

2022 ESO TRAUMA INDEX

INSIGHTS AND BEST PRACTICES FOR TRAUMA SYSTEMS

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CONTEXT AND OVERVIEW FOR THE INDEX

The world moves fast. A year ago, we were mired in a pandemic, attempting to navigate challenges presented by COVID-19—both clinical and operational. We are beginning to see the light at the end of this tunnel, but there are other obstacles and challenges for us to overcome, including the emergence of Monkeypox, Polio virus, and other diseases. It's truly a unique time as we rely more and more on data to make informed decisions.

At the beginning of 2022, we predicted that technology (and, by extension, the use of accurate data) would continue to change the healthcare landscape. Hospitals would increase their use of analytics to be more efficient and better manage resources; mitigate staff burnout; improve patient care; understand facility, system, and state-level challenges; and unearth evidence-based approaches to solutions. In other words, data (and understanding of that data) remain critically important.

To that end, here are some of the questions we hope the 2022 Trauma Index will help you answer and investigate using your own data:



What percentage of trauma patients meet the need for blood transfusion based on the Early Blood Transfusion Needs Score (EBTNS)ⁱ for receiving whole blood?



What is the time to antibiotics in open long bone fractures? Does it differ for different age groups?



What is the time to surgical repair for a geriatric patient with a hip fracture?



What is the percentage occurrence of key hospital eventsⁱⁱ (such as delirium or unplanned visits to OR)?



What is the injury severity score (ISS)ⁱⁱⁱ breakdown?

This year is our second year of the ESO Trauma Index (accompanying our EMS Index and Fire Service Index) to help hospital leaders answer the following questions, among others:



Is my organization aligned with other organizations around the country when it comes to patient care, including response to fractures?



Are we above or below the national average when it comes to hospital events?



What are the best practices for each measure in the Index?

The appropriate metric for evaluating the success of your hospital or hospital system will vary depending upon a number of factors, including the size of the population served and geographic location. However, we believe an objective look at aggregate data across the United States gives a good idea of how you perform compared to your peers.

This Index serves as a point of reference for hospitals and trauma centers to identify which areas are in alignment and which areas represent an opportunity for improvement—or at least further assessment and evaluation. This quantitative approach to measuring performance gives hospital systems a framework to continually refine tactics, improve efficiency and outcomes, and allocate resources appropriately.

LIMITATIONS

This index is retrospective and looks at aggregate data from 2021 hospital admissions. There are no universal rules designed around these measures. The purpose of the Index is to be informative and directional, but it is not intended to be a scientific study. Nor is it intended to be comprehensive in nature. We hope it serves as a body of literature that adds to the discussion and conversation around best practices for each of the measures identified in this Index to improve positive patient outcomes.



**884,456
PATIENT
RECORDS**

The Trauma Index uses ESO data compiled from nearly 550 hospital systems and represents 884,456 patient records from January 1, 2021 through December 31, 2021. The ESO Trauma Index is created from the [ESO Data Collaborative](#), the world's largest de-identified trauma registry data program that is available to anyone interested at no cost.

We hope you find this Index helpful, enlightening, and empowering. We're always here to answer any questions, clarify any of the data, and share our expertise. Enjoy!

KEY METRICS



BLOOD USAGE FOR TRAUMA PATIENTS BASED ON AN EARLY BLOOD TRANSFUSION NEEDS SCORE (EBTNS)^{IV} GREATER THAN 5



TIME TO ANTIBIOTICS IN OPEN LONG BONE FRACTURES, INCLUDING PEDIATRICS (AGE <18 YEARS) AND GERIATRICS (AGE >64 YEARS)



