Impact of trauma audit on NHS major trauma care - 25 years of the Trauma Audit and Research Network

Fiona Lecky

Clinical Professor / Honorary Consultant in Emergency Medicine, University of Sheffield / Salford Royal (Hope) Hospital, &TARN Research Director - University of Manchester
Proposals for change - 1988

• Improve pre-hospital care
• Introduce ATLS principles
• Integrate trauma care services
• Invest in rehabilitation services
• Audit and Research – MTOS (UK) then Trauma Audit and Research Network (TARN)
TARN Patient Inclusion Criteria

• Hospital admission >72 hours
• Any ICU admission
• Transfer to tertiary centre
• Death within (93) 30 days
• Excluding:
  – Femoral neck or single pubic ramus fracture (age >65 years)
  – Simple isolated (and now nearly all isolated closed limb) injuries
Calculating the Injury Severity Score (ISS)

- Assign scores to individual injuries
- Identify the highest score in each body area
- Square the highest score in each body area
- Add together the highest AIS$^2$ from 3 different body areas
# Injury Severity Score (ISS)

<table>
<thead>
<tr>
<th>Body Region</th>
<th>Injury descriptor</th>
<th>ISS</th>
<th>$a^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>3cm Intracerebral haemorrhage</td>
<td>140640.4</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>2cm Brain contusion</td>
<td>140606.3</td>
<td></td>
</tr>
<tr>
<td>Face</td>
<td>Closed fracture to nose</td>
<td>251000.1</td>
<td></td>
</tr>
<tr>
<td>Abdomen</td>
<td>4 cm spleen contusion</td>
<td>544212.2</td>
<td>4</td>
</tr>
<tr>
<td>Extremities</td>
<td>Open book pelvic fracture with extensive</td>
<td>856164.5</td>
<td>25</td>
</tr>
</tbody>
</table>

**ISS: $16 + 4 + 25 = 45$**
Calculating the New Injury Severity Score (NISS)

- Assign scores to individual injuries
- Square each score
- Add together the 3 highest AIS\(^2\) from any body region
### New Injury Severity Score (NISS)

<table>
<thead>
<tr>
<th>Body Region</th>
<th>Injury descriptor</th>
<th>Score</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>3cm Intracerebral haemorrhage</td>
<td>140640.4</td>
<td>$4^2 = 16$</td>
</tr>
<tr>
<td></td>
<td>2cm Brain contusion</td>
<td>140606.3</td>
<td>$3^2 = 9$</td>
</tr>
<tr>
<td></td>
<td># to Base of skull</td>
<td>150200.3</td>
<td>$3^2 = 9$</td>
</tr>
<tr>
<td>Face</td>
<td>Closed fracture to nose</td>
<td>251000.1</td>
<td></td>
</tr>
<tr>
<td>Abdomen</td>
<td>4 cm spleen contusion</td>
<td>544212.2</td>
<td></td>
</tr>
</tbody>
</table>

**NISS: 16 + 9 + 9 = 34**
Assessment of Trauma Severity (TRISS)

Anatomical Injury ISS → Age → Blunt/Penetrating → Probability of survival of individual patients → Hospital Comparisons and Research

Physiological Measurements RTSS
Trauma audit – closing the loop

Hope Hospital, Salford, UK

The philosophy of medical audit and methods of data collection and statistical analysis have been extensively reviewed but less has been written about the effect of audit on medical practice. The measurement of performance is only valuable if it identifies areas of concern and stimulates appropriate change. This paper describes the work of the Salford Trauma Audit Group which has been developed at Hope Hospital, the problems that have been recognized, the strategies that have been introduced to effect change and their influence on management and outcome. Analysis of performance reveals an initial fall in adjusted mortality rate from severe injury after the introduction of resuscitation teams, the adherence to Advanced Trauma Life Support protocols and an integrated multidisciplinary approach to trauma care. Problems remain and there is continuing concern about trauma management in the hospital. This has been reinforced by performance feedback through the Trauma Audit Group which has attracted the interest of senior clinicians in several specialties.

Injury, 1994, Vol. 25, 511–514, September

outcome. Furthermore any change in management may not be immediately reflected in a change in survival. A more sensitive measurement of outcome which assessed temporary or permanent disability would be most helpful but no scoring systems are currently available to measure this.

