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**Original Article**

**The impact of ‘unofficial trauma’ on a major trauma centre: a service evaluation of accident and emergency department trauma team activations**.

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**Abstract**

**Introduction**

Trauma remains a leading cause of death worldwide and is the most common cause of death in 15-44-year olds in England and Wales. In the UK, data for trauma patients is prospectively collected locally and collated by “The Trauma Audit & Research Network” (TARN). However, not all patients who trigger a trauma call meet criterion for subsequent TARN data collection. Our aim was to assess and describe the subgroup of patients who trigger a trauma call but who subsequently do not meet criteria for TARN data submission. To address this question, we performed a retrospective cohort study of all “trauma calls” admitted to our institution since 2012.

**Methods**

We conducted a single centre, retrospective observational study of trauma call admissions to our institution. All patients activating a trauma call between 1 June 2012 to 31 August 2018 were included. The following variables were explored: Age, Mechanism of Injury, Ambulance Pre-Alert Received, CT performed at trauma call, Transfer to the Operating Theatre within 4 hours of admission, Critical Care Admission, Hospital Length of Stay and Death within 30 days. We determined which trauma calls had been submitted to TARN by cross referencing with our submission database. Data were tested for normality (Shapiro-Wilk test) and appropriate statistical tests employed to determine differences between inclusion and non-inclusion groups. For categorical data we used Chi-squared tests to examine for differences.

**Results**

There were 6529 trauma team activations. Of these, 3837 (58.8%) patients were not registered on the TARN database. Patients excluded from TARN were significantly younger (mean 42.4 years SD 19.2) than those who met inclusion criteria (mean 50.3 years, SD 21.8), p<0.001 and were significantly more likely to suffer from penetrating trauma (18.6% vs. 8.2%, p<0.001), the majority (77.8%, 553/713) caused by stabbings. Patients excluded were less likely to be involved in a road traffic accident (31.1% vs. 35.3%, p<0.001), less likely to have fallen downstairs (15.2% vs. 18.7%, p<0.001) and less likely to have fallen from a height of greater than two metres (8.1% vs. 12.7%, p<0.001). Patients excluded from the TARN database were significantly more likely to be directly discharged within one day of admission (49.7% vs. 18.5%, p<0.001). For patients admitted for one day or more, patients excluded from TARN had significantly lower length of hospital stay (median 2.2 vs. 6.0 days, p<0.001).

**Discussion**

Patients who trigger a trauma call but who subsequently do not meet the criteria for TARN data submission place a significant burden on healthcare provision. To our knowledge this is the first investigation to specifically explore this group of at-risk patients. To enable medical planners and clinicians a more accurate view of activity on the ‘shop floor’, particularly in reference to knife crime injuries we ask the question as to whether a separate database should be held of trauma calls as currently occurs in the UK-Defence Medical Services. This proposal would require additional research and funding.

**Introduction**

Trauma remains a leading cause of death worldwide [1] and is the most common cause of death in 15-44-year olds in England and Wales [2]. Over the last decade there has been a reorganization of the Trauma services in England [3]. Any patient who suffers traumatic injury, with a pre-defined mechanism and/or derangement of physiological parameters [4] now bypasses non-specialist hospitals and is taken directly to a specialist regional major trauma Centre [5]. In the UK, data for trauma patients is prospectively collected locally and collated by “The Trauma Audit & Research Network” (TARN). However, not all patients who trigger a trauma call meet criteria for subsequent TARN data collection.

TARN data is an important audit and research tool to inform medical care [6,7]. There are specific inclusion criteria for submission to TARN depending on the injuries sustained, the length of stay, admission to critical care and transfer from another facility (Table 1) [8]. This data is used to compare performance between different centres in England and to monitor defined standards (e.g. CT imaging of the head should be performed within 1 hour of arrival for patients meeting the NICE Head Injury Criteria [9]). Hospitals must submit local data to TARN within 25 days of admission for best practice tariff payment eligibility [10].

[Table 1 Here]

Our institution has been a Major Trauma Centre (MTC) in the North West of England since 2012 and became the single receiving site for major trauma in Cheshire and Merseyside in 2016. There were over 1500 trauma calls in 2018. Our aim was to assess and describe the subgroup of patients who trigger a trauma call but who subsequently do not meet criteria for TARN data submission. To address this question, we performed a retrospective cohort study to examine all “trauma calls” admitted to Aintree University Hospital since 2012.

