicable

* Documented assessment for disability could be performed by the admitting physician service, consulting physiatrist, consulting geriatrician, physical therapist, occupational therapist and/or speech therapist.

‡ Post-acute therapy can be inpatient (e.g. inpatient rehabilitation unit) or outpatient and could include treatment from physical therapists, occupational therapists and/or speech therapists.

Summary

This indicator is intended to monitor whether patient function is assessed while still in hospital and whether a decision is made regarding the need for post-acute care therapy. Not all injured patients are likely to benefit from therapy following discharge from acute care. However,

assessment of function and decision-making regarding prescription of post-acute care therapy can perhaps be most efficiently performed during initial acute care hospitalization.

Panel Review

Panelists reported that the indicator measures an important aspect of posthospital healthcare, but that there were many implementation challenges from a trauma system perspective, specifically provider and institution specific practice patterns and the need for additional data collection. Panelists suggest that opportunities may exist to develop quality indicators focused on resource delivery following hospital discharge.

Trauma Center Review

While the trauma centers reported the indicator to be valuable, many suggested that the cost of implementation was likely to be too great. Centers indicated that current practices make access to the necessary information difficult and that implementation would require increased documentation as well as communication between trauma registries and other medical record registries. It was also noted that practice variation between institutions may complicate measurement.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study demonstrated that reduced transfer delay to rehabilitation was associated with a reduction in rehabilitation length of stay and better cognitive functional outcomes in traumatic brain injured patients at discharge[103].

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: Indicators focused on rehabilitation therapy are used by a small number of trauma centers: USA 2% (3/200), Canada 9% (3/35), Australasia 0% (0/12).

[103] Sirois MJ, Lavoie A, Dionne CE. Impact of transfer delays to rehabilitation in patients with severe trauma. Arch Phys Med Rehabil. 2004;85(2):184-191.

Discussion of this indicator in the literature is almost non-existent. However, there appears to be a suggestion that early access of patients to rehabilitation may be associated with better patient outcomes for patients and more economical use of resources in both the acute and rehabilitation environments[103].

Source

The indicator *Rehabilitation Facility Transfer* was proposed by the Trauma Quality Indicator Consensus Panel and revised to *Therapy Evaluation* based on panel member feedback.

[103] Sirois MJ, Lavoie A, Dionne CE. Impact of transfer delays to rehabilitation in patients with severe trauma. Arch Phys Med Rehabil. 2004;85(2):184-191.

4.2 Multiple Hospital Visits

Description of Indicator

Relationship to Quality	Medical care should be safe, effective and efficient
Type of Indicator	Posthospital Outcome, System level
Propose Data Sources	Administrative Data
Definition	Number of patients with an injury* diagnosis AND non-elective injury* related hospital visit within 7 days of hospital discharge per 100 patients
Numerator	All patients age 18 years and older diagnosed with a head injury, spine injury, intra-abdominal injury or long bone fracture* AND a non-elective injury related hospital visit within 7 days of hospital discharge (ward discharge or ED discharge)
Denominator	All patients age 18 years and older diagnosed with a head injury, spine injury, intra-abdominal injury or long bone fracture* AND discharged from hospital (ward discharge or ED discharge)
Benchmark	Not specified at present
Risk Adjustment	Not specified at present

* Inclusion criteria for the indicator is limited to specific diagnoses that may be associated with increased risk of delayed presentation or adverse events: head, spine (cervical, thoracic, lumbar), intra-abdominal and long bone fractures.

Summary

This indicator is intended to monitor the rate that recently discharged patients re-present to hospital with a non-elective injury problem. It is an amalgamation of two indicators, *Readmission* and *Multiple ED Visits*.

Panel Review

Panelists noted this to be a particularly interesting indicator as it could be used to perform comparisons across different health domains (e.g. injury versus myocardial infarction) and institutions. Measurement challenges that were noted included identifying appropriate data sources and distinguishing elective from non-elective hospital visits. It was suggested that the indicator may be helpful to trigger a full medical record audit. Panelists discussed whether risk adjustment was important for this indicator.

While the proposed indicator suggests measuring hospital visits within 7 days of hospital discharge, some panel members suggested longer time frames up to 30 days post-discharge may be more appropriate.

Trauma Center Review

It was noted that some trauma centers and hospitals already collect this data for visits up to 30 days post discharge and it was suggested that this timeframe may be more appropriate. It was discussed that the reason for a subsequent visit must be identified, as this may be appropriate for this to occur in some cases (e.g. follow up with surgeon, suture removal). Trauma centers had concerns that current documentation procedures make it difficult to access information about care of patients at other facilities and implementation may require additional resources to ensure that information is consistently reported and is accessible to all trauma centers.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study showed no significant association between the quality indicator and hospital mortality[15]. Two studies demonstrated that implementation of a trauma quality improvement program that included the quality indicator was associated with a reduction in preventable death[44,45].

Reliability: No studies identified.

Risk Adjustment: No studies identified.

