# State Quality Indicators and Risk Adjusted Mortality Metrics

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To promote continuous quality improvement, the Bureau of Emergency Medical and Trauma Services (BEMTS) is committed to delivering high-quality statistical outputs to Iowa's verified trauma centers—facilities that save lives every day.

The System Evaluation and Quality Improvement Committee (SEQIC) is a multidisciplinary group of stakeholders, including Iowa HHS public health professionals, trauma surgeons, nurses, registrars, abstractors, epidemiologists, trauma program managers, and other professionals dedicated to advancing trauma care in Iowa. SEQIC, in concert with Iowa HHS, has developed a set of performance indicators designed to monitor statewide trauma care quality and provide hospitals with actionable insights to support ongoing quality and process improvement efforts.

Each trauma center will receive two key statistical reports:

- **Risk-adjusted mortality metrics**
- **SEQIC performance indicators**

## How Indicators and Risk Adjusted Mortality Metrics are Calculated

BEMTS has published an open-source package in the R statistical computing language called {traumar}. This package is fully free to use to the public, and full documentation on the methods used to calculate pertinent statistics can be found at the source GitHub page and at the package website.

## Risk-Adjusted Mortality Metrics

### Understanding TRISS and the Probability of Survival (Ps)

The **TRISS method** (Trauma and Injury Severity Score) is a widely used model in trauma research and performance evaluation to estimate the **Probability of Survival (Ps)** for individual trauma patients. This predicted survival probability is essential for benchmarking, risk-adjusting outcomes, and comparing trauma center performance fairly (Boyd et al., 1987, Copes et al., 1988).

## What is the Probability of Survival (Ps)?

**Ps** is the estimated likelihood that a trauma patient will survive, based on their injury severity and physiological status at presentation. It is expressed as a number between **0 and 1**, where:

- **0.90** means a 90% chance of survival,
- **0.10** means a 10% chance of survival.

TRISS uses this value to set expectations for survival on a per-patient basis, adjusting for case mix in performance evaluation.

## How is Ps Calculated Using TRISS?

TRISS combines anatomical and physiological data into a logistic regression model. The main inputs include:

- **Injury Severity Score (ISS):** Quantifies anatomical injury severity.
- **Revised Trauma Score (RTS):** Captures physiological status based on Glasgow Coma Scale (GCS), systolic blood pressure (SBP), and respiratory rate (RR).
- **Age:** Stratified to account for increased risk with older patients.
- **Mechanism of Injury:** Separate models for blunt vs. penetrating trauma. Burn patients have a separate calculation and are not included in the model.

The TRISS equation is:

$$Ps = 1\frac{1}{1 + e^{-b}}$$

Where:

$$b = \beta_0 + \beta_1(RTS) + \beta_2(ISS) + \beta_3(AgeIndex)$$

The **β coefficients** differ slightly for blunt and penetrating trauma and are based on logistic regression models from the MTOS dataset. Also, for patients less than 55 years of age, their AgeIndex is 0, whereas patients 55 years of age and above have an AgeIndex of 1.

$$b_{blunt} = -0.4499 + 0.8085\,x\,RTS - 0.0835\,x\,ISS - 1.7430\,x\,AgeIndex$$

$$b_{penetrating} = -2.5355 + 0.9934\,x\,RTS - 0.0651\,x\,ISS - 1.1360\,x\,AgeIndex$$

## How to Interpret Ps

- Ps is used as a benchmark: if a patient with a Ps of 0.95 dies, that is an unexpected outcome; if a patient with Ps of 0.05 survives, that's a favorable outlier.
- Aggregating Ps across patients allows for calculation of expected mortality for a facility.
- When compared to actual mortality, Ps helps assess whether a center's outcomes are better, worse, or consistent with expectations.

In summary, TRISS-derived **Probability of Survival** is a foundational component of trauma outcome evaluation. It enables case-mix adjustment and provides the statistical basis for advanced metrics such as W, Z, and Relative Mortality scores.

## W Score: Interpreting Survival Beyond Expectations

The **W score** is a practical metric that describes **the number of unexpected survivors or deaths per 100 trauma patients**, based on individualized probabilities of survival (Champion et al., 1990). It quantifies performance without relying on an external benchmark group, making it highly flexible for internal quality review and subgroup analyses.

### *What Does the W Score Tell You?*

- A positive W score means your trauma center had more survivors than expected.
- A negative W score indicates fewer survivors than expected.
- The W score is scaled per 100 patients to allow easy interpretation. For example, a W score of +2.0 means that, out of every 100 patients, 2 more survived than predicted.