**Methods**

**Setting**

We conducted a single centre, retrospective observational study of trauma call admissions to Aintree University Hospital NHS Foundation Trust, Liverpool, UK. Aintree Hospital is a large teaching hospital in Liverpool. There are 706 inpatient beds, serving a population of 350,000 adults in North Liverpool, South Sefton and Kirkby (paediatric patients are served by a separate hospital). The hospital provides a full range of acute services including accident and emergency and acute medicine. Aintree is a tertiary referral centre for major trauma, head and neck surgery, upper gastrointestinal and hepatobiliary surgery. The accident and emergency department assess approximately 100,000 patients per year.

**Patients**

All patients who had attended the Emergency Department as a trauma team activation (trauma call) between 1 June 2012 to 31 August 2018 were included in the study.

**Data collection**

All patients who activated a trauma call in our institution were included. Patient data is prospectively recorded on an in-house database by a trauma nurse coordinator present at the trauma call and held on a secure network as a Microsoft ExcelTM (Redmond, Washington, US) Spreadsheet. As a major trauma centre, our centre is mandated to submit data to TARN according to their guidelines [8]. We reviewed all trauma calls and TARN submissions from the study period and determined which trauma calls were not included in the TARN submission data. The following variables were available for analysis: 1) Age, 2) Mechanism of Injury, 3) Ambulance Pre-Alert Received, 4) CT performed at trauma call, 5) Transfer to the Operating Theatre within 4 hours of admission, 6) Critical Care Admission, 7) Hospital Length of Stay and 8) Death within 30 days.

**Research approval**

Approval was granted from the Clinical Audit Department in our institution (CAMS/6955). No patient identifiable data were used in data synthesis or analysis.

**Statistical analysis**

Data were analysed using Stata V15 (StataCorp, Stata Statistical Software: Release 15, College Station, Texas, USA). Data were tested for normality (Shapiro-Wilk test) and appropriate statistical tests employed to determine differences between inclusion and non-inclusion groups. For categorical data we used Chi-squared tests to examine for differences. We considered that a p value of <0.05 demonstrated a significant difference between comparison groups as per convention.

**Results**

There were 6529 trauma team activations between 1 June 2012 to 31 August 2018. Of these, 3837 (58.8%) patients were not registered on the TARN database. Patients excluded from the TARN database (mean 42.4 years SD 19.2) were significantly younger than those who met inclusion criteria (mean 50.3 years, SD 21.8), p<0.001. Data on gender was not available for analysis. We observed that patients excluded from the TARN database were significantly more likely to suffer from penetrating trauma (18.6% vs. 8.2%, p<0.001) and that the majority of these (77.8%, 553/713) were caused by stabbings. In addition, patients excluded from TARN were less likely to be involved in a road traffic accident (31.1% vs. 35.3%, p<0.001), less likely to have fallen downstairs (15.2% vs. 18.7%, p<0.001) and less likely to have fallen from a height of greater than two metres (8.1% vs. 12.7%, p<0.001). Table 2 describes mechanism of injury data in more detail.

Patients excluded from the TARN database were significantly more likely to be directly discharged within one day of admission (49.7% vs. 18.5%, p<0.001). For patients admitted for one day or more, patients excluded from TARN had significantly lower length of hospital stay (median 2.2 vs. 6.0 days, p<0.001). We observed that the proportion of patients requiring urgent surgery, those requiring ICU admission and those who died within hospital were also lower in patients excluded from the TARN database (Table 3). However, there was no significant difference in the proportion of patients who required a trauma CT between the two groups (83.9% vs. 83.1%, p=0.433).

**[Table 2 Here]**

**[Table 3 Here]**

**Discussion**

Our study demonstrates that patients who trigger a trauma call but who subsequently do not meet the criteria for TARN data submission place significant burden on healthcare provision. To our knowledge this is the first investigation to specifically explore this group of at-risk patients. A trauma team activation requires the mobilisation of multiple highly skilled personnel increasing pressure on stretched emergency services. The majority of our patients who were excluded from TARN data collection required a CT scan and whilst length of stay and mortality were lower, a relatively high proportion of patients still required emergency surgery and intensive care admission. Our exploratory study highlights an important subgroup, but prospective multicentre studies are required to better define this patient population and explore potential socioeconomic costs.

The guidance on best practice tariffs in England stipulate that patients admitted to a major trauma centre (directly or emergency transfer) must be received by a consultant-led trauma team [10]. The composition of the Aintree University Hospital trauma team is described in Table 4. Over the study period there were 3837 (58.8%) trauma calls not included in our TARN submission, representing a substantial workload. TARN is currently the largest trauma database in Europe and is an important national resource for research, audit and service evaluation. The NHS is already over stretched and as there were so many of our trauma calls not included in our TARN submission, we ask the question as to whether there should be an alternative recording system for trauma calls at major trauma centres? This opens the door to a range of other discussions some of which will require additional resources themselves and are topics for future research. Questions include, 1) Are all trauma calls warranted? This itself requires continuous prospective audit by major trauma networks with targeted education to those activating a trauma call in the trauma cells. 2) Are there issues in our own data collection processes? We identified 151 cases not included in our TARN submission that subsequently were transferred to Critical Care and these cases should actually have been included. There were probably other patients that should have been included too and is an acknowledged limitation of our study. 3) Should the data collection itself be more automated? A future introduction of truly electronic notes may reduce the potential for human error and could mitigate this problem ensuring a higher quality of data.

