

TRAUMA GOVERNANCE IN THE UK DEFENCE MEDICAL SERVICES

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Introduction

Clinical governance is concerned with the application and enforcement of good clinical practice [1-4] and the management of military trauma patients is no exception. To this end, a framework of governance has been implemented to facilitate best practice, and to ensure that Service personnel who are seriously injured on deployed operations receive exemplary care.

This paper describes the processes in place to capture data, interpret the data, and audit the process of trauma management in the UK Defence Medical Services.

OpEDAR

The Operational Emergency Department Attendance Register (OpEDAR) is a log of patients who have attended the Emergency Department (ED) of a Role 2 Enhanced (R2E) or Role 3 (R3) facility on operations. This is described in detail elsewhere [5].

Major Trauma Audit for Clinical Effectiveness (MACE)

Major Trauma Audit for Clinical Effectiveness (MACE) is a cyclical process of continuous quality improvement through clinical audit (Figure 1). Data on all seriously injured casualties treated by UK Defence Medical Services (UK military, coalition forces, detainees, civilian population) is collected by the deployed Trauma Nurse Co-ordinator and returned to the Joint Theatre Trauma Registry (JTTR) maintained by the Academic Department of Military Emergency Medicine (ADMEM) at the Royal Centre for Defence Medicine (RCDM) in Birmingham. JTTR holds continuous data on this cohort from 2003, coinciding with the start of hostilities in Iraq. Returns are electronic (where deployed IT systems allow), with hard copy accompanying UK military patients evacuated to RCDM for definitive care.

The default entry criterion for UK JTTR is a casualty who triggers trauma team activation in a deployed field hospital or Primary Casualty Receiving Facility afloat (Role 2 Enhanced and Role 3). Trauma team activation criteria are listed in Figure 2.

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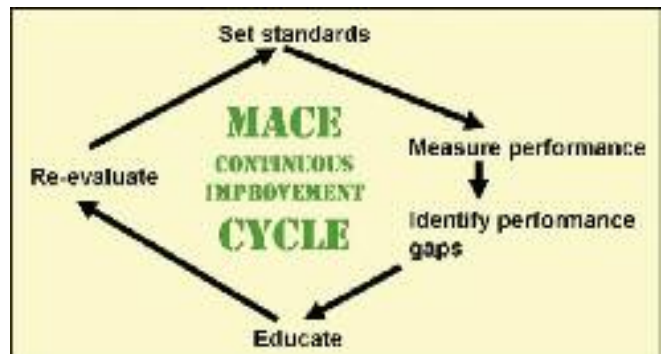


Figure 1: The MACE Continuous Improvement Cycle

TRAUMA TEAM ACTIVATION CRITERIA		PREPARATION 3
<p>MECHANISM / HISTORY</p> <p>Penetrating trauma Gunshot or shrapnel wound Blast injury (mine/IED/grenade) Stab wound</p> <p>Blunt trauma Motor vehicle crash with ejection Motorcyclist or pedestrian hit by vehicle >30 km/h Fall >5 metres Fatality in the same vehicle Entrapment and/or crush injury Inter-hospital trauma transfer meeting activation criteria</p>	<p>You may only receive a triage category and a mechanism of injury. For T1 casualties activate the Trauma Team.</p>	
and		
<p>ANATOMY</p> <p>Injury to two or more body regions Fracture to two or more long bones Spinal cord injury Amputation of a limb Penetrating injury to head, neck, torso, or proximal limb Burns >15% BSA in adults or >10% in children or airway burns Airway obstruction</p>	or	
<p>PHYSIOLOGY</p> <p>Systolic blood pressure <90mmHg or pulse >120 bpm (adults) Respiratory rate < 10 or > 30 per minute (adults); SpO₂ <90% Depressed level of consciousness or fitting Deterioration in the Emergency Department Age >70 years Pregnancy >24 weeks with torso injury</p>		

Figure 2: Trauma Team Activation Criteria (source: JDP 4-03.1, Clinical Guidelines for Operations).

The entry criteria have been expanded in 2007 to include all trauma patients returned to RCDM for definitive treatment, irrespective of whether a trauma team response was mandated. All UK Service deaths from trauma are subject to post mortem examination on repatriation: a representative of ADMEM attends all post mortem examinations and records the detailed findings within JTTR, subject to confirmation on receipt of the formal report of the Home Office Pathologist.

The continuous improvement of care is related to two distinct processes (Figure 3):

- i. A systematic evaluation of outcomes (including a series of performance indicators (PIs) and the analysis of all deaths) that are published as internal reports.
- ii. Near-real time clinical feedback from RCDM through weekly joint theatre clinical case conferences (JTCCC), conducted by telephone.

for example, ISS would score only one traumatic amputation in a patient with bilateral amputations, whereas NISS would score both.