Utilization: Measures of *Multiple Hospital Visits* are used by a moderate number of trauma centers: USA 19% (37/200), Canada 29% (10/35), Australasia 17% (2/12).

Source

This indicator is an amalgamation of two indicators: *Readmission and Multiple ED Visits* proposed by the American College of Surgeons Committee on Trauma[2] and Chadbunchachai et al.[44,45].

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[15] Copes WS, Staz CF, Konvolinka CW, Sacco WJ. American College of Surgeons audit filters: associations with patient outcome and resource utilization. J Trauma. 1995;38(3):432-438.

[44] Chadbunchachai W, Saranrittichai S, Sriwiwat S, Chumsri J, Kulleab S, Jaikwang P. Study on performance following Key Performance Indicators for trauma care: Khon Kaen Hospital 2000. J Med Assoc Thai. 2003;86(1):1-7.

[45] Chadbunchachai W, Sriwiwat S, Kulleab S, Saranrittichai S, Chumsri J, Jaikwang P. The comparative study for quality of trauma treatment before and after the revision of trauma audit filter, Khon Kaen hospital 1998. J Med Assoc Thai. 2001;84(6):782-790.

5 Secondary Prevention Indicators

Secondary Prevention Quality Indicators are designed to measure the quality of injury prevention initiatives for patients who have already experienced an injury. The indicators are intended to examine select domains of injury care and be applicable across geographical areas in high-income countries.

5.1 Chemical Dependence Screening

Description of Indicator

Relationship to Quality	Medical care should be effective
Type of Indicator	Secondary prevention, Hospital level
Proposed Data Sources	ED Records, Trauma Registry
Definition	Number of patients with a primary diagnosis of injury who are screened for chemical dependency using a validated tool* per 100 patients
Numerator	All patients age 18 years and older admitted to hospital or the ED with a primary diagnosis of injury AND screened for chemical dependency‡ using a validated tool*
Denominator	All patients age 18 years and older admitted to hospital or the ED with a primary diagnosis of injury
Benchmark	Not specified at present
Risk Adjustment	Not applicable

* Validated tools refer to screening instruments previously validated (e.g. CAGE, Michigan Alcoholism Screening Test [MAST])[104].

‡ Chemical dependency is defined as the subjective sense of a need for a psychoactive substance (e.g. alcohol) either for its positive effects or to avoid negative effects associated with its absence[104].

[104] Arenth PM, Bogner JA, Corrigan JD, Schmidt L. The utility of the Substance Abuse Subtle Screening Inventory-3 for use with individuals with brain injury. Brain Inj. 2001;15(6):499-510.

Summary

This indicator is intended to monitor hospital-based screening for chemical dependency among patients admitted with an injury diagnosis.

Panel Review

The panel noted that a large number of patients with injury diagnoses admitted to hospital have chemical dependence. Hospital presentation represents an excellent opportunity to identify and intervene for secondary prevention purposes. Panelists indicated that this was an important indicator and provided a basic platform for institutions to evaluate the effectiveness of their trauma care programs. Panelists debated whether the indicator should be restricted to screening (panel decision) or also include intervention for chemical dependence among patients who screen positive.

Trauma Center Review

Centers reported that it is important, but may be difficult to implement because current documentation practices may not capture this information. Some trauma centers expressed preference for the term “chemical dependence” as opposed to “substance use”.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: One study demonstrated that trauma patients with positive toxicology results have an injury mortality rate that is twice that of patients with negative results[105]. When patients received a single, brief alcohol intervention during hospitalization, trauma recidivism was reduced by as much as 50%[106].

[104] Arenth PM, Bogner JA, Corrigan JD, Schmidt L. The utility of the Substance Abuse Subtle Screening Inventory-3 for use with individuals with brain injury. Brain Inj. 2001;15(6):499-510.

[105] Dischinger PC, Mitchell KA, Kufera JA, Soderstrom CA, Lowenfels AB. A longitudinal study of former trauma center patients: the association between toxicology status and subsequent injury mortality. J Trauma. 2001;51(5):877-884; discussion 884-876.

[106] Charbonney E, McFarlan A, Haas B, Gentilello L, Ahmed N. Alcohol, drugs and trauma: Consequences, screening and intervention in 2009. Trauma. 2010;12(1):5-12.

Reliability: No studies identified.

Risk Adjustment: Not applicable.

Utilization: Chemical Dependency Screening and/or Intervention is used as a quality indicator by a small number of trauma centers: USA 9% (17/200), Canada 0% (0/35), Australasia 0%.

Evidence from the literature suggests that chemical dependence screening and intervention could provide opportunity for secondary injury prevention and is an avenue that many trauma systems have either not considered or have yet to implement[105,106,107]. The majority of the literature is focused on alcohol consumption and there is limited evidence for screening and intervention for other substances commonly resulting in chemical dependence[108]. This initiative has been shown to be feasible, is supported by trauma surgeons[109] and many valid screening measures for different types of injury having been identified[104,106].