TIME TO SURGICAL REPAIR FOR GERIATRIC AGE >64 WITH HIP FRACTURES



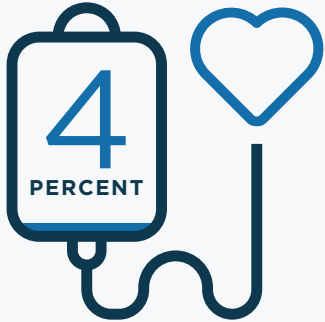
PERCENT OCCURRENCE OF HOSPITAL EVENTS



ISS SCORE SUMMARY

KEY FINDINGS

The 2022 ESO Trauma Index looks at 884,456 deidentified patient records with hospital admission dates between January 1-December 31, 2021. At a macro level, the data revealed the following:

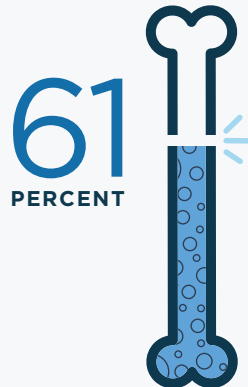
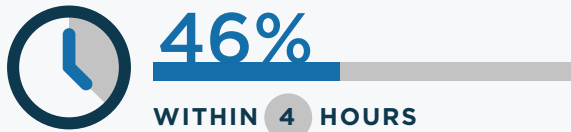


Whole Blood Usage: Nearly 4% of those patients meeting the EBNS definition for blood transfusion received whole blood.

95% WITHIN 24 HOURS

Surgical Repair of Hip Fractures: Geriatric patients requiring surgery for a hip fracture were moved from the Emergency Department (ED) to the Operating Room (OR) in 24 hours or less more than 95% of the time. The majority of the remaining were in the OR in less than 48 hours.

Red Blood Cells: Among those who received Packed Red Blood Cells (PRBC) and met the EBNS definition for blood transfusion, 46% received PRBC within four hours of arrival at the hospital.

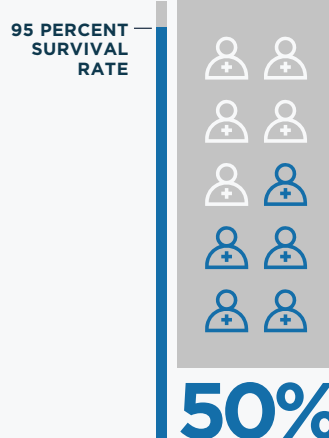


Antibiotics and Open Long Bone Fractures: Of the patients suffering from an open long bone fracture, 61% received antibiotics within 60 minutes upon arrival at the hospital. This excludes patients that received antibiotics prior to hospital arrival.

Hospital Events: Nearly 8% of patients had at least one hospital event reported. The most reported hospital events included unplanned admission to ICU, delirium, unplanned intubation, cardiac arrest with CPR, and unplanned visit to the OR.



WITH COMPLICATION REPORTED



Injury Severity Score (ISS): More than 50% of all patients with trauma-related injuries received treatment at a Level I trauma center, and these patients had a greater than 95% survival rate based on crude mortality. As expected, those patients with the most severe injuries (ISS scores greater than or equal to 25) experienced the highest mortality rates at 30%-plus.

INDEX METRICS BLOOD



For the purpose of this Index, “blood” includes both the whole blood metric and the packed red blood cells (PRBC) metric.

Using blood for trauma patients needing blood transfusions has a positive impact on patient morbidity and mortality.^{v,vi} We know mortality from hemorrhage is a problem impacting community health and safety worldwide, resulting in more than 60,000 deaths in the United States and almost 2 million hemorrhagic deaths worldwide. Of the 2 million deaths worldwide, 1.5 million can be attributed to a traumatic injury.^{vii} Early identification of trauma patients in need of blood and starting transfusions before arriving at the hospital or within the first four hours of arrival has shown to produce positive trauma patient outcomes.^{viii}

We refined our criteria for this Index to focus on patients with an EBTNS that is greater than 5.^{ix} By doing so, we eliminated records for which no EBTNS was calculated. The EBTNS provides a much clearer picture regarding the need for blood transfusions in trauma patients.^x We found that approximately 8.3% of trauma patients with complete data met the EBTNS criteria, qualifying for a blood transfusion.