Because it is not dependent on comparison to national data, the W score can be used to analyze **any subgroup** of your trauma population—by mechanism, injury type, age, or time period. This makes it a valuable tool for trauma registrars, performance improvement coordinators, and program managers.

### *How to Calculate a W Score*

To compute a W score, you need:

- **Probability of survival (Ps)**: Calculated automatically by most trauma registry systems using TRISS.

- **Outcome**: Survival or death.

The formula is:

$$W = \frac{(A - B)}{C/100}$$

Where:

- **A** = Total number of survivors among patients with a Ps
- **B** = Sum of Ps values for those patients
- **C** = Total number of patients with a Ps

*Example*

Suppose your trauma registry identifies **600 patients** with **blunt injuries** who have complete Ps data. Of these, **18 patients died**, and the **sum of all Ps values** is **561.45**.

We compute:

- **A** = 600 − 18 = **582** (observed survivors)
- **B** = 561.45 (expected survivors based on Ps)
- **C** = 600 (total patients with Ps)

$$W = \frac{(582 - 561.45)}{600/100} = \frac{20.55}{6} = 3.43$$

**Interpretation**: Your trauma center had **3.43 more survivors per 100 patients** than expected—evidence of favorable performance for this patient group.

The W score is a powerful, accessible metric for evaluating trauma care outcomes at a granular level. Its strength lies in its adaptability—allowing local analysis tailored to your program's unique priorities and patient populations.

## M Score: Assessing Case Mix Comparability

The **M score** measures how closely your trauma center's patient case mix aligns with a standard reference population—specifically, the Major Trauma Outcome Study (MTOS) cohort, which includes over 80,000 trauma patients from 139 North American hospitals (Boyd et al., 1987, Champion et al., 1990). Although dated, MTOS remains a widely used benchmark for trauma outcome comparisons.

A valid performance comparison requires a similar case mix. The M score quantifies that similarity based on predicted survival probabilities (Ps).

### *How the M Score is Calculated*

- **Group your patients** into six ranges of predicted survival probability (Ps).
- **Calculate the proportion** of your patients falling into each Ps range.
- **Compare those proportions** to the MTOS group for each Ps range.
- **Sum the minimum proportion** for each of the six Ps intervals:

$$M = s_1 + s_2 + s_3 + s_4 + s_5 + s_6$$

Where $s_i$ is the smaller of your facility's proportion and MTOS's proportion in the *i-th* Ps range.

### *Example*

Below, we will follow the steps given above to calculate your M statistic. First, we will provide the MTOS Study's benchmark proportion of patients in each bin, and a fake facility's proportions in another column, with the computed lesser of the two proportions in the far-right column. Recall, the proportion columns reflect the proportion of patients that fall in each Ps range bin.

| Ps Range | MTOS Proportion | Facility Proportion | Min(Proportions) = $s_i$ |
|---|---|---|---|
| **0.96 – 1.00** | 0.842 | 0.810 | 0.810 |
| **0.91 – 0.95** | 0.053 | 0.070 | 0.053 |
| **0.76 – 0.90** | 0.052 | 0.060 | 0.052 |
| **0.51 – 0.75** | 0.000 | 0.010 | 0.000 |
| **0.26 – 0.50** | 0.043 | 0.030 | 0.030 |
| **0.00 – 0.25** | 0.010 | 0.020 | 0.010 |

### Final Calculation

$$M = 0.810 + 0.053 + 0.052 + 0.000 + 0.030 + 0.010 = 0.955$$

**Interpreting the M Score:**

- **M ≥ 0.88**: Your case mix is considered **statistically similar** to MTOS; comparisons using mortality metrics (e.g., Z score) are valid.

- **M < 0.88**: Your case mix is **dissimilar**, and comparisons should be interpreted with caution.

For example, an M score of **0.944** indicates excellent alignment between your patient population and the MTOS benchmark—supporting valid outcome comparisons.

Once case mix similarity is established, the next step is calculating your **Z score** to evaluate performance relative to expected outcomes.

## Z Score: Measuring Whether Outcomes Are Statistically Different from Expected

The **Z score** is a standard statistical tool used to assess whether your trauma center's observed outcomes are significantly different from what would be expected based on patient characteristics (Boyd et al., 1987, Champion et al., 1990). It quantifies how far your outcomes deviate from the expected number of deaths or survivals, assuming your patient mix is similar to a national benchmark, such as the Major Trauma Outcome Study (MTOS).

### *What Does the Z Score Tell You?*

The Z score answers this question:
*"Did significantly more or fewer patients die (or survive) than expected, given their injuries and physiological status?"*

- A **Z score greater than +1.96** indicates significantly more patients **survived** than expected, when studying survival.
- A **Z score less than –1.96** indicates significantly **more deaths** than expected, when studying survival.
- A Z score **between –1.96 and +1.96** suggests your outcomes are **not statistically different** from what would be expected.