Hope Hospital provides an emergency service to a population of 250 000 people mainly residing in inner city and suburban areas with a small rural population. Three neighbouring districts refer patients to the neurosurgical centre (catchment population, 1.2 million). The Emergency Department receives about 60 000 new patients each year. The TRISS methodology was first used in the hospital in July 1988 when the UK Major Trauma Outcome Study (MTOS) was set up. In 1990 a more extensive local auditing system was introduced in an attempt to promote a more comprehensive review of pre-hospital and hospital care. This paper describes the evolution of trauma audit in the hospital and the process used to identify deficiencies in the system, introduce improvements and measure their effectiveness.
Standardized Comparison of Performance Indicators in Trauma: A New Approach to Case-Mix Variation

Hollis, S. MSc; Yates, D. W. MD, FRCS; Woodford, M. AIMLS; Foster, P. PhD

Author Information
From Hope Hospital, Salford (S.H., D.W.Y., M.W.) and the Department of Statistics, University of Manchester, Manchester (P.F.), England.
Address for reprints: Sally Hollis, MTOS U.K., CSB, Hope Hospital, Salford, M6 8HD, U.K.

Abstract

An institution’s trauma survival rate can be compared with that predicted by TRISS using definitive outcome-based evaluation. This examines $W$, the difference between actual and predicted survival rates; $Z$, the statistical significance of this difference; and $M$, a measure of the similarity of injury severity mix to the prediction data base. However, it is possible for two institutions with the same survival rate within each band of injury severity to have very different $W$ and $Z$ scores whilst retaining a similar $M$ score. Clearly this is unsatisfactory.

A new statistic, $W_{sub s}$, is therefore proposed, which is standardized with respect to injury severity mix, producing more accurate comparisons between different institutions. Confidence intervals are used to graphically illustrate the magnitude of $W_{sub s}$, its direction, accuracy, and statistical significance. Data from the U.K. Major Trauma Outcome Study are used to demonstrate the calculations and presentation of $W_{sub s}$ and its advantages.
Odds ratio of death adjusted for ISS90 RTS and Age  
(All hospitals)  N=83,929

Lack of change in the process and outcome of trauma care in England & Wales since 1994
TARN 1989-2000

- TRISS methodology
- Ws – direct standardisation for comparison
- Unfavourable international comparisons
- Showing reduced case fatality probably related to ATLS
Revised Trauma Score

Combination of:

- Systolic Blood pressure
- Respiratory Rate
- Glasgow Coma Score
- 0-12 in clinical environment
- 0-7.84 Trauma Registries
A New Approach to Outcome Prediction in Trauma: A Comparison With the TRISS Model

Omar Bouamra, PhD, Alan Wrotchford, MMS, MILT, Sally Hollis, MSc, Andy Vail, MSc, Maralyn Woodford, BSc, and Fiona Lecky, MD, PhD

Background: The Trauma Audit & Research Network (TARN) has been using the TRISS methodology since 1989. Its database contains 200,000 hospital admissions from 110 hospitals over the country. To improve outcome prediction, a revision of the current model became necessary. Our model tried to overcome some of the concerns of the trauma community, namely missing data, functional form of the predictors, inclusion criteria and patient’s death within 30 days.

Methods: The data for modelling consisted of 100,399 anonymized hospital trauma admissions during the period 1996 to 2001. Cross validation was performed on this data set, and a multiple logistic regression model was derived using the prediction set and then its prediction ability was tested on the validation set. Fractional polynomials modeling showed that the linear functional form of the Injury Severity Score (ISS) in the model was not satisfactory. Using the Glasgow Coma Score (GCS) instead of the revised trauma score (RTS) has dramatically reduced the number of missing cases. Sex and its interaction with age have also been included in the model. The model was tested on different subsets of cases, traditionally excluded, such as children, those with penetrating injuries, and ventilated and transferred patients. The new model included all those subsets using age, a transformation of ISS, GCS, sex, and sex by age interaction as predictors.

Results: The model has shown a good discriminant ability tested by the Area under the Receiver Operating Characteristic (AROC) curve. The values of the AROC for the new model were 0.947 (95% confidence interval [CI]: 0.943–0.951) on the prediction set and 0.952 (95% CI: 0.946–0.957) on the validation set compared, respectively, with 0.937 (95% CI: 0.932–0.943) and 0.941 (95% CI: 0.936–0.952) for TRISS.