**[Table 4 Here]**

Another question is whether we should look to include all patients with particular mechanisms of injury such as knife crime? In England and Wales, the use of a knife or other sharp instrument was the most common method of killing in homicide offences in 2017-18 [11] and 43,516 knife crime offences were committed in the 12 months ending March 2019 [12]. There were 553 patients involved in a stabbing and not reported in our TARN dataset. Creation of a specific database could facilitate triangulation between hospital and police. Knife crime is increasing and adding to the trauma workload of our MTCs. Reliable, real time data could assist quality improvement and community prevention projects. Moving forward, a database of all trauma calls would more allow a more accurate overview of the actual trauma workload on the ‘shop floor’ and better inform potential mortality improvements and educational needs. Considering hospital tariffs payments, we suggest that commissioners consider the application of best practice criteria to all patients who activate a trauma call. Payment could potentially be administered in two tranches dependent on admission to hospital for more than 24 hours.

The Joint Theatre Trauma Register (JTTR), complied by the UK-Defence Medical Services, is an established database that records all trauma team activations in UK Field Hospitals [13]. This model has successfully helped to transfer lessons learnt from recent conflicts in Iraq and Afghanistan to UK National Health Service practice. A civilian-military comparison was recently published using a local database in conjunction with the JTTR reviewing damage control laparotomies [14]. We suggest that TARN administrators consider incorporation of relevant components of this register to augment existing data collection activities.

In this exploratory study, we have identified an important gap in data collection for a group of patients who trigger trauma calls but are not formally recording using the TARN system. These patients require substantial healthcare resources which may not be recognised by current tariff systems. At the patient level, there were a disproportionate number of patients subject to stabbing injuries. Given national drives to better record and respond to knife crime [15], a more robust recording system with modified inclusion criteria for TARN data submission may be useful. There is a need for multicentre prospective studies to further investigate this patient subgroup and explore the socioeconomic impact.

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**Table 1.** TARN Eligibility Criteria (Taken from (8))

|  |
| --- |
| **1 All trauma patients irrespective of age who fulfil one of the following length of stay criteria** |
| 1. **Direct admissions**
* Trauma admissions whose length of stay is 3 days or more
* Trauma patients admitted to a high dependency area regardless of length of stay
* Deaths of trauma patients occurring in the hospital including the emergency department (even if the cause of death is medical)
* Trauma patients transferred to other hospital for specialist care or for an ICU/HDU bed.

OR1. **Patients transferred in**
* Trauma patients transferred into your hospital for specialist care or ICU/HDU bed whose combined hospital stay at both sites is 3 days or more
* Trauma admissions to a ICU/HDU area regardless of length of stay
* Trauma patients who die from their injuries (even if the cause of death is medical)
 |
| **2 Whose isolated injuries meet the following criteria**  |
| **Limb – below knee (except feet/toes)** * Any open injury.
* Any 2 limb fractures &/or dislocations.

**Pelvis** * All isolated fractures to ischium, sacrum, coccyx, ileum, acetabulum.
* Multiple pubic rami fractures.
* Single pubic rami fracture <65 years old.
* Any fracture involving SIJ or symphysis pubis.

**Nerve** * Any injury to sciatic, facial, femoral, cranial nerve or brachial plexus

**Vessel** * All injuries to femoral, neck, facial, cranial, thoracic or abdominal vessels.
* Transection or major disruption of any other vessel.
 | **Neck** * page5image468094848page5image468092256Any organ injury, injury to the carotid artery, vertebral artery or jugular veins, hyoid fracture

**Femoral fracture** * All shaft, distal, head or subtrochanteric fractures, regardless of age.
* Isolated neck of femur or inter/ greater trochanteric fractures **<65 years old**

**Foot or hand: joint or bone** * Crush or amputation only.

**Finger or toe (**None)**Limb – upper (except hands/fingers)** * Any open injury.
* Any 2 limb fractures &/or dislocations.
 | **Skin** * Laceration or penetrating skin injuries with blood loss >20% (1000mls)
* Major degloving injury (>50% body region).