The calculation can be oriented toward **survivals** (desirable outcomes) or **deaths** (adverse outcomes). The direction of the score (positive or negative) depends on which framing is used, but the statistical meaning is the same.

### *How Is the Z Score Calculated?*

The {traumar} package implements the formula from **Boyd et al. (1987)**. Here is the concept:

- Estimate individual survival probabilities (Ps) from TRISS.

- Calculate the probability of death (1 – Ps) and use it to compute the expected number of deaths or survivals.
- Apply the Z score formula to assess whether observed outcomes differ significantly from expected.

The general form is:

$$Z = \frac{Observed - Expected}{\sqrt{\sum Ps * (1 - Ps)}}$$

Where numerator can be observed deaths minus expected deaths (when studying mortality), or observed survivals minus predicted survivals (when studying survival). The denominator accounts for statistical variability in the outcome (analogous to standard error). {traumar} uses:

- The numerator: actual deaths (or survivals) minus expected
- The denominator: square root of the sum of the scale factor

Depending on whether you're analyzing **mortality** or **survival**, the sign of the Z score shifts:

- If assessing **mortality**, a **negative** Z score is desirable (fewer deaths than expected).
- If assessing **survival**, a **positive** Z score is desirable (more survivors than expected).

*Example*

Suppose you calculate a Z score of **+2.3** using the survival method. This means your trauma center had significantly more survivors than expected—suggesting excellent performance. If the Z score were **–2.5** using the mortality method, it would indicate a significantly lower-than-expected death rate.

The Z score is a statistically rigorous, interpretable measure that supports quality benchmarking, especially when used in conjunction with M and W scores. It enables trauma systems to close the loop on performance improvement by identifying whether outcome deviations are likely due to chance—or are truly meaningful.

## Relative Mortality Metric (RMM): A Risk-Adjusted Benchmarking Tool

The **Relative Mortality Metric (RMM)** is a composite statistic that quantifies how a trauma center's observed mortality compares to the mortality

anticipated by a national benchmark—typically derived from the TRISS methodology and the Major Trauma Outcome Study (MTOS) dataset (Napoli et al., 2017; Kassar et al., 2016; Schroeder et al., 2018). RMM values range from **–1 to +1** and are designed to enable fair performance comparisons across institutions by accounting for differences in patient risk (Napoli et al., 2017).

### *How to Interpret the RMM*

- **RMM = 0** → The center's observed mortality matches expected mortality based on TRISS; this implies performance is on par with national benchmarks.
- **RMM > 0** → The center is **outperforming** expectations (fewer deaths than predicted).
- **RMM < 0** → The center is **underperforming** (more deaths than predicted).

This measure provides a summary of institutional performance that adjusts for injury severity, age, and physiologic status, helping reduce confounding due to case mix variability.

### *How RMM Is Calculated*

BEMTS utilizes the {traumar} package to calculate the RMM using methods described in Napoli et al. (2017). First, the trauma data are summarized into non-linear bins, which is an approach unlike the MTOS approach of using bins with identical widths (i.e. 0 – 0.25, 0.26 – 0.5, 0.51 – 0.75, etc.). The non-linear binning algorithm from Napoli et al. (2017) is implemented via the {traumar} package, and then for each bin the following statistics are calculated.

Let:

- $A_b$: expected mortality for bin $b$
- $O_b$: observed mortality for bin $b$
- $R_b$: weight (bin range interval size) associated with bin $b$
- $j$: total number of bins
- $b$: a given bin in the set of calculated bins

Then:

$$RMM = \frac{\sum_{b=1}^{j} R_b(A_b - O_b)}{\sum_{b=1}^{j} R_b(A_b)}$$

Alternatively:

$$RMM = 1 - \frac{\sum_{b=1}^{j} R_b O_b}{\sum_{b=1}^{j} R_b (A_b)}$$

The RMM captures the aggregate deviation from expected mortality across risk strata, weighted by the contribution of each bin to the total mortality risk.

## What is in the Risk-Adjusted Mortality Report?

BEMTS' epidemiologist will typically utilize the most recent *complete* five years of data to create this report. It is important to note that the W, M, and Z scores will be calculated in three ways

- W, M, and Z statistics for each of the last five years.
- W, M, and Z statistics grouped by mechanism of injury as aggregate scores from all years included in the data (i.e. not reported by year with these strata).
- W, M, and Z statistics grouped by whether there was a trauma team activation (i.e. not reported by year with these strata).