The whole blood measure looks at how many trauma patients with an EBTNS greater than 5 received whole blood at the hospital, while the PRBC measure explores the number of patients meeting the EBTNS criteria with a PRBC transfusion within four hours of arrival at the hospital.

Chart 1

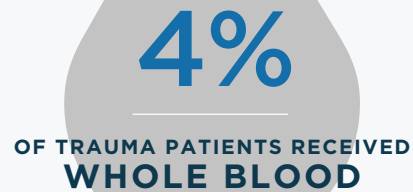


Chart 1 shows that, by and large, the use of whole blood by trauma centers is sparse. More than 96% of patients meeting EBTNS criteria did not receive whole blood, with fewer than 4% receiving whole blood at a trauma center.

Chart 2

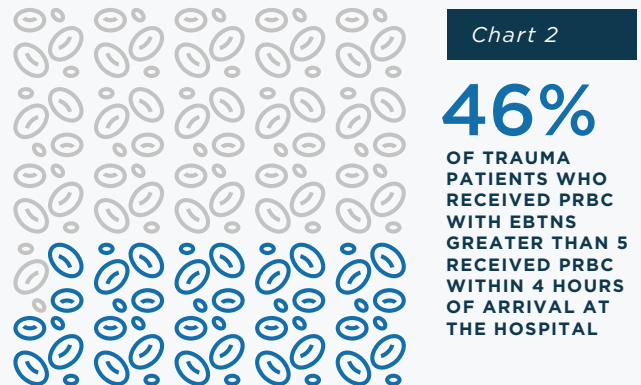


Chart 2 illustrates the timing of PRBC transfusions within four hours of arrival at the hospital for trauma patients. 46% of trauma patients with an EBTNS greater than five received PRBC within four hours, while 54% received PRBC more than four hours later.

BLOOD INSIGHTS

Uncontrolled hemorrhages are the most common cause of death within the first hour of a patient's arrival to a trauma center. Blood transfusions are a vital part of resuscitating injured trauma patients who are in hemorrhagic shock.^{xi}

Recent research indicates the use of whole blood over component blood products (plasma, platelets, and PRBCs) is linked to improved clinical outcomes.^{xii}

There is also a growing body of evidence that indicates the use of whole blood in the prehospital setting is superior to component therapy while being a life-saving treatment for hemorrhage.^{xiii} And whole blood is a more efficient means of resuscitation, with one bag of whole blood in a transfusion providing similar benefits as up to three bags of a balanced blood component transfusion. The use of component blood products for hemorrhagic shock became a common practice with limited clinical evidence to back up whether it is comparable to using whole blood or whether it improves patient safety and effectiveness. In recent years as the availability of whole blood returns, we have seen peer-reviewed publications indicate trauma patients who do receive whole blood received fewer transfusion volumes when compared to component blood products.^{xiv} Trauma data from the National Trauma Data Bank (NTDB) show an increased mortality rate for adult patients who received blood components when compared to whole blood.^{xv}

As of 2020, the American College of Surgeons Trauma Quality Improvement Program defined a trauma system's hemorrhagic shock cohort as a patient with an initial hospital systolic blood pressure (SBP) between 0 and 90 mmHg and transfusion PRBCs ≥ 6 unit and/or whole blood ≥ 6 units within the first four hours of arrival.

BLOOD BEST PRACTICES



A trauma system's ability to monitor treatment outcomes for patients in hemorrhagic shock and timely transfusion of whole blood or PRBCs is essential.



Whole blood has the potential to improve outcomes for patients experiencing severe hemorrhage and shock.



Assess your trauma system's use of whole blood against the outcomes of injured trauma patients who are in hemorrhagic shock.



Evaluate your trauma system's current policies and procedures around the prehospital EMS and hospital administration of whole blood. EMS whole blood programs require close coordination with trauma systems to ensure blood is available where it is needed and does not expire.



Consider implementing changes that facilitate clinicians' use of whole blood for patients with life-threatening hemorrhages when appropriate.