Conclusion: The new model has enabled us to include most of the cases that were excluded under the TRISSs inclusion criteria, less missing data are incurred and the predictive performance was significantly better than that of the TRISS model as shown by the AROC curves.

Key Words: Trauma, Outcome, Fractional polynomials, Prediction, Validation.

Assessment of Trauma Severity Ps04

Probability of survival of individual patients: $Ps = 59\%$

Comparative Outcome (Ws) graph

Anatomical Injury
ISS = 41

Physiological Measurement
GCS = 7

Sex
Male

Age
35
COMPARATIVE OUTCOME ANALYSES

Hospital '8100' is highlighted

Grouped according to the number of patients admitted to each hospital from February 2005 as a percentage of their admissions 2002/06 *

Ws = -0.72 (± 1.18) - Highlighted above

Of the 909 eligible cases 75% were used to calculate Ws. 25% (224) of your cases had missing GCS data. 42% of the cases were admitted in last 2 years
Steps in dealing with poor hospital performance

- Nationally have a plan agreed from the independent hospital auditors and professional bodies such as the Royal College of Surgeons
- Inform the service commissioners and obtain permissions to investigate further
- Inform the hospital board of the need to investigate
- Check the data for completeness of cases and accurate injury scoring
- Root cause analysis – in our case poor access to neuro ICU beds has led to 8 new beds being commissioned
- 2013/4 all outliers are trauma units (positive and negative) data quality seems to be underlying issue in all
Strategy Delivery

- **November 2006**
  - Hospital correspondence (all sites across UK)
  - **Launch 1 (14th November):** Demonstration pages - secure area of website only

- **January 2007**
  - **Launch 2 (22nd January):** ‘Standards of Care’ patient & public group collaboration

- **July 2007**
  - **Launch 3 (16th July):** revised website and re-analysis

- **August 20th 2007**
  - **Launch ‘standards of care’ to public**
Welcome

Every year across England and Wales, 12,500 people die after injury. It is the leading cause of death among children and young adults of 44 years and under. In addition, there are many thousands who are left severely disabled for life.

Our foundation in research and our highly skilled team ensures that we provide accurate and relevant information to help Doctors, Nurses and Managers improve their services.

Link to the ‘Standards of Care’
Performance Comparison: Information For Patients

Information for Patients

This website tells you what we know about the rate of survival for patients who undergo treatment of their injuries in England and Wales. You can use this website to look up a particular hospital and find out what percentage of their patients leave hospital alive after being injured compared to those expected to survive.

You can also find out whether the rate of survival is within the range that we would expect, taking into account the type of patients treated and how old the patients are before their injury. We continually assess the quality of care across England and Wales and you will be reassured to know that doctors themselves use this information to monitor the services they provide and to understand how they compare to other hospitals.

The website has been designed in collaboration with patients. It is intended to provide useful information about care of the injured:

- Why we assess the quality of care for different types of injury
- How to read the rates of survival on this site
- The yearly figures for the rates of survival
- The breakdown rate of survival
- How patients and the public have been involved in the development of this site
- How good are the data we use?
- Quality Assurance

Why we assess the quality of care for different types of injury

A person can be injured in many different ways. A car driver may be in a road traffic incident and sustains a head injury, an injury to the thigh bone and part of the spleen is torn. A person could be stabbed in the chest and suffer an injury to the heart. Another person may fall downstairs and suffer a serious fracture to the leg. All these examples are very different and require varying treatments by a range of specialist doctors at the right time and in the right hospital. This will result in the best possible outcomes.

Injuries to the Brain & Skull

Evidence from the UK and Europe has shown improved survival in head injury patients treated in specialised units.
Performance Comparison: Information For Hospitals

Survival rates of major injury for patients who have been admitted to hospital

To review expected survival rates across England and Wales, or your own area, use the navigation menu on the left hand side of this page.

The Trauma Audit and Research Network, the independent monitor of trauma care in England and Wales, is committed to making a real difference to the delivery of the care of those who are injured. One of the ways we do this is by promoting improvements in care through national comparative clinical audit.