The relative mortality metric data will be calculated by year and for each Ps bin in the data.

The risk-adjusted mortality metrics will be sent in two files to each facility:

- W, M, and Z scores will be sent in a file with columns
  - **Year**: Calendar year of the trauma data aggregation.
  - **Current Facility Name**: Name of the trauma center or reporting facility.
  - **Patients**: Total number of trauma patients included in the analysis for that year and facility.
  - **Survivors**: Count of patients who survived to discharge.
  - **Deaths**: Count of patients who died (in-hospital mortality).
  - **Predicted Survivors**: Sum of predicted survivors based on individual TRISS survival probabilities.
  - **Predicted Deaths**: Sum of predicted deaths derived from $1 - Ps$ survival probabilities.
  - **Patient Estimate**: An estimate of the **actual number of lives saved or lost** beyond what was expected based on risk adjustment. This is achieved via a formula of the form: $W * (\frac{N\_Patients}{100})$

- **W Score**: Risk-adjusted number of excess survivors per 100 patients. Positive values suggest better-than-expected survival.
- **M Score**: Average difference between observed and expected survival per patient. Like W but not scaled to 100 patients.
- **Z Score**: Standardized statistic indicating whether observed survival is significantly different from expected. Values beyond ±1.96 suggest statistical significance at the 0.05 level.

- The relative mortality metric data will be sent in a file with columns
  - **Year**: Calendar year of the trauma data aggregation.
  - **Current Facility Name**: Name of the trauma center or reporting facility.
  - **bin_number**: Index number identifying each bin in the Ps stratification.
  - **TA_b**: Total number of patients alive in the bin (observed survivors).
  - **TD_b**: Total number of patients dead in the bin (observed deaths).
  - **N_b**: Total number of patients in the bin ($TA_b + TD_b$).
  - **EM_b**: Estimated mortality for the bin; calculated as $\frac{TD_b}{N_b}$.
  - **AntiS_b**: Sum of predicted survivors in the bin (based on TRISS probabilities).
  - **AntiM_b**: Sum of predicted deaths in the bin ($1 - TRISS\ probability$).
  - **bin_start**: Lowest probability of survival (Ps) value in the bin.
  - **bin_end**: Highest Ps value in the bin.
  - **midpoint**: Midpoint Ps value for the bin; difference of bin_start and bin_end.
  - **R_b**: Bin width; difference between bin_end and bin_start.
  - **population_RMM_LL**: Lower limit of the population-based Relative Mortality Metric (RMM) confidence interval.
  - **population_RMM**: Point estimate of the population-based RMM.
  - **population_RMM_UL**: Upper limit of the population-based RMM confidence interval.
  - **population_CI**: Width of the population-based RMM confidence interval.
  - **bootstrap_RMM_LL**: Lower limit of the bootstrapped RMM confidence interval.
  - **bootstrap_RMM**: Bootstrapped point estimate of RMM (from resampling).

- **bootstrap_RMM_UL**: Upper limit of the bootstrapped RMM confidence interval.
- **bootstrap_CI**: Width of the bootstrapped RMM confidence interval.

*Practical Value*

RMM provides a single, interpretable value to summarize mortality performance while adjusting for injury severity. It's especially useful in trauma system evaluation, benchmarking, and performance improvement efforts where case mix varies considerably between centers. Unlike raw mortality or even W scores, RMM incorporates *expected* outcomes across a risk distribution, offering a robust and fair comparison. You will want to look at the RMM score to see how your facility performed among each group of patients within each bin. If you have negative scores among any group of patients, that is an opportunity for you to engage in your program's performance improvement (PI) process to see how to better serve that group.

Facilities should examine RMM scores within each risk bin to evaluate performance across patient subgroups. Negative RMM values indicate potential areas for targeted performance improvement (PI) interventions, while positive RMM values highlight patient subgroups where interventions are working well. These data help you answer the question "How are we serving subgroups of our patients with differing likelihoods of survival?".

Please note that the RMM is calculated on the unique Ps distribution within each year, and so each year may have a different number of bins and different bin ranges for the bins.

For centers with small annual trauma patient volumes (e.g., $n < 100$) overall or within any given bin, reviewing the bootstrap RMM is essential. This value reflects the point estimate from numerous resampled iterations of the observed data, mitigating the influence of outliers due to small sample size and providing a stable inference of performance. It is not necessary to utilize the bootstrap point estimate for larger facilities as the sample point estimate will be more stable.

