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Assessing trauma care provider judgement in the prediction of need for life-saving interventions

Amechi N. Anazodo [a,*], Sarah B. Murthi [c], M. Kirsten Frank [b], Peter F. Hu [a,c], Lauren Hartsky [b], P. Cristina Imle [a], Christopher T. Stephens [c], Jay Menaker [c], Catriona Miller [b], Theresa Dinardo [c], Jason Pasley [b,c], Colin F. Mackenzie [a]

[a] Shock Trauma & Anesthesiology Research (STAR) Center, University of Maryland School of Medicine, USA
[b] USAF Center for Sustainment of Trauma and Readiness Skills (C-STARS), Baltimore, MD, USA
[c] R Adams Cowley Shock Trauma Center, University of Maryland Medical Center, USA

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ABSTRACT

Introduction: Human judgement on the need for life-saving interventions (LSI) in trauma is poorly studied, especially during initial casualty management. We prospectively examined early clinical judgement and compared clinical experts' predictions of LSI to their later occurrence.

Patients and methods: Within 10–15 min of direct trauma admission, we surveyed the predictions of pre-hospital care providers (PHP, 92% paramedics), trauma centre nurses (RN), and attending or fellow trauma physicians (MD) on the need for LSI. The actual outcomes including fluid bolus, intubation, transfusion (<1 h and 1–6 h), and emergent surgical interventions were observed. Cohen's kappa statistic (K) and percentage agreement were used to measure agreement among provider responses. Sensitivity, specificity, negative predictive value (NPV) and positive predictive value (PPV) were calculated to compare clinical judgement to actual patient interventions.

Results: Among 325 eligible trauma patient admissions, 209 clinical judgement of LSIs were obtained from all three providers. Cohen's kappa statistic for agreement between pairs of provider groups demonstrated no "disagreement" ($K < 0$) between groups, "fair" agreement for fluid bolus ($K = 0.12$–0.19) and blood transfusion 0–6 h ($K = 0.22$–0.39), and "moderate" ($K = 0.45$–0.49) agreement between PHP and RN regarding intubation and surgical interventions, but no "excellent" ($K \geq 0.81$) agreement between any pair of provider groups for any intervention. The percentage agreement across the different clinician groups ranged from 50% to 83%. NPV was 90–99% across providers for all interventions except fluid bolus.

Conclusions: Expert clinical judgement provides a benchmark for the prediction of major LSI use in unstable trauma patients. No excellent agreement exists across providers on LSI predictions. It is possible that quality improvement measures and computer modelling-based decision-support could reduce errors of LSI commission and omission found in resuscitation at major trauma centres and enhance decision-making in austere trauma settings by less well-trained providers than those surveyed.

Introduction

Understanding how provider-related decisions impact patient care is critical in efforts to improve care in trauma settings [1]. However, as research and systems development progresses towards the increasing automation of monitoring and decision-assist technology [2–5], particularly to support trauma care in forward-deployed, field, and austere settings, the factoring-in of clinical judgement constants has lagged. Human judgement is complex, influenced by a myriad of social and individual factors, and very difficult to quantify in a manner accessible to math-based systems. In this era of protocol-driven emergency and trauma care, provider judgement is therefore undervalued and understudied. Much of this clinical judgement happens in the background and is particularly uncertain with regard to the anticipation of future

* Corresponding author at: Shock Trauma & Anesthesiology Research (STAR) Center, University of Maryland School of Medicine, 11 South Paca Street, Suite LL01, Baltimore, MD 21201, USA. Tel.: +1 410 328 1252; fax: +1 410 328 7230.
E-mail address: aanazodo@stapa.umm.edu (A.N. Anazodo).

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events [6–10]. In preventable trauma deaths, issues with clinical judgement have been found to occur more frequently than those related to skill [11,12]. Additionally, errors of commission and omission leading to trauma mortality still occur even in mature trauma centres [11,13]. Given that most trauma deaths occur within the first 24 h after injury [14], research and development strategies aimed at decreasing trauma mortality must include understanding and improving clinical prognostication as the trigger for timely and effective treatment of potentially fatal injuries.

As part of our ongoing research into human factors in trauma care and developing computer support systems for the next generation of forward-deployable clinical monitoring and decision-assist instrumentation, we asked whether documenting and assessing key prognostic decisions made by three groups of trauma care clinicians—field medical personnel and trauma centre nurses and physicians involved as the patient was being admitted—regarding the proximate need for selected life-saving interventions (LSIs), could provide key insights into the early decision-making process in trauma care. Our goal