INDEX METRICS FRACTURES



“Fractures” include two metrics examined. First, the amount of time it takes to get a patient on antibiotics once they arrive at the trauma center in the event of an open long bone fracture. Second, the amount of time it takes to begin surgical repair of a hip fracture for patients 65 years and older. For these data, we removed “negative times” or administration of antibiotics prior to hospital arrival.

For patients with open long bone fractures, it’s critical to begin antibiotic treatment quickly to minimize the risk of infection.^{xvi, xvii} **Chart 3** shows the percent of patients with open long bone fractures receiving antibiotics within 60 minutes (61%).

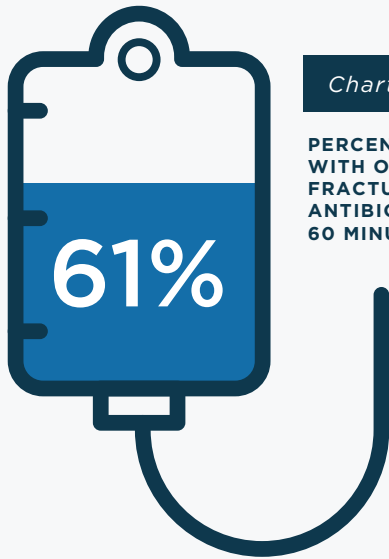


Chart 3

PERCENTAGE OF PATIENTS WITH OPEN LONG BONE FRACTURES RECEIVING ANTIBIOTICS WITHIN 60 MINUTES

ONE HOUR

Chart 4

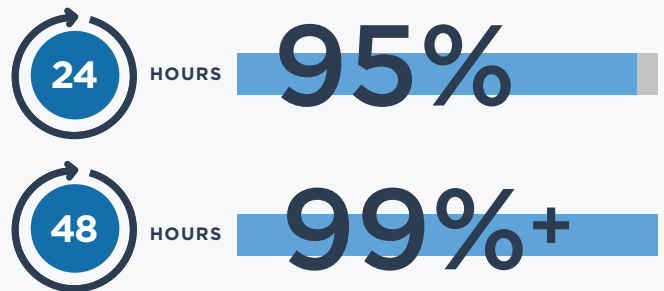
62% PEDIATRIC (18 & BELOW)
59% GERIATRIC (65 & OLDER)
66% ADULT (18-64)

Interestingly, pediatric patients (younger than 18) and geriatric patients (65 or older) received antibiotics less frequently than adults aged 18-64. **Chart 4** shows that pediatric patients received antibiotics within 60 minutes 62% of the time, geriatric patients 59% of the time, and adults 18-64 66% of the time.

Chart 5 highlights the percentage of geriatric patients moving from ED to OR in 24 hours or less (95%) and 48 hours or less (99%-plus).

Chart 5

GERIATRIC (65 AND OLDER) PATIENTS MOVING FROM ED TO OR



FRACTURES INSIGHTS

Fractures happen to millions of people throughout the United States every year and it is projected that the number of fractures treated in the United States will exceed 3 million annually by 2025.^{xviii} The majority of open long bone fractures are of the tibia, which tends to be more severe than upper-body long bone fractures. According to research from the Global Burden of Disease, lower leg fractures are the most common and burdensome to patients, with older adults having a higher risk of experiencing a fracture.

Hip fractures are one of the most serious fall injuries. According to the CDC, more than 300,000 people aged 65 and older are hospitalized yearly with a hip fracture.^{xix} Ninety-five percent (95%) of all hip fractures are caused by falling, usually sideways. Women experience 75% of all hip fractures.

