

Methodology

Scottish Trauma Audit Group

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Version history

Version	Date	Summary of changes
1.2	08/07/2022	Updated in line with current methodology and PHS branding.

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Data collection

The Scottish Trauma Audit Group (STAG) has a team of local audit coordinators (LACs) who are employed by the participating health boards to identify eligible patients, enter data, and feedback results to their local sites.

Data are recorded prospectively by clinical and administrative staff, as part of the patient's routine care and are collected retrospectively by the STAG LACs. Data sources include patient's case notes, patient administration systems, results of diagnostic imaging and surgical procedures and post-mortems.

From November 2017, data are collected via eSTAG, a bespoke electronic data collection system.

Eligibility

An inclusion criterion is reviewed regularly to ensure STAG are capturing all patients who have had a significant injury. **Current Inclusion Criteria**

Patients are followed up for 30 days, or until death or discharge from a hospital with an emergency department (ED) or regional specialty.

Injury coding dictionary

STAG use the **Abbreviated Injury Scale (AIS)** dictionary (2008 update) to code and score patient injuries.

Quality assurance (QA)

A high standard of data quality is essential to ensure the STAG database is accurate, consistent, and comparable across time, and between hospitals. This will ensure decisions to improve quality of care and service provision at hospital, health board and regional network are based on correct information.

The data quality processes undertaken by STAG are incorporated into the following:

- At point of data collection.
- Central validation by PHS team.
- QA visits to each site at least once a year, which includes comparing data held in eSTAG with documentation in clinical notes (case note validation).
- QA by LACs and Lead Audit Consultants prior to public release.

Glasgow coma scale (GCS) and intubation

The first observation of the GCS recorded on arrival to the STAG ED or assessment unit (within first hour) is used to calculate the probability of survival (see below).

Where this is not available, the last observation recorded by the Scottish Ambulance Service, or the first within the ED/assessment unit (after first hour) are used.

If the patient was intubated, this is only used instead of a GCS for the calculation if a pre-intubation GCS score was not available. Patients with no GCS recorded and not intubated we assume to have GCS=15.

Interpretation of statistics

STAG data are subject to ongoing validation and must be regarded as dynamic.

Therefore, if analysis was to be re-run at a later stage it may be subject to change.

Probability of survival

STAG use a logistic regression model developed by the Trauma Audit and Research Network (TARN) to assign a probability of survival for each patient (Ps12). The model uses a patient's age, sex, GCS and intubation, a transformation of injury severity score (ISS) and an interaction between age and sex to determine whether a patient would normally be expected to survive. It is important to acknowledge that Ps12 does not take consideration of any pre-existing medical conditions. Ps12 is a statistical model which gives an indication of the probability of survival and is not an absolute measure of mortality.

The aggregation of all eligible trauma patients within a hospital gives a w-statistic (W) for that hospital and can be interpreted as the excess survivorship per 100 patients. This is achieved by subtracting the sum of all probabilities of survival (expected number of survivors, E) from the number of observed survivors (O) and scaling to 100 patients:

$$W = \frac{O - E}{N} \times 100$$

where N is the number of patients.

A positive w-statistic indicates unexpected survivors, whereas a negative w-statistic indicates unexpected deaths. Please note that for a patient to be included in the w-statistic we need to hold complete data across the variables listed above to allow a probability of survival to be computed.

The revised w-statistic (W_s) is standardised to allow for case-mix variation amongst hospitals. This is achieved by constructing six probability of survival bands in such a way that there are an equal number of deaths in each band. For each band a w-statistic is computed, and we then take a weighted average. The weighting corresponds to the number of patients within each band. That is:

$$W_s = \sum_{j=1}^6 F_j W_j \quad W_j = \begin{cases} \frac{O_j - E_j}{N_j} \times 100, & \text{if } N_j > 0 \\ 0, & \text{if } N_j = 0 \end{cases}$$

where

F_j is the population density in probability of survival band j ;

W_j is the W-statistic for probability of survival band j ;

O_j is the observed number of survivors in probability of survival band j ;

E_j is the expected number of survivors in probability of survival band j ;

N_j is the number of patients in probability of survival band j .