**Burn** * Any full thickness burn or partial/superficial burn >10% body surface areanot referred to a burns unit

**Inhalation** * All included - if not referred to burns unit

**Frostbite (**Severe frostbite)**Asphyxia** **Drowning** **Explosion** **Hypothermia (a**ccompanied by another TARN eligible injury )**Electrical**  |

**Table 2.** Mechanism of injury for patients who activated a trauma call. Data is displayed as frequency and percentage. Statistical analysis conducted using Chi-squared tests.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Mechanism** | **Total****(%, n=6526)** | **TARN Exclusion****(%, n=3837)** | **TARN Inclusion****(%, n=2689)** | **P value** |
| **Penetrating trauma** | **14.3 (933)** | **18.6 (713)** | **8.2 (220)** | **<0.001** |
| Stabbing | 10.9 (710) | 14.4 (553) | 5.8 (157) | <0.001 |
| Self-harm (Stabbing) | 0.9 (57) | 1.5 (57) | 0.0 (0) | NA |
| Penetrating (non-specified) | 0.4 (28) | 0.6 (23) | 0.2 (5) | NA |
| GSW | 2.1 (135) | 2.1 (79) | 2.1 (56) | NA |
| Amputation | 0.1 (3) | 0.0 (1) | 0.1 (2) | NA |
| **Blunt Trauma** | **85.7 (5596)** | **81.4 (3124)** | **91.8 (2472)** | **<0.001** |
| Vehicle Incident | 32.9 (2144) | 31.1 (1194) | 35.3 (905) | <0.001 |
| Fall Downstairs | 16.7(1087) | 15.2 (584) | 18.7 (503) | <0.001 |
| Fall <2m | 14.0 (915) | 13.6 (523) | 14.6 (392) | 0.286 |
| Fall >2m | 10.0 (652) | 8.1 (310) | 12.7 (342) | <0.001 |
| Assault | 4.2 (277) | 4.9 (188) | 3.3 (89) | 0.002 |
| Blows | 1.4 (90) | 1.6 (60) | 1.1 (30) | NA |
| Crush | 1.4 (91) | 1.3 (50) | 1.5 (41) | NA |
| Self-Harm | 1.6 (106) | 1.7 (66) | 1.5 (40) | NA |
| Blast | 0.1 (6) | 0.1 (5) | 0.0 (1) | NA |
| Burn | 0.1 (8) | 0.1 (5) | 0.1 (3) | NA |
| Collapse | 0.2 (12) |  (0.2) 7 | 0.2 (5) | NA |
| Submersion | 0.0 (2) | 0.0 (1) | 0.0 (1) | NA |
| Other | 3.1 (203) | 3.4 (131) | 2.7 (72) | NA |

**Table 3.** Hospital admission and outcome data patients who activated a trauma call. Data is displayed as frequency and percentage unless indicated. CT: computed tomography; ICU: intensive care unit; LOS: length of stay Statistical analysis conducted using Chi-squared tests and unpaired t-test for hospital LOS.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **TARN exclusion** | **TARN inclusion** | **P value** |
| **Ambulance Pre-Alert** | 3346/3837 (87.2%) | 2390/2589 (92.3%) | <0.001 |
| **Trauma Call CT** | 3216/3835 (83.9%) | 2227/2679 (83.1%) | 0.433 |
| **Theatre <4hrs** | 189/3837 (4.9%) | 371/2688 (13.8%) | <0.001 |
| **ICU Admission** | 151/3837 (3.9%) | 578/2685 (21.5%) | <0.001 |
| **Hospital LOS (median, IQR)** | 2.2 (1.5-4.5) | 6.0 (3.7-10.1) | <0.001 |
| **Death within 30 days** | 76/3837 (2.0%) | 193/2692 (7.2%) | <0.001 |

**Table 4.** The composition and roles of a Complex Trauma Team at a typical Major Trauma Centre in England

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| --- | --- |
| **Role**  | **Function in the Trauma Team** |
| Team Leader [Emergency Department Consultant] | Allocation of roles to the teamMaintaining situational awareness |
| Primary Survey Doctor [Emergency Department Trainee ST3+] | Conducts the Primary Survey |
| Anaesthetist [Senior Trainee (ST5+)] | Airway management |
| Operator Department Practitioner (ODP)  | Assisting the AnaesthetistSetting up anaesthesia equipment |
| Radiographer | Portable x-ray |
| Orthopaedic Surgeon [ST4+] | Responsible for orthopaedic injuries |
| General Surgery [ST4+] | Responsible for surgical injuries |
| Runner [HCA] | Collects blood and blood products from the transfusion laboratory and other equipment as necessary |
| Emergency Department Nurse (1) | Obtaining intravenous access and blood transfusion |
| Emergency Department Nurse [2] | Drawing up intravenous medication |
| Scribe [Senior Nurse] | Accurately recording observations and drug administration |