FRACTURES BEST PRACTICES



Early administration of antibiotics for open fractures is linked to a significant decrease in infection.^{xx}



To reduce risk of infection and complications for trauma patients with open fractures, antibiotics should be given within 60 minutes or less from arrival at the ED.^{xxi}



Encourage prehospital personnel to provide antibiotics for patients with open fractures prior to arrival at trauma centers, thus reducing time to antibiotics and decreasing infection rates.^{xxii}



Surgical intervention within 48 hours of hip fracture substantially reduces morbidity and mortality in geriatric patients.^{xxiii, xxiv}



Timing of surgical repair of hip fractures will impact patients' length of stay. Decreasing the arrival to surgical intervention decreases hospital length of stay and has been shown to reduce discomfort during the acute pain period.^{xxv}

INDEX METRICS HOSPITAL EVENTS

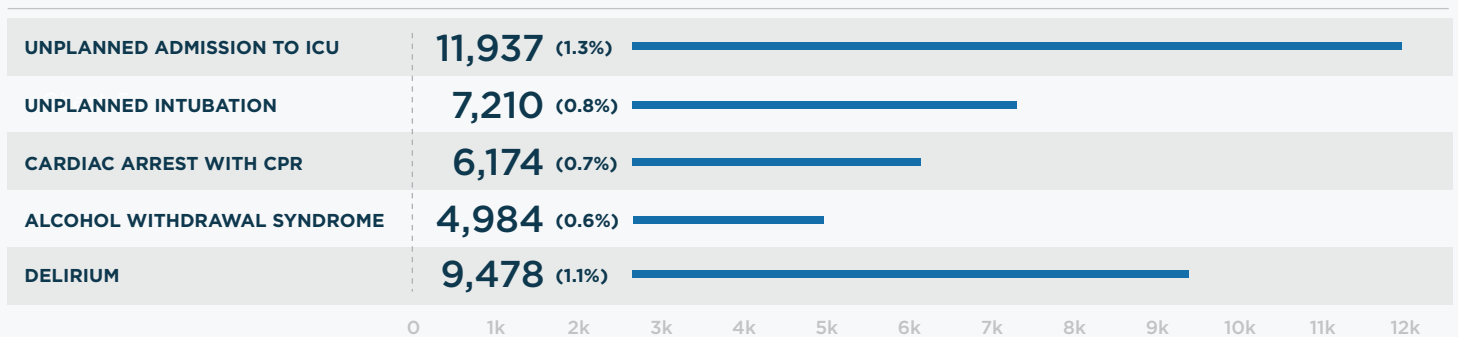


Our ability to mitigate and reduce hospital events is crucial to improving patient outcomes. There were 69,300 patients with at least one hospital event (about 8% of all patient records); there were more than 97,000 total reports of hospital events in 2021. It's important to remember that some patients experience multiple events.

In **Chart 6**, we look at the most common events by number of patients.

Chart 6

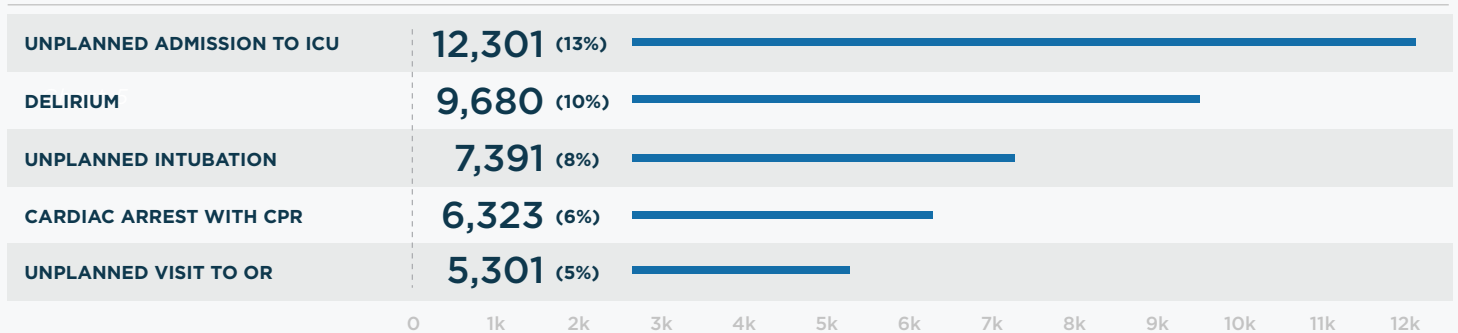
MOST COMMON EVENTS BY NUMBER OF PATIENTS



In **Chart 7**, we look at the top five most common hospital events by raw number of events. This includes patients experiencing multiple events or the same event more than once.