The Abbreviated Injury Scale (AIS) was introduced by the American Medical Association and the Association for the Advancement of Automotive Medicine in 1971 to provide researchers with a simple numerical method for ranking and comparing injuries by severity, and to standardize the terminology used to describe injuries. It was modified in 1998 (AIS 98, still in common use) and in 2005. Each injury receives a unique 6-figure identifier code, followed by a grading of severity (from 1, 'minor', through 6, 'currently untreatable').

Box 1: The Abbreviated Injury Scale



Figure 3: The MACE process

Evaluation of outcomes

All injuries (detected by clinical examination, plain radiology, CT scan, operative findings and post mortem findings) are coded using the Abbreviated Injury Scale (AIS) and patients are then scored on the basis of injury severity (using Injury Severity Score, ISS [6] and New Injury Severity Score, NISS [7]). AIS 98 and AIS 2005 (Military) are both used.

AIS 2005 (Military) has been developed by the US military to overcome the inadequacies of AIS 98 in coding battle injuries, although it has yet to be validated [8]. NISS is a more reliable indicator of injury severity than ISS [9,10] particularly for the military population. ISS only allows one injury from each anatomical region to contribute to the total score. In the military population, multiple ballistic wounds commonly occur in the same body region causing distinct, significant injuries:

The Injury Severity Score (ISS) is an anatomical scoring system that can be used to predict probability of survival (Ps) following injury. The score ranges from zero (no injury) to 75 (injuries incompatible with life), although the probability does not fall in a linear fashion with a rising score. An ISS of 16 is associated with a mortality of ~10% and is the benchmark for classifying "major trauma".

ISS is calculated from the sum of the squares of up to three injury severity codes in up to three of six body regions. Only the most serious injury in any one region is permitted to be counted.

The New Injury Severity Score (NISS) recognises that multiple injuries in the same body region can adversely affect outcome and scores up to three injuries irrespective of the body region.

Box 2: ISS and NISS

Performance measurement assesses both the performance in relation to an individual patient and overall system performance. Clinical effectiveness in managing the individual patient is assessed by:

- i. Identification of unexpected survivors and unexpected deaths using internationally accepted mathematical models to predict probability of survival (TRISS Methodology [11] and A Severity Characterisation of Trauma, ASCOT [12]).
- ii. Peer review of all deaths and peer review of all unexpected outcomes.

Peer review is essential in order to validate the mathematical prediction [13,14]. Review of all deaths is done jointly with military clinicians, the Home Office pathologist and experts in combat body armour development [15]. Unexpected deaths identify system weaknesses, whereas unexpected survivors identify system strengths that require reinforcement. Attendance by ADMEM at each post mortem identifies clinical practice issues, which are actioned in near real-time (within days of occurrence) through the chain of command and the weekly Joint Theatre Clinical Case Conference. This telephone conference has proved to be a powerful driver for immediate change.

System effectiveness and benchmarking against military allies delivering combat casualty care as well as against NHS standards is an important component of trauma system quality assurance [16]. Benchmarking tools include the Standardised Mortality Ratio (SMR, Box 3) and Wesson's Criteria (E value, described later), the number of unexpected survivors in a matched trauma population, performance against specific clinical performance indicators, and clinical timelines.

$$\text{SMR} = \frac{\text{Observed deaths}}{\text{Expected deaths (TRISS)}}$$

Those with a TRISS probability of survival <50% are expected deaths.

A ratio >1.0 implies a reduced performance and <1.0 implies a better performance than Major Trauma Outcome Study standard norms.

Box 3: Standardised Mortality Ratio (SMR)

The use of AIS 2005 (Military) will facilitate benchmarking with our principal allies; parallel coding with AIS 98 will allow comparison with NHS civilian performance nationally.

Probability of survival (Ps) is measured using TRISS Methodology. This is a complex mathematical formula (Box 4) that takes into account the anatomical injuries (using the ISS) and the physiological derangement on arrival at the Emergency Department (using the Revised Trauma Score, which is the sum of a weighted numerical representation of the respiratory rate, systolic blood pressure and the Glasgow Coma Score). A Ps of <50% identifies an expected death, while a Ps of >50% identifies an expected survivor. The limitations of ISS are translated into limitations of TRISS.

TRISS Methodology estimates the probability of survival through a combination of the Revised Trauma Score (probability related to physiology on first presentation at hospital) and ISS (probability related to anatomical injury). A crude account is taken of the patient's age (above or below 55 years). A series of coefficients are used in the equation and these differ for blunt or penetrating trauma.

