To improve the applicability and usability of the MPTT we increased the upper respiratory rate threshold to 24 breaths per minute (MPTT-24), to make it divisible by four, and included an assessment of external catastrophic haemorrhage. The aim of this study was to conduct a feasibility analysis of the proposed MPTT-24 (figure 1).

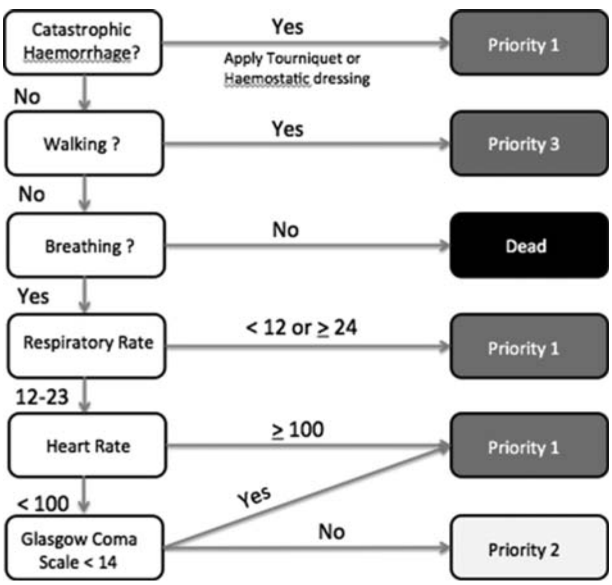


**Figure 1** MPTT-24

**Methods** A retrospective review of the Joint Theatre Trauma Registry (JTTR) and Trauma Audit Research Network (TARN) databases was performed for all adult (≥18 years) patients presenting between 2006–2013 (JTTR) and 2014 (TARN). Patients were defined as priority one (P1) if they had received one or more life-saving interventions.

Using first recorded hospital physiology, patients were categorised as P1 or not-P1 by existing triage tools and both MPTT and MPTT-24. Performance characteristics were evaluated using sensitivity, specificity, under and over-triage with a McNemar test to determine statistical significance.

**Results** Basic study characteristics are shown in Table 1. Both the MPTT and MPTT-24 outperformed all existing triage methods with a statistically significant (p<0.001) absolute reduction of between 25.5%–29.5% in under-triage when compared to existing UK civilian methods (NARU Sieve). In both populations the MPTT-24 demonstrated an absolute reduction in sensitivity with an increase in specificity when compared to the MPTT. A statistically significant difference was observed between the MPTT and MPTT-24 in the way they categorised TARN and JTTR cases as P1 (p<0.001).

**Table 1** Study characteristics

| | JTTR (2006-2013) | TARN (2006-2014) |
|---|---|---|
| Number cases | 3,654 | 127,233 |
| Male N, % | 3,593 (98.3%) | 70,747 (55.6%) |
| Age, Median (IQR) | 24 (21-29) | 61.4 (43.1-80.0) |
| ISS, Median (IQR) | 5 (2-16) | 9 (9-16) |
| Mortality | 2.1% | 5.7% |
| Mechanism of injury N,% | Explosive. 2,012, 55.1%<br>GSW. 1252, 34.3% | Fall < 2m. 18,141, 14.3%<br>RTC. 27915, 21.9% |
| Injured body region N,% | Lower extremities. 1317, 36.0%<br>Upper extremities. 593, 16.2% | Limb. 43,989, 34.6%<br>Head. 24,732, 19.4% |
| Priority One N,% | 1738, 47.6% | 24,791, 19.5% |

**Conclusion** Existing UK methods of primary major incident triage, including the NARU Sieve, are not fit for purpose, with unacceptably high rates of under-triage. When compared to the MPTT, the MPTT-24 allows for a more rapid triage assessment and continues to outperform existing triage tools at predicting need for life-saving intervention. Its use should be considered in civilian and military major incidents.