Chart 7

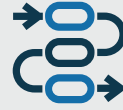
MOST COMMON EVENTS BY RAW NUMBER OF EVENTS



HOSPITAL EVENTS INSIGHTS

Adverse hospital events impact approximately 8% of hospital patients in the United States, with some of these events leading to preventable death. The financial impact of such events reaches into the millions. Not surprisingly, the most vulnerable and marginalized of our society experience the lion's share of these types of events, including children, the elderly, and the poor.^{xxvi}

HOSPITAL EVENTS BEST PRACTICES



Create a process for identifying hospital events concurrently.



Prospective data validation and accurate benchmarking of hospital events should be priorities for trauma centers.



Establish a non-punitive process to review select hospital events and identify potential factors that could be incorporated into a hospital performance improvement project.



Engage the trauma team to take action by implementing performance improvement projects to address systematic issues.



Participating in trauma data quality improvement collaboratives is associated with decreased occurrence of hospital events and improved patient outcomes.^{xxvii}

INDEX METRICS INJURY SEVERITY SCORE SUMMARY



Susan P. Baker, MPH is widely known for developing the Injury Severity Score (ISS)^{xxviii} to help determine the severity of a traumatic injury (see **Chart 8**). The higher the number, the more severe the injury. The metric in this study explores the frequency of scores across different ranges (see **Chart 9**), the trauma level most frequently transported to (see **Chart 10**), as well as a look at the survival and fatality rates (mortality) based on severity (see **Chart 11**).

More than 50% of trauma patients receive treatment at a Level I trauma center, regardless of the injury severity score.

Mortality rates are highest for patients with the most severe injuries, with those with an ISS score greater than 24 experiencing a 30% mortality rate.