The information on this website has been collected from many hospitals that treat patients with injury in England and Wales. Other hospitals, which do not currently collect this information are also listed for completion. It shows information about rates of survival after injury in patients admitted to hospital. Please use the hyperlinks below for further information upon this page:

- Presenting rates of survival
- Adjusting for risk
- The Yearly Figures for Rates of Survival
- The Breakdown Rate of Survival
- Standards of Care
- How good is the data we use?
- Quality Assurance

Presenting rates of survival

Injury is a major cause of death and disability in this country. Preventing the incident is obviously important and understanding the factors that influence the outcome of patients after injury can be equally important. This section presents the rates of survival for patients presenting from different settings.

Detailed Explanation of Ps04
Performance Comparison: Trauma Care

Trauma Care in England and Wales

Every year across England and Wales, 10,000 people die after injury. It is the leading cause of death among children and young adults of 44 years and under. In addition, there are many millions of non-fatal injuries each year.

Understanding the benefits and the risks associated with different types of treatment is important for all patients. However, it is not generally appreciated that there are variations in the success of treatment in different hospitals. It follows that there are probably opportunities to improve care.

This website was developed by the Trauma Audit & Research Network to help patients who have been injured. The Care Quality Commission (formerly The Healthcare Commission), the independent regulator of healthcare in England and Wales has advised The Trauma Network on the design of the website using the Heart Surgery Website as a model.

This website provides information about the rates of survival for patients who have been injured and treated at different hospitals across England and Wales. It also provides information about the benefits of certain kinds of treatment.

How to use this information

To read more about this website and to review survival rates at different hospitals, continue here

To interpret the information on this site, please go to Information for Patients

What it can’t tell you

Your own chances of surviving injury. This is dependent on your individual circumstances such as your age and general health.

Feedback
Performance Comparison: Greater Manchester

Last updated 17th March 2015. All data shown is by calendar year.

<table>
<thead>
<tr>
<th>Hospital Name</th>
<th>Completeness of Data 2011 - 2012</th>
<th>Completeness of Data 2013</th>
<th>Completeness of Data 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Manchester University Hospitals NHS Foundation Trust</td>
<td>95.2%</td>
<td>102.1%</td>
<td>108%</td>
</tr>
<tr>
<td>Royal Manchester Children’s Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manchester Royal Infirmary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Cheshire NHS Trust</td>
<td>48.4%</td>
<td>31.7%</td>
<td>20.7%</td>
</tr>
<tr>
<td>Macclesfield District General Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pennine Acute Hospitals NHS Trust</td>
<td>89%</td>
<td>67%</td>
<td>63.8%</td>
</tr>
<tr>
<td>North Manchester General Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairfield General Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Royal Oldham Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rochdale Infirmary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Royal Bolton Hospital NHS Foundation Trust</td>
<td>47.5%</td>
<td>50.9%</td>
<td>42.9%</td>
</tr>
<tr>
<td>Royal Bolton Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salford Royal NHS Foundation Trust</td>
<td>74.1%</td>
<td>94.5%</td>
<td>103.9%</td>
</tr>
<tr>
<td>Salford Royal Hospital</td>
<td><strong>90.5%</strong></td>
<td><strong>90.5%</strong></td>
<td><strong>90.5%</strong></td>
</tr>
<tr>
<td>Stockport NHS Foundation Trust</td>
<td>81.3%</td>
<td>106.9%</td>
<td>108%</td>
</tr>
<tr>
<td>Stepping Hill Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tameside Hospital NHS Foundation Trust</td>
<td>78.4%</td>
<td>71.5%</td>
<td>61.8%</td>
</tr>
<tr>
<td>Tameside General Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University Hospital Of South Manchester NHS Foundation Trust</td>
<td>67.6%</td>
<td>83.6%</td>
<td>93.4%</td>
</tr>
</tbody>
</table>
Completeness of Data

<table>
<thead>
<tr>
<th>Data Monitoring</th>
<th>2011 - 2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Data Completeness</td>
<td>74.1%</td>
<td>94.5%</td>
<td>103.9%</td>
</tr>
<tr>
<td>Hospital Data Accreditation</td>
<td>85.4%</td>
<td>94.3%</td>
<td>97.3%</td>
</tr>
</tbody>
</table>

The number of injured patients submitted to the Trauma Audit & Research Network database is compared to the number of patients with a primary diagnosis of ICD10 S00-T75 contained in HES (Hospital Episode Statistics).