## SEQIC Performance Indicators

Currently, indicator reports are distributed in the form of individual .csv files for each indicator. Each file includes the following columns:

- **Year**: The reporting year
- **Trauma Facility Verification Level**: Your facility's verification level

- **Emergency Preparedness Service Area**: Your facility's designated region
- **Facility Name**: Name of the reporting trauma center
- **Indicator Number**: SEQIC-assigned number
- **Indicator Name**: Full description of the measure
- **Numerator**: Cases meeting indicator criteria
- **Denominator**: Eligible population for the indicator
- **Performance Rate (%)**: $(\frac{Numerator}{Denominator}) \times 100$
- **Benchmark (Goal)**: SEQIC's target performance level
- **95% Confidence Interval**: Statistical range estimating true performance, accounting for sampling uncertainty
- **Peer Comparison (Verification Level)**: Average performance for centers with the same verification level
- **Regional Comparison**: Average performance for centers within the same emergency preparedness service area

Not all SEQIC indicators have established benchmarks or target goals. Indicator 1a is reported only for Level I and II trauma centers, while Indicators 1b and 1c are applicable to Level I, II, and III centers.

Please be aware that, due to data limitations, the denominator for some indicators may not represent the total number of relevant incidents or patients at your facility.

For indicators referencing "transferred patients" or "transfers," non-acute transfers are excluded from calculation. A patient is considered transferred only if they meet at least one of the following criteria:

- **Emergency department disposition**: "Transferred to another hospital"
- **Hospital discharge disposition**: "Acute care hospital"
- **Hospital discharge disposition**: "Burn care hospital"

Further details on indicator definitions and methodologies are provided below. For questions or clarification, please reply to the email that delivered your indicator report or contact the BEMTS epidemiologist listed at the end of this document.

## Indicators

### *Indicator 1a – Trauma surgeon present in ED within 15 mins. of patient arrival*

- For level 1 trauma activations, how often did the first responding trauma surgeon arrive within 15 minutes of the arrival of the patient?

- Trauma surgeons are defined as trauma team members who have 'Surgery/Trauma' selected for the Trauma Team Member Service Type on the incident form.
- The response time is calculated as the minutes from the ED/Acute Care Admission Time to the Trauma Team Member Arrived Time.
- 15 minutes is the indicator for Level I and II facilities.
- This indicator disregards incidents for which there was no calculable response time for a 'Surgery/Trauma' trauma team member.

*Indicator 1b – Trauma surgeon present in ED within 30 mins. of patient arrival*

- Calculated the same as 1a, but 30 minutes is the indicator for Level III facilities.

*Indicator 1c – Trauma surgeon response time unknown*

- For level 1 trauma activations, how often are we unable to calculate the response time of the trauma surgeon?
- This calculation is filtered down to a unique incident identifier and will include all unduplicated trauma team members involved with that incident who have 'Surgery/Trauma' selected for the Trauma Team Member Service Type. The calculation then looks at the proportion of all those provider response times to see the proportion missing. As such, the denominator for this indicator 1c will be higher than 1a and 1b as it includes all providers involved with each incident. Indicators 1a and 1b only include one row per incident which is the earliest arriving surgeon and exclude null values for the response time. This allows for the calculation of the true proportion of missing values for this use case given that all applicable providers are included in the calculation including providers with null response times.
- If we are unable to calculate the response time, that means that we are missing at least one of ED/Acute Care Admission Date/Time or Trauma Team Member Arrived Date/Time.

*Indicator 1d – 1st physician (Trauma surgeon or ED physician) present in ED within 5 mins. of patient arrival*

- For level 1 and 2 trauma activations, how often did the first responding physician arrive within 5 minutes of the arrival of the patient?

- Physicians are defined as trauma team members who have 'Surgery/Trauma', 'Emergency Medicine', 'Family Practice', 'Nurse Practitioner', 'Physician Assistant', 'Surgery Senior Resident', 'Hospitalist', or 'Internal Medicine' selected for the Trauma Team Member Service Type on the incident form.
- The response time is calculated as the minutes from the ED/Acute Care Admission Time to the Trauma Team Member Arrived Time.
- 5 minutes is the indicator for Level I and II facilities. This indicator is calculated for level I, II, III, and IV trauma centers.
- This indicator disregards incidents for which there was no calculable response time for the above-mentioned trauma team member service types.

*Indicator 1e – 1st physician (Trauma surgeon or ED physician) present in ED within 20 mins. of patient arrival*

- Calculated the same as 1d, but 20 minutes is the indicator for Level III and IV facilities.