Chart 8 ISS GROUP DESIGNATIONS

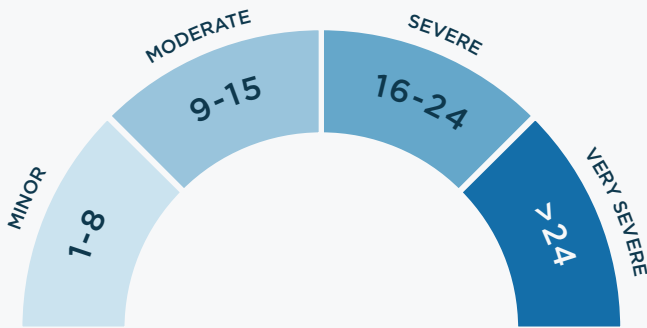


Chart 9 FREQUENCY OF TRAUMATIC INJURIES BY SEVERITY

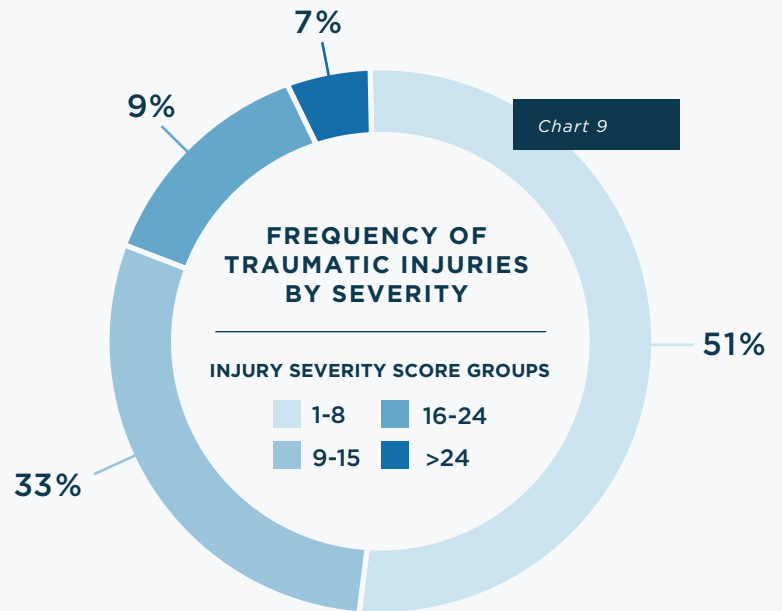


Chart 10 LEVEL OF TRAUMA CENTER RECEIVING PATIENTS

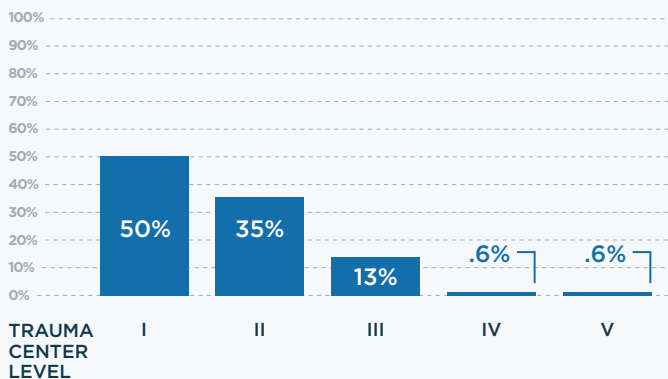
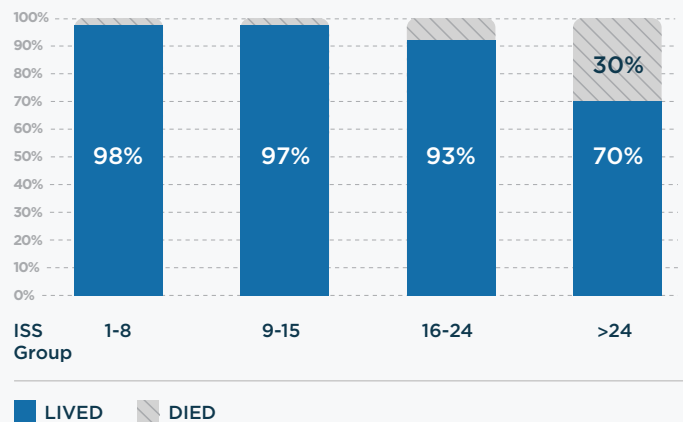


Chart 11 MORTALITY RATES BY INJURY SEVERITY SCORE



CONCLUSION

SO, WHAT DOES THIS MEAN?

We are seeing solid performance across a couple of metrics, including time to surgery for geriatric patients with hip fractures. However, there is room for improvement across some of the other metrics, including:

- **Whole blood usage.** A small percentage of hospital systems use whole blood for traumatic injuries. Consider the use of whole blood for treatment in place of component therapy.
- **Administration of antibiotics for patients with an open long bone fracture.** We see a 61% administration rate of antibiotics in less than 60 minutes upon arrival to the trauma center. Measure yourself against this national benchmark to see where you stand.
- **Trauma Centers.** Those centers participating in the ESO Data Collaborative are successfully getting geriatric patients with hip fractures to the OR within 48 hours 99+% of the time. Measure yourself against this national benchmark to see where you stand.
- **Management of hospital events.** Compared to 2020, patients experiencing a hospital event remained steady across all systems at 8%. Hospital events can be debilitating to both hospitals and patients, so establishing a non-punitive process to review hospital events and identify risk factors could make an impact on hospital performance.

METHODOLOGY

The dataset for the ESO Trauma Index is real-world, deidentified data compiled and aggregated from nearly 550 hospital systems across the United States that use ESO's products and services and agreed to have their data used for research purposes. These data are based on 884,456 anonymized patient records between January 1, 2021 and December 31, 2021, representing a full calendar year.

There is a 95% confidence level in the numbers used in the Index within a 1% +/- range.

OK, NOW WHAT?

Organizations may use this information to understand which metrics and drivers can affect your organization and the patients you serve. With this Index as a foundation, you can do your own analysis to serve as the basis for other modeling and outcomes.