The TARN inclusion criteria is translated into an algorithm to allow specific comparisons to HES.

We would expect a figure of more than 80% (GREEN) of injured patients to have been submitted by the Trust.

Figures of less than 80% show that fewer than the expected number of injured patients have been submitted by the Trust. Process and outcome measures should therefore be reviewed with this in mind.

Occasionally the number of injured patients identified by the Trust is greater than those in HES and therefore the number shown is greater than 100%.
Salford Royal Hospital

Last updated 17th March 2015. All data shown is by calendar year.

All rates of survival information shown here must be looked at in conjunction with data completeness. If data completeness is low then the figures may not be reflective of true practice.

### Data Monitoring

<table>
<thead>
<tr>
<th></th>
<th>2011 - 2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Data Completeness</td>
<td>74.1%</td>
<td>94.5%</td>
</tr>
<tr>
<td>Hospital Data Accreditation</td>
<td>85.4%</td>
<td>94.3%</td>
</tr>
</tbody>
</table>

Cases submitted and eligible for Rate of Survival calculation:

<table>
<thead>
<tr>
<th>Year</th>
<th>Total cases</th>
<th>Eligible cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>394</td>
<td>288</td>
</tr>
<tr>
<td>2012</td>
<td>624</td>
<td>524</td>
</tr>
<tr>
<td>2013</td>
<td>927</td>
<td>843</td>
</tr>
<tr>
<td>2014</td>
<td>1019</td>
<td>963</td>
</tr>
</tbody>
</table>

### Specialist Facilities

- Neurosurgical Unit: 48 beds
- Paediatric ICU: No Unit
- Burns & Plastic Surgery Unit: No Unit

### Emergency Department Details

- Number of Consultants: 8

### NHS Links

- Trust Website
- Trust NHS Gateway
Rate of Survival at this Hospital

Between January 1st 2011 and December 31st 2014

0.4 additional survivors out of every 100 patients

Outcomes (survival or death) after trauma is best measured by the number of those who actually survived compared with the number who are expected to survive.

The numbers of expected survivors is generated from our database of thousands of patients who have already been treated for similar injuries.

The horizontal white line in the chart represents a 95% Confidence Interval. Please refer to the 'Survival Rates' page for further information.

Rate of Survival at this Hospital: Yearly Figures

13/14: 1.2 additional survivors out of every 100 patients
11/12: 1.5 additional deaths out of every 100 patients

Outcomes (survival or death) after trauma is best measured by the number of those who actually survived compared with the number who are expected to survive.

The numbers of expected survivors is generated from our database of thousands of patients who have already been treated for similar injuries.

The horizontal white line in the chart represents a 95% Confidence Interval. Please refer to the 'Survival Rates' page for further information.

Rate of Survival Breakdown at this Hospital

<table>
<thead>
<tr>
<th>Survival band %</th>
<th>Number in group</th>
<th>Expected survivors</th>
<th>Actual survivors</th>
<th>Difference</th>
<th>Adjusted difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>95 - 100</td>
<td>1663</td>
<td>1637</td>
<td>1636</td>
<td>-0.1</td>
<td>-0.1</td>
</tr>
<tr>
<td>90 - 95</td>
<td>338</td>
<td>314</td>
<td>313</td>
<td>-0.3</td>
<td></td>
</tr>
<tr>
<td>80 - 90</td>
<td>278</td>
<td>238</td>
<td>240</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>65 - 80</td>
<td>148</td>
<td>109</td>
<td>118</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>45 - 65</td>
<td>89</td>
<td>49</td>
<td>56</td>
<td>6.8</td>
<td></td>
</tr>
<tr>
<td>25 - 45</td>
<td>65</td>
<td>23</td>
<td>24</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>0 - 25</td>
<td>37</td>
<td>5</td>
<td>7</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2618</td>
<td>2378</td>
<td>2394</td>
<td>0.6</td>
<td>0.4</td>
</tr>
</tbody>
</table>
COMPARATIVE OUTCOME ANALYSES.- All Cases
Admission dates: 2008-2011