*Indicator 1f – Physician response time unknown*

- For level 1 and 2 trauma activations, how often are we unable to calculate the response time of the physician?
- This calculation is filtered down to a unique incident identifier and will include all unduplicated trauma team members involved with that incident who have 'Surgery/Trauma', 'Emergency Medicine', 'Family Practice', 'Nurse Practitioner', 'Physician Assistant', 'Surgery Senior Resident', 'Hospitalist', or 'Internal Medicine' selected for the Trauma Team Member Service Type. The calculation then looks at the proportion of all those provider response times to see the proportion missing. As such, the denominator for this indicator 1f can be higher than 1d and 1e as it includes all providers involved with each incident. Indicators 1d and 1e only include one row per incident which is the earliest arriving surgeon and exclude null values for the response time. This allows for the calculation of the true proportion of missing values for this use case given that all applicable providers are included in the calculation including providers with null response times.
- If we are unable to calculate the response time, that means that we are missing at least one of ED/Acute Care Admission Date/Time or Trauma Team Member Arrived Date/Time.

*Indicator 2 – Missing injury time*

- Calculated as the number of incidents with a missing injury time divided by the total number of incidents for the period.

*Indicator 3 – Trauma patient had a Probability of Survival (Ps) score calculated*

- Calculated as the number of incidents with a valid Probability of Survival score divided by the total number of incidents for the period.
- This calculation will include all probability of survival calculations where an incident included more than one so that the true proportion of missing values can be estimated.
- Probability of Survival is calculated using the following factors:
- Injury Severity Score (ISS): Derived from the AIS codes associated with the diagnosis codes.
- Revised Trauma Score (RTS): Derived from Glasgow Come Scale, systolic blood pressure, and respiratory rate.
- Patient age.
- Trauma type: Derived from the injury code (found on the Injury tab in ImageTrend) and its associated trauma type. Only trauma types of Penetrating or Blunt are accepted. Trauma Types of Burns are filtered out.
- If any of those factors are missing, the Probability of Survival score will not be calculated.

*Indicator 4a – Deceased trauma patient was autopsied*

- Calculated as the number of incidents with a 'Yes' value for Autopsy divided by the number of incidents with a value of 'Deceased/Expired' for either ED/Acute Care Disposition or Hospital Discharge Disposition.

*Indicator 4b – No autopsy done on death with stay greater than 72 hours*

- Calculated as the number of incidents that included a deceased patient who was at the facility for over 72 hours and did not have an autopsy performed divided by all incidents that included a deceased patient who was at the facility for over 72 hours.

*Indicator 5a – Blood ETOH was measured*

- Calculated as the number of incidents where the patient had blood ETOH measured divided by all incidents.
- This does not exclude any patients, so pediatric patients are included.

*Indicator 5b – Blood ETOH was positive*

- Calculated as the number of incidents where the patient had a positive blood ETOH divided by the number of incidents where the patient had blood ETOH measured.

*Indicator 5c – Drug Screen Completed*

- Calculated as the number of incidents where the patient had a drug screen completed divided by all incidents.
- This does not exclude any patients, so pediatric patients are included.

*Indicator 5d – Drug Screen Positive*

- Calculated as the number of incidents where the patient had a positive drug screen completed divided by the number of incidents where the patient had a drug screen completed.

*Indicator 6 – Patients with a GCS < 9 arrived at definitive care in > 3 hours in transferred patients*

- Calculated as the number of incidents where the patient arrives to definitive care with a GCS less than 9 over 3 hours from injury time, divided by the number of incidents where the patient had a GCS less than 9 and arrived at definitive care.
- A filter on the Time From Injury to Arrival calculated field is applied to remove rows where this value cannot be calculated.
- For a case to be counted it must be possible to calculate the GCS score.
- In the numerator, you have the case when the patient arrived as an interfacility transfer at definitive care in greater than 3 hours with a GCS score less than 9. Arrive From, Referring Hospital Name, or the Inter-facility Transfer field must be used to indicate that the patient was transferred in to their “last stop” at definitive care. The patient is not documented as being transferred out to count in the numerator here, it is the definitive care episode.

- In the denominator, it must be possible to tell that the facility documented transferring the patient out or receiving the patient from an inter-facility transfer. The following fields are used: Arrive From, Referring Hospital Name, or the Inter-Facility Transfer field, along with ED Disposition (Referred to another hospital), Discharge Disposition (Acute care hospital or burn care hospital), or a non-missing value in the Hospital Transferred To fields. In this way, the total transfers are seen as the number of patients documented being received at definitive care from an interfacility transfer.

*Indicator 7 – Total patients that arrived at definitive care in > 3 hours from injury time*

- Calculated as the number of incidents where the patient took more than 3 hours to arrive at the definitive care facility from injury time divided by all incidents.