The metrics shown in this Index are by no means exhaustive. Every organization is unique and has its own strengths, structure, and goals. Because of these attributes, results achieved by one organization may not be attainable by another for various reasons. However, these metrics should provide a foundation to compare your measurements and outcomes to what we see nationally.

TO LEARN MORE ABOUT THE ESO DATA COLLABORATIVE, VISIT

[ESO.COM/DATA-AND-RESEARCH](https://eso.com/data-and-research)

CITATIONS

- i. <https://www.jocmr.org/index.php/JOCMR/article/view/2598>
- ii. https://www.facs.org/media/ouzfthead/ntds_data_dictionary_2021.pdf
- iii. <https://pubmed.ncbi.nlm.nih.gov/4814394/>
- iv. <https://www.jocmr.org/index.php/JOCMR/article/view/2598>
- v. <https://www.scopus.com/home.uri>
- vi. https://www.facs.org/media/zcjdtrd1/transfusion_guidelines.pdf
- vii. <https://www.nejm.org/doi/full/10.1056/NEJMra1705649>
- viii. <https://www.jocmr.org/index.php/JOCMR/article/view/2598>
- ix. <https://www.jocmr.org/index.php/JOCMR/article/view/2598>
- x. <https://www.jocmr.org/index.php/JOCMR/article/view/2598>
- xi. <https://stopthebleedproject.org/about/>
- xii. https://journals.lww.com/jtrauma/Abstract/2009/04001/Warm_Fresh_Whole_Blood_Is_Independently_Associated.8.aspx
- xiii. https://journals.lww.com/jtrauma/Abstract/2009/04001/Warm_Fresh_Whole_Blood_Is_Independently_Associated.8.aspx
- xiv. <https://doi.org/10.1097/SLA.0b013e3182a4ffa0>
- xv. <https://doi.org/10.1097/JTN.000000000000025>
- xvi. <https://doi.org/10.3928/01477447-20221003-08>
- xvii. https://www.facs.org/media/mkbnhqtq/ortho_guidelines.pdf
- xviii. <https://asbmr.onlinelibrary.wiley.com/share/SIIJWY2ASWVD4MI5MS9D?target=10.1002/jbmr.2072>
- xix. <https://www.cdc.gov/injury/features/older-adult-falls/index.html>
- xx. <https://pubmed.ncbi.nlm.nih.gov/33009232/>
- xxi. https://www.facs.org/media/mkbnhqtq/ortho_guidelines.pdf/
- xxii. <https://doi.org/10.1080/10903127.2018.1514089>
- xxiii. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3463569/>
- xxiv. <https://doi.org/10.1016/j.jss.2021.03.027>
- xxv. <https://doi.org/10.1046/j.1532-5415.2002.50353.x>
- xxvi. <https://www.ncbi.nlm.nih.gov/books/NBK558963/>
- xxvii. <https://doi.org/10.1001/jamasurg.2018.0985>
- xxviii. https://journals.lww.com/jtrauma/Fulltext/1974/03000/THE_INJURY_SEVERITY_SCORE__A_METHOD_FOR_DESCRIBING.1.aspx?WT.mc_id=EMxALLx20100222xxFRIEND

ABOUT ESO

ESO (ESO Solutions, Inc.) is dedicated to improving community health and safety through the power of data. Since its founding in 2004, the company continues to pioneer innovative, user-friendly software to meet the changing needs of today's EMS agencies, fire departments, hospitals, and state EMS offices. ESO currently serves thousands of customers throughout North America with a broad software portfolio, including the industry-leading [ESO Electronic Health Record \(EHR\)](#), the next-generation ePCR; [ESO Health Data Exchange \(HDE\)](#), the first-of-its-kind healthcare interoperability platform; [ESO Fire RMS](#), the modern fire Record Management System; [ESO Patient Registry](#) (trauma, burn and stroke registry software); and [ESO State Repository](#). ESO is headquartered in Austin, Texas.



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