'Hope Hospital' is highlighted

Current data: 22% of the cases were admitted in the last 12 months
i.e. 1st Nov10 - 31st Oct11
W = 1.17
Ws = 1.34 (+/- 1.20) - Highlighted above
1149 eligible cases were used to calculate Ws.
Trends in head injury outcome from 1989 to 2003 and the effect of neurosurgical care: an observational study

H C Patel, O Bouamra, M Woodford, A T King, D W Yates, F E Leddy, on behalf of the Trauma Audit and Research Network

Background Case fatality rates after all types of blunt injury have not improved since 1994 in England and Wales, possibly because not all patients with severe head injury are treated in a neurosurgical centre. Our aims were to investigate the case fatality trends in major trauma patients with and without head injury, and to establish the effect of neurosurgical care on mortality after severe head injury.

Methods We analysed prospectively collected data from the Trauma Audit and Research Network database for patients presenting between 1989 and 2003. Mortality and odds of death adjusted for case mix were compared for patients with and without head injury, and for those treated in a neurosurgical versus a non-neurosurgical centre.

Findings Patients with head injury (n=22 216) had a ten-fold higher mortality and showed less improvement in the adjusted odds of death since 1989 than did patients without head injury (n=154 231). 2305 (33%) of patients with severe head injury (presenting between 1996 and 2003) were treated only in non-neurosurgical centres; such treatment was associated with a 26% increase in mortality and a 2.15-fold increase (95% CI 1.77–2.60) in the odds of death adjusted for case mix compared with patients treated at a neurosurgical centre.

Interpretation Since 1989 trauma system changes in England and Wales have delivered greater benefit to patients without head injury. Our data lend support to current guidelines, suggesting that treatment in a neurosurgical centre represents an important strategy in the management of severe head injury.
Annual Odds of death compared to 1989 baseline adjusted for Age, ISS and RTS

<table>
<thead>
<tr>
<th></th>
<th>Head injury</th>
<th>No Head Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of patients</strong></td>
<td>22009</td>
<td>153830</td>
</tr>
<tr>
<td><strong>Median age yrs (IQR)</strong></td>
<td>32 (18-55)</td>
<td>43 (25-64)</td>
</tr>
<tr>
<td><strong>Percentage Male (95%CI)</strong></td>
<td>73 (72-74)</td>
<td>58 (58-59)</td>
</tr>
<tr>
<td><strong>Median ISS (IQR)</strong></td>
<td>22 (16-29)</td>
<td>9 (5-9)</td>
</tr>
<tr>
<td><strong>%Transferred</strong></td>
<td>34%</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Mortality (95%CI) (number of deaths)</strong></td>
<td>28 (24-32) (6140)</td>
<td>3 (3) (3951)</td>
</tr>
</tbody>
</table>
## Casemix adjusted odds of death for patients with SHI treated in a Non-neuroscience (NNC) versus a neuroscience (NC) centre 1996-2003 (TARN)

<table>
<thead>
<tr>
<th>Number of patients</th>
<th>Group</th>
<th>Adjusted Odds Ratio (95%CI) for predicting death when treated in NNC versus NC</th>
</tr>
</thead>
<tbody>
<tr>
<td>3069</td>
<td>SHI with complete RTS</td>
<td>2.15 (1.77-2.60)</td>
</tr>
<tr>
<td>6921</td>
<td>All SHI patients</td>
<td>2.39 (2.11-2.69)</td>
</tr>
<tr>
<td>456</td>
<td>Isolated, non-surgical SHI (Age 16-65) with complete RTS</td>
<td>1.92 (1.11-3.30)</td>
</tr>
<tr>
<td>894</td>
<td>All isolated, non-surgical SHI (Age 16-65) patients</td>
<td>2.08 (1.42-3.02)</td>
</tr>
</tbody>
</table>
Trends in location of care for severe head injuries – Fuller et al BJNS 2011

- Directly admitted to NSU
- Secondarily transferred to a NSU
- Treated entirely in non-NSU
Case mix adjusted trends in outcome TARN TBI 1989-2009
TARN 2000-2010

- New Model TRISS replaced by Ps04
- Mechanism for addressing outliers
- De-anonimisation
- Identification of importance of specialist care
- Further unfavourable international comparisons
- New Trauma systems
9M children: 16 Major Trauma Networks
44M Adults: 22 Major Trauma Networks
What has changed

On scene patient triage:

Direct to MTC (< 45 mins travel)