Source

The indicator, "*Substance Abuse Screening"* was proposed by the Trauma Quality Indicator Consensus Panel and subsequently revised to "*Chemical Dependency Screening"* based on panel member and trauma center feedback.

[104] Arenth PM, Bogner JA, Corrigan JD, Schmidt L. The utility of the Substance Abuse Subtle Screening Inventory-3 for use with individuals with brain injury. Brain Inj. 2001;15(6):499-510.

[105] Dischinger PC, Mitchell KA, Kufera JA, Soderstrom CA, Lowenfels AB. A longitudinal study of former trauma center patients: the association between toxicology status and subsequent injury mortality. J Trauma. 2001;51(5):877-884; discussion 884-876.

[106] Charbonney E, McFarlan A, Haas B, Gentilello L, Ahmed N. Alcohol, drugs and trauma: Consequences, screening and intervention in 2009. Trauma. 2010;12(1):5-12.

[107] Worrell SS, Koepsell TD, Sabath DR, Gentilello LM, Mock CN, Nathens AB. The risk of reinjury in relation to time since first injury: a retrospective population-based study. J Trauma. 2006;60(2):379-384.

[108] Nilsen P, Baird J, Mello MJ, et al. A systematic review of emergency care brief alcohol interventions for injury patients. J Subst Abuse Treat. 2008;35(2):184-201.

[109] Schermer CR. Feasibility of alcohol screening and brief intervention. J Trauma. 2005;59(3 Suppl):S119-S123.

6 Global Indicator

The Global Quality Indicator is designed to measure the quality of care provided to patients with major injuries. It should be used as a tool of injury surveillance that captures the location and time of death from injury. The indicator is intended to examine select domains of injury care and be applicable according to geographical areas in high-income countries.

6.1 Injury Burden

Description of Indicator

Relationship to Quality	Medical care should be effective
Type of Indicator	Prehospital, Hospital and Posthospital outcome, System level
Proposed Data Sources	EMS Records, Coroner Data, Trauma Registries, Administrative Data
Definition	Number of injury associated ED visits, hospital admissions and deaths per 100,000 population*
Numerator	All patients age 18 years and older with a primary injury diagnosis AND associated: ED visit(s) Hospital admission(s) Death
Denominator	Population in metropolitan area, health region or State/Province, age 18 years and older
Benchmark	Not specified at present
Risk Adjustment	Not applicable

* We propose reporting a separate measure for the 3 outcomes of interest: ED visits, hospital admissions and deaths, each with a numerator and denominator.

Summary

This indicator is intended to summarize the burden of injury according to geographical area.

Panel Review

Panelists agreed that deaths are only a small component of injury burden. They suggested that a more comprehensive, bur practical measurement of injury burden, could include total injury

deaths, total number of injury admissions and total number of ED visits that are injury related. They suggested that this indicator could provide an excellent opportunity to facilitate injury prevention through monitoring of injuries and death. It was noted that all injury deaths should be reviewed in some way and suggested that using injury surveillance that captures the location and time of death from injury would be one informative way of doing so. In addition panelists noted that for many trauma systems there is a disconnect between the coroner and trauma center. Establishing a connection between the two would be important in order to ensure successful and effective implementation of this indicator.

Trauma Center Review

The trauma centers noted this indicator to be an important population based measure and useful tool for comparing injury burden across different geographical areas. However, centers noted implementation challenges due to limited access to essential documentation. It was noted that electronic medical records could decrease the resources needed to collect and analyze data for this indicator, but had concerns that a large number of trauma systems are not equipped with these electronic databases.

Review of Literature & Evidence

Face Validity: No studies identified.

Construct Validity: No studies identified.

Reliability: No studies identified.
Risk Adjustment: Not applicable.

Utilization: Measures of injury burden do not appear to be used as a quality indicator by trauma centers.

The risk of injury and injury-related mortality vary amongst developed countries, states/provinces and other geographical areas[110]. Kortbeek and Buckley described the injury burden on the Canadian health system[111].

[110] Fingerhut LA, Cox CS, Warner M. International comparative analysis of injury mortality. Findings from the ICE on injury statistics. International Collaborative Effort on Injury Statistics. Adv Data. 1998;303:1-20.
[111] Kortbeek JB, Buckley R. Trauma-care systems in Canada. Injury. 2003;34(9):658-663.

Some countries with national trauma registries report injury rates and mortality at a population level[3].

International comparisons of injury death rates among high income countries have demonstrated clinically important variation between countries[110].

Source

Derived from the American College of Surgeons Committee on Trauma audit filter A*ll Trauma Deaths*[2].

[2] American College of Surgeons Committee on Trauma. Resources for Optimal Care of the Injured Patient 2006. Chicago: American College of Surgeons; 2006.

[3] Canadian Institute for Health Information. National Trauma Registry 2011 report: hospitalizations for major injury in Canada (includes 2008-2009 data). 2011; https://secure.cihi.ca/estore/productFamily.htm?pf=PFC1600&lang=en&media=0. Accessed September 26, 2011.

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