## 3 DERIVATION AND INTERNAL VALIDATION OF A CLINICAL DECISION RULE TO GUIDE WHOLE BODY COMPUTED TOMOGRAPHY SCANNING IN TRAUMA

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**Background** There are no widely accepted validated clinical decision rules for the use of WBCT in trauma. Given the potential risks and costs, there is a clear need for a clinical decision rule (CDR) to safely guide targeted use of WBCT. We aimed to derive a CDR to guide clinical decisions on WBCT utilisation by detecting patients at high and low risk of multi-region trauma.

**Methods** We retrospectively identified consecutive patients who had presented to a major trauma centre with suspected major trauma. Study took place at Aintree University Hospital, Merseyside. After extracting data, we derived a clinical decision rule for detection of multi-region trauma by logistic regression and recursive partitioning. The primary outcome was defined as injuries of AIS≥2 in two or more body regions, while the secondary outcome was the presence of two injuries of AIS≥3 in two or more body regions. This rule was cross-validated on the original sample using bootstrapping.

**Table 2** Performance analysis

| | JTTR | | | | TARN | | | |
|---|---|---|---|---|---|---|---|---|
| | *Sensitivity* | *Specificity* | *Under-triage* | *Over-triage* | *Sensitivity* | *Specificity* | *Under-triage* | *Over-triage* |
| **MPTT-24** | 66.3% (64.1-68.5) | 69.9% (67.8-71.9) | 33.7% | 33.4% | 53.5% (52.9-54.1) | 74.8% (74.6-75.1) | 46.5% | 66.0% |
| **MPTT** | 69.5% (67.3-71.6) | 65.3% (63.2-67.4) | 30.5% | 35.5% | 57.8% (56.9-58.2) | 71.5% (71.3-71.8) | 42.5% | 67.1% |
| **NARU Sieve/ UK Military Sieve** | 43.2% (40.9-45.6) | 93.7% (92.5-94.7) | 56.8% | 13.9% | 28.0% (27.5-28.6) | 94.1% (93.9-94.2) | 72.0% | 46.7% |
| **MIMMS Triage Sieve** | 24.2% (22.2-26.3) | 94.8% (93.8-95.7) | 75.8% | 19.1% | 12.9% (12.5-13.4) | 96.7% (96.5-96.8) | 87.1% | 51.6% |
| **START (US)** | 38.1% (35.8-40.4) | 96.9% (96.1-97.6) | 61.9% | 8.1% | 28.8% (28.2-29.4) | 94.3% (94.2-94.5) | 71.2% | 45.0% |
| **Careflight (AUS)** | 32.9% (30.7-35.2) | 98.4% (97.8-98.9) | 67.1% | 5.0% | 23.6% (23.1-24.1) | 95.9% (95.7-96.0) | 76.4% | 42.1% |

MPTT: *12<RR≥22, HR≥100, GCS<14*, NARU Sieve/UKMilitary Sieve: *10<RR>30, HR>120, GCS<13*, MIMMS Triage Sieve: *10<RR>30, HR>120*, START: *RR≥30, SBP<90, GCS<13*, Careflight: *SBP<90, GCS<13*

Step 1. Calculate Physiological score

| Characteristic | Score | Tick box |
|---|---|---|
| Age ≥ 55 | 4 | |
| Oxygen Saturations ≥ 95 | 0 | |
| Oxygen Saturations 94—88 | 7 | |
| Oxygen Saturations <88 | 16 | |
| Respiratory rate <24 | 0 | |
| Respiratory rate 24—37 | 4 | |
| Respiratory rate ≥ 38 | 9 | |
| Heart rate <100 | 0 | |
| Heart rate 100 — 119 | 5 | |
| Heart rate ≥ 120 | 7 | |
| SBP ≤ 90 | 12 | |
| SBP 91 — 105 | 6 | |
| SBP 106 — 120 | 4 | |
| SBP > 120 | 0 | |
| GCS ≤ 10 | 10 | |
| GCS 11 – 14 | 7 | |
| GCS = 15 | 0 | |