Indirect Transfer (>45 mins, time critical intervention)

MAJOR TRAUMA CENTRE

- Consultant led trauma team
- Immediate operating theatre
- All specialties: neurosciences
- Immediate CT scan
- Interventional radiology
- Specialist critical care

Trauma Unit

Trauma team
Immediate CT Resuscitate, Assess & ? Transfer
Most Networks live in April 2012
Major Trauma Centre: Best Practice Tariff Year 3 (14-15)

- Payment made to Major Trauma Centres
- Encourage best practice treatment & management of Trauma patients within a regional Trauma Network
- 2 payment levels based on Injury Severity Score (ISS)
- Conditional on achieving the following criteria
Major Trauma Centre: Best Practice Tariff Year 3 (14-15)
14-15 changes shown in green

Level 1: ISS>8

- TARN data is completed and dispatched within 25 days of discharge/death.
- Rehabilitation prescription completed for each patient & recorded on TARN.
- Tranexamic acid (TXA) administered within 3 hours of injury for any patient receiving blood. *Exclusions: Isolated AIS3+ Head injuries*
- Non-emergency transfers: Patient must be admitted to MTC within 2 calendar days of referral from Trauma Unit
Major Trauma Centre: Best Practice Tariff Year 3 (14-15)

Level 2: ISS>15

- Level one and
- Consultant within 5 minutes of arrival
- If GCS < 13 and Head AIS 1+ CT head scan within 30 minutes of arrival
Percentage of adult head injury patients aged 65 and over


EMRiS Emergency Medicine Research in Sheffield
Salford Royal NHS Foundation Trust
University Teaching Hospital

TARN THE TRAUMA AUDIT & RESEARCH NETWORK
Modelling with Comorbidity and different time horizons

• Model 1: Current TARN model (in-hospital deaths within 30 days)

• Model 2: TARN model + CCI (categorised)

• Model 3: as Model 2 but using deaths occurring 30 days after discharge from acute hospital

• Model 4: as Model 2 but using deaths occurring 30 days after admission
Modelling with Comorbidity and different time horizons

<table>
<thead>
<tr>
<th>Model’s evaluation</th>
<th>TARN model</th>
<th>TARN Model + Comorbidity</th>
<th>Outcome 30 days after discharge</th>
<th>Outcome 30 days after admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>H- L (p-value)</td>
<td>46.0(&lt;0.001)</td>
<td>63.7 (&lt;0.001)</td>
<td>78.9(&lt;0.001)</td>
<td>42.2(&lt;0.001)</td>
</tr>
<tr>
<td>Brier score</td>
<td>0.0434</td>
<td>0.0431</td>
<td>0.0435</td>
<td>0.043</td>
</tr>
<tr>
<td>AROC (95% CI)</td>
<td>0.899 (0.894 – 0.904)</td>
<td>0.904 (0.900 – 0.909)</td>
<td>0.894 (0.889 – 0.898)</td>
<td>0.899 (0.896 - 0.904)</td>
</tr>
<tr>
<td>Akaike Information criteria (AIC)</td>
<td>20159</td>
<td>19861</td>
<td>23009</td>
<td>21152</td>
</tr>
</tbody>
</table>
Odds ratio of survival in England
Hospitals with consistent submissions

ISS > 8  n = 65,399 (8.8% mortality)
Imputed:
missing GCS  n=6,834 (10.4%),
Odds ratio of survival in England
MTCs with consistent submissions

ISS > 8  \( n = 47,418 \) (9.1% mortality)

Imputed:

missing GCS  \( n = 5,832 \) (12.3%).
TARN 2010 onwards

• Increasing membership
• ROI joined!
• Monitoring of new trauma systems
• Improved model for ageing population
• Research +++
Acknowledgements

Clinicians and data-co-ordinators at TARN participating hospitals since 1989!
David Yates, Maralyn Woodford, Omar Bouamra, Staff at TARN Salford,
co-ordinating centre
TARN Board, SBNS collaborating researchers
25 Years of TARN in the NHS

- Turning trauma data into information
- Changing the culture from anecdote to evidence
- Building a collaboration that uses data to discover effective care, address outliers before the media, make the case for specific change
- Identification of importance of specialist care
- Improving investment, public confidence and quality in trauma care