Box 4: TRISS Methodology

A Severity Characterisation of Trauma, ASCOT, is a second international standard mathematical predictive tool, but it is expressed as a predicted death rate (PDR) rather than Ps (Box 5).

ASCOT includes an assessment of injury severity by body region and has an improved classification to take account of the patient's age. It also uses a series of coefficients that differ for blunt or penetrating trauma. The most important difference over TRISS is that it takes account of all injuries classified serious, severe or critical (AIS 3, 4 or 5).

Box 5: ASCOT Methodology

TRISS and ASCOT do not always concur in their prediction of survival and this is a recognised limitation of trauma audit: it emphasises the requirement for peer review if either of these models predicts an unexpected outcome.

The clinical effectiveness of a trauma system can also be measured using Wesson's Criteria ("E" Value). Although crude, this recognised standard allows comparisons between trauma systems. Wesson's Criteria incorporates major trauma patients with an ISS of 16-59, while those with an ISS ≥60 are excluded on the grounds that they are unsalvageable: specifically, it is the ratio of patients who were salvageable and survived to the total who were deemed salvageable.

When using ISS (rather than NISS) and/or AIS 98 (rather than AIS 2005 Military), Wesson's Criteria will potentially demonstrate under-performance of the deployed military trauma system. It must also be recognised that Wesson's Criteria does not take any account of the tactical military environment. A casualty with "survivable" injuries may die because no help can reach them due to an on-going fire-fight or other confounding factors (eg entrapment in a minefield).

An assessment of the "preventability" of all deaths is therefore undertaken by peer review, alongside the assessment of clinical "survivability", where preventability relates to an assessment of the tactical situation.

Standards for individual aspects of clinical care are measured by performance indicators (PIs), based on best available evidence. 68 PIs are currently captured in 9 domains (pre-hospital care; emergency department resuscitation; operative care; critical care; post-operative care; ward care; follow-up care; and burns).

Education

Education is an essential component of the MACE process. The accuracy of JTTR is entirely dependent on the quality of data collected by the Trauma Team Scribe and the deployed Trauma Nurse Co-ordinator. Education for deploying Trauma Nurse Co-ordinators (TNCs) against the MACE curriculum is undertaken within HOSPEX (a hospital exercise that constitutes part of pre-deployment training for deploying medical units). While deployed, day-to-day feedback is provided from ADMEM to deployed TNCs by phone or e-mail regarding clinical outcomes (and post mortem findings where necessary). Regular in-theatre Trauma Clinical Case Conferences have historically been encouraged since 1999 [17], but these have been succeeded by the weekly Joint Theatre Clinical Case Conference (JTCCC).

Critical event reporting

Critical event reporting (by patients returned to RCDM and by deployed clinicians) and analysis of both clinical practice weaknesses and emerging injury trends have been used to trigger organisational change. In some instances formal academic review has been stimulated, which has been used to shape policy and clinical doctrine, pre-deployment training and operational clinical practice. Examples include the provision of topical haemostatics [18], the effectiveness of battlefield analgesia [19], the competencies of the Medical Emergency Response Team (MERT)[20] and a timelines review in relation to outcomes [21].

Operational trauma reports

As a product of MACE, trauma registry analysis reports have been periodically produced for specific phases of deployment (22, 23). These serve as a summary of the epidemiology of injury and an aid to planning of future resource utilisation. Evidence from JTTR analysis is informing changes to equipment and clinical practice, and providing the necessary background to support proposals for both clinical and protective systems research. There is close liaison with Defence Analytical and Statistical Agency (DASA) in the preparation of reports to ensure consistency in published headline rates (KIA, DOW, WIA, Casualty Fatality Rate) and expert advisory support from both Defence Science and Technology Laboratories (Dstl) and Defence Clothing Implementation Project Team (DC IPT) in the interpretation of how patterns of injury and outcomes can direct future vehicle and personal protection.

JTCCC

The Joint Theatre Clinical Case Conference (JTCCC) is held weekly and is co-ordinated by ADMEM in Birmingham. The telephone conference uses a star phone at each location, with participation from in-theatre clinicians on TELIC (Iraq) and HERRICK (Afghanistan), RCDM (military and civilian clinicians), the Defence Rehabilitation Centre (Headley Court) and RAF Brize Norton (co-ordinating all aeromedical movements).

Structured feedback is provided on patients admitted during the previous 2 weeks (with written case summaries forwarded the previous day via a secure e-mail system). The conference has repeatedly highlighted issues that are relevant across both operational theatres and is the catalyst for rapid policy change, co-ordinated by the Director of Medical Policy in Defence Medical Services Directorate (the action addressee for the weekly minutes). Confidentiality is assured by referring to patients only by their Field Hospital admission numbers.

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