*Indicator 8 – Survival rate by risk for death (high, moderate, and low) stratified by patient risk level*

- The definitions for risk levels are as follows (Abnormal Physiology thresholds also listed):
- Abnormal Physiology
- GCS 3-5
- Respiration <5 or >30 respirations per minute
- Systolic Blood Pressure <60 mm Hg
- Risk Definitions
- High
- Probability of Survival < .2 **OR**
- ISS >41 **OR**
- ISS >24 if Abnormal Physiology
- Moderate
- Probability of Survival 0.2-0.5 **OR**
- ISS 16-41
- Low
- Probability of Survival 0.5-1.0 **OR**
- ISS <16 **OR**
- Normal range physiology

- All survival rates are calculated as the number of incidents where the patient did not have an ED/Acute Care Disposition or Hospital Discharge Disposition of 'Deceased/Expired' divided by all incidents.
- The denominator for the case where the risk category above is shown and counts and proportions are provided may be different if the risk category is not able to be assigned due to missingness in the data referenced above.

*Indicator 9a – Transfer Delays – Incidents involving a length of stay greater than 2 hours in the ED*

- This indicator is calculated as the number of incidents that include acute transfers out at any stage in their care (even counting double and triple jumps) that had a length of stay greater than 2 hours in the ED, divided by the total number of incidents that are acute transfers.
- This indicator is focused on physical discharge, not decision to discharge.
- To calculate this indicator, it must be possible to tell that a patient was a an acute transfer via the ED Disposition field or Hospital Disposition field being "transferred to another hospital", "acute care hospital", or "burn hospital".
- It must be possible to calculate the ED length of stay. This requires that the ED admission date/time and the corresponding discharge date/times are all present.
- Incidents that have null values for the length of stay calculation will be excluded.

*Indicator 9b – Transfer Delays – Incidents involving a length of stay greater than 3 hours in the ED*

- This indicator is calculated as the number of incidents that include acute transfers at any stage in their care (even counting double and triple jumps) that had a length of stay greater than 3 hours in the ED, divided by the total number of incidents that are acute transfers.
- This indicator is focused on physical discharge, not decision to discharge.
- To calculate this indicator, it must be possible to tell that a patient was a an acute transfer via the ED Disposition field or Hospital Disposition field being "transferred to another hospital", "acute care hospital", or "burn hospital".

- It must be possible to calculate the ED length of stay. This requires that the ED admission date/time and the corresponding discharge date/times are all present.
- Incidents that have null values for the length of stay calculation will be excluded.

*Indicator 9c – Transfer Delays – Incidents involving a time from patient arrival to decision to discharge greater than 60 minutes in the ED*

- This indicator is calculated as the number of incidents that include acute transfers at any stage in their care (even counting double and triple jumps) that had a time from patient arrival to decision to discharge greater than 60 minutes in the ED, divided by the total number of incidents that are acute transfers.
- To calculate this indicator, it must be possible to tell that a patient was a an acute transfer via the ED Disposition field or Hospital Disposition field being “transferred to another hospital”, “acute care hospital”, or “burn hospital”.
- It must be possible to calculate the ED length of stay. This requires that the ED admission date/time and the corresponding decision discharge date/times are all present.
- Incidents that have null values for the length of stay calculation will be excluded.

*Indicator 9d – Transfer Delays – Incidents involving a time from patient arrival to decision to discharge greater than 120 minutes in the ED*

- This indicator is calculated as the number of incidents that include acute transfers at any stage in their care (even counting double and triple jumps) that had a time from patient arrival to decision to discharge greater than 120 minutes in the ED, divided by the total number of incidents that are acute transfers.
- To calculate this indicator, it must be possible to tell that a patient was a an acute transfer via the ED Disposition field or Hospital Disposition field being “transferred to another hospital”, “acute care hospital”, or “burn hospital”.
- It must be possible to calculate the ED length of stay. This requires that the ED admission date/time and the corresponding decision to discharge date/times are all present.

- Incidents that have null values for the length of stay calculation will be excluded.

*Indicator 9e – Transfer Delays – Incidents involving a time from decision to discharge to physical discharge greater than 60 minutes in the ED*

- This indicator is calculated as the number of incidents that include acute transfers at any stage in their care (even counting double and triple jumps) that had a time from patient arrival to decision to discharge greater than 120 minutes in the ED, divided by the total number of incidents that are acute transfers.
- To calculate this indicator, it must be possible to tell that a patient was a an acute transfer via the ED Disposition field or Hospital Disposition field being “transferred to another hospital”, “acute care hospital”, or “burn hospital”.
- It must be possible to calculate the ED length of stay. This requires that the ED corresponding discharge date/times are all present.
- Incidents that have null values for the length of stay calculation will be excluded.