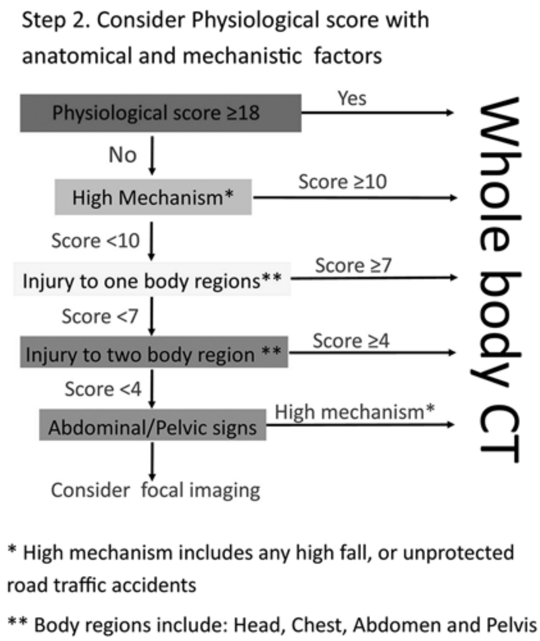


**Figure 1**

**Results** 1608 patients were included in the study. The derived model combined a bespoke physiological score with mechanistic and anatomical factors. The physiological score identified the risk of multi-region injury at various cut-offs of age, systolic blood pressure, GCS, heart rate and respiratory rate. Patients were further categorised according to mechanism of injury and clinical findings, and specific physiological scores were applied to each category to determine which patients in these categories required WBCT. 'High risk' injury mechanisms included high falls and unprotected road traffic collisions. Clinical signs of injury were categorised by body region, including the head, chest, abdomen and pelvis (figure 1). The overall sensitivity of the clinical decision rule for the primary objective was 96.0% (95% CI:94.8 to 97.2) while the specificity was36.1% (95% CI:33.3 to 39.0). The negative likelihood ratio was 0.11. For the secondary objective the sensitivity was 98.5%, the negative likelihood ratio 0.04.
**Conclusion** This study derived a two stage CDR which was highly sensitive for identifying patients at high risk of multiregion injury. A prospective external validation study is now required to further refine and improve this model. This could provide a useful screening tool in the future.

## 4 THE RISK OF DETERIORATION IN CT IDENTIFIED MILD TRAUMATIC BRAIN INJURY: A SYSTEMATIC REVIEW AND META-ANALYSIS

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**Background** The optimal management of minor head injured patients with brain injury identified by CT imaging is unclear. Some guidelines recommend routine hospital admission of GCS13–15 patients with traumatic brain (TBI) injury identified by CT imaging. Others argue that selected lower-risk patients can be discharged from the Emergency Department (ED).
**Objective** To estimate the risk of death, neurosurgery and clinical deterioration minor head injured patients with TBI identified by CT imaging, and assess which factors affect the risk of these outcomes.
**Methods** A systematic review and meta-analysis adhering to PRISMA standards of reporting. Four electronic data bases and a range of additional literature were searched using a

| Factor | Unit Increase Affect Odds Univariable Model | Unit Increase Affect Odds Multivariable Model |
|---|---|---|
| Mean Age Study Population | 1.01 (95% C.I. 1.02- 1.11) P=0.01 | 1.09 (95% C.I. 1.02-1.16) P=0.02 |
| Mean GCS Study Population | 0.71 (95% 0.01- 0.56) P=0.01 | 0.12 (95% C.I. 0.02- 0.91) P=0.04 |
| Lower risk study population versus ICU population | 0.13 (95% C.I. 0.04- 0.41) P<0.01 | 0.67 (95% C.I. 0.10- 4.37) P=0.66 |
| Unselected study population versus ICU population | 0.95 (95% C.I. 0.43- 2.12) P=0.90 | 1.34 (95% C.I. 0.45-4.02) P=0.58 |
| Percentage population Anticoagulated | 1.1 (95% C.I. 1.01-1.19) P=0.04 | |
| Exclusion of anti-coagulated patients in study selection | 0.63 (95% C.I. 0.27- 1.43) P=0.26 | 1.33 (95% C.I. 0.51- 3.49) P=0.54 |

**Figure 1** Risk of neurosurgery stratified by the initial GCS of the study population

# 3 Derivation and internal validation of a clinical decision rule to guide whole body computed tomography scanning in trauma

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