Please note that the bands and population density for each band is based at Scotland level and applied to all hospitals in the same manner. When the number of eligible cases in each survival group is small, the estimated rates may be unreliable because the direct standardisation is very sensitive to small numbers.

In recognising the limitations of analysis that is based on non-Scottish reference data and given that STAG now have sufficient data we have now 'recalibrated' this model to STAG data from 2013 – 2018 for year-on-year comparisons.

The variable intubated is nested within the GCS variable and has the following levels: 13 – 15, 9 – 12, 6 – 8, 4 – 5, 3 and intubated. As STAG also collects pre-hospital/pre-intubation GCS, we hold GCS information on patients that were intubated. STAG have found that we obtain greater sensitivity in correctly predicting deaths if we use pre-hospital/pre-intubation GCS for patients that are intubated. Therefore, the Ps12 model implemented by STAG will only use intubation if there is no GCS available from pre-hospital/pre-intubation.

The STAG Steering Group agreed that, for the purpose of hospital comparison and governance processes, data should only include patients where active treatment has been commenced and since this data has only been collected since 2019 it was agreed that the number of predicted survivors should be based on a model calibrated to the same time period. The number of expected survivors is generated from the STAG database and exclude patients where an end-of-life decision has been made in the ED or pre-injury.

Funnel plots

Funnel plots are a type of chart in which an indicator is placed on the y-axis and sample size on the x-axis. To each chart we plot the positioning of each hospital/health board and add a Scottish level straight line. In addition, we then add control limits which represent the bounds of statistical confidence across the Scottish level straight line as the sample size varies. It is as the sample size increases the control limits become narrower giving the characteristic funnel shape.

Typical control limits are constructed at both 2 and 3 standard deviations representing a 95% and 99.8% statistical confidence respectively. Any observation that lies within the control limits indicates that the corresponding confidence interval would contain the Scottish level and would be expected even when we only observe purely random variation. Observations that are out with a control limit therefore indicate that the corresponding Scottish confidence interval would not contain the observation and therefore gives a statistically significant difference between the observation and Scotland.

Even with expected random variation, 5 in 100 (5%) observations are likely to be out with 2 standard deviations and 2 in 1000 (0.2%) observations are likely to be out with 3 standard deviations. It is therefore important to take this into consideration when interpreting funnel charts with multiple hospitals.

Median and inter-quartile range

Medians are used as a measure of central tendency. The median is simply the point at which, if values in the data range were sorted from high to low, the middle point would lie. Where median values are reported the inter-quartile range (IQR) is also given. The IQR represents the data range within which the middle 50% of values lie.

STAG key performance indicators

The use of indicators in the trauma patient journey is to identify patients who have not had the optimal journey, for local review maximising learning and improving patient care through use of the audit data.

If an indicator has not been achieved, or the information required to determine this is not available, then the case should be reviewed locally where there is a comprehensive understanding of how trauma services are configured, and individual patient information is available.

The fact that an indicator has not been met does not infer that the management of the patient has been sub-optimal however this should be considered. Often the

number and severity of injuries sustained by a patient may not initially be fully apparent and may only become evident following further care or investigation.

Hospitals have access to this information via Tableau™ reports and within the eSTAG database where compliance is calculated on each patient record.

References

The Association for the Advancement of Automotive Medicine. Abbreviated Injury Scale. Available at <https://www.aaam.org/abbreviated-injury-scale-ais/> [last accessed 08 July 2022]

The Trauma Audit & Research Network, Ps12 details.
Available: <https://www.tarn.ac.uk/Content.aspx?c=3065> [last accessed on 08 July 2022]

Baker SP, O'Neill B, Haddon W, Long WB. (1974). The Injury Severity Score: a method for describing patients with multiple injuries and evaluating emergency care. *J Trauma - Injury Infection & Critical Care*. 14:187-196.