*Indicator 9f – Transfer Delays – Incidents involving a time from decision to discharge to physical discharge greater than 120 minutes in the ED*

- This indicator is calculated as the number of incidents that include acute transfers at any stage in their care (even counting double and triple jumps) that had a time from patient arrival to decision to discharge greater than 120 minutes in the ED, divided by the total number of incidents that are acute transfers.
- To calculate this indicator, it must be possible to tell that a patient was an acute transfer via the ED Disposition field or Hospital Disposition field being “transferred to another hospital”, “acute care hospital”, or “burn hospital”.
- It must be possible to calculate the ED length of stay. This requires that the ED corresponding decision and physical discharge date/times are all present.
- Incidents that have null values for the length of stay calculation will be excluded.

*Indicator 10a – Under-Triage (Cribari Method)*

- Please check important information about definitions of over-triage and under-triage using the Cribari Matrix and the Need For Trauma Intervention, which were used to develop the analytics for this metric. If you have questions about this, please reach out using my information below.
- To calculate this indicator, first we look at either cases where the trauma team activation was not called, or where the trauma team activation was not a full activation.
- For the numerator, we look at the number of incidents with Need For Trauma Intervention Positive and either a trauma team activation was not called, or the trauma team activation was called with the trauma team activation level being “not activated”, “Level 2”, “Level 3”, or “Consultation”.
- For the denominator, we look at the total number of incidents where the patient was kept at the facility and where either a trauma team activation was not called, or a trauma team activation was called with the trauma team activation level being “not activated”, “Level 2”, “Level 3”, or “Consultation”.

*Indicator 10b – Over-Triage*

- Please check important information about definitions of over-triage and under-triage using the Cribari Matrix, which was used to develop the analytics for this metric. If you have questions about this, please reach out using my information below.
- To calculate this indicator, first we look at incidents and where the highest trauma team activation was called (i.e. Level 1 in ImageTrend Patient Registry).
- For the numerator, we look at the number of incidents with Need for Trauma Intervention Positive where the patient was kept at the facility and the highest trauma team activation was called.
- For the denominator, we look at the total number of incidents where the patient was kept at the facility and where the highest trauma team activation was called.

*Indicator 10c – Under-Triage (Modified Cribari)*

- Please check important information about definitions of over-triage and under-triage using the Cribari Matrix and the Need For Trauma Intervention, which were used to develop the analytics for this metric. If you have questions about this, please reach out using my information below.
- To calculate this indicator, first we look at either cases where the trauma team activation was not called, or where the trauma team activation was not a full activation.
- For the numerator, we look at the number of incidents with Need For Trauma Intervention Positive and either a trauma team activation was not called, or the trauma team activation was called with the trauma team activation level being “not activated”, “Level 2”, “Level 3”, or “Consultation”.
- For the denominator, we look at the total number of major traumas (i.e. Need For Trauma Intervention Positive).
- This is a much more conservative measure that will typically detect a greater proportion of records that can be classified as under-triaged.

*Indicator 11 – Incidents transferred to definitive care with ISS < 9 and who are discharged from the ED at definitive care in less than 24 hrs.*

- This indicator is calculated by looking at cases where the patient arrived at definitive care after an interfacility transfer.
- The numerator includes patients that had an ISS < 9 at definitive care, and were discharged from the ED at definitive care in less than 24 hrs.
- The denominator will be the number of definitive care incidents where the patient was transferred from another hospital/ED.

*Indicator 12 – Incident submitted within 60 days of patient discharge*

- Calculated as the number of incidents entered in the trauma registry within 60 days of patient discharge divided by the number of all incidents.
- The data dictionary specifies that 80% of incidents should be entered within 60 days of patient discharge, and 100% of incidents should be entered within 120 days of patient discharge.
- The patient discharge date is the later of ED/Acute Care Admission Date and Hospital Discharge Date.

*Indicator 13 – Incident has validity score of 85% or greater*

- Calculated as the number of incidents with a validity score of 85% or greater divided by all incidents.

## Conclusion

Thank you for taking the time to review the quality improvement indicator documentation! It is BEMTS' hope that this resource will give verified trauma centers the information they need to fully understand the quality reports we send.

Should you have any questions about the risk-adjusted mortality metrics or the SEQIC indicators, please do not hesitate to reach out to me!

**Nicolas Foss, Ed.D., MS**

**Epidemiologist**

Bureau of Emergency Medical and Trauma Services

Bureau of Health Statistics

321 E 12th St., Des Moines, IA 50319

515-985-9627 mobile

nicolas.foss@hhs.iowa.gov

https://hhs.iowa.gov/public-health/emergency-medical-services-trauma

https://hhs.iowa.gov/public-health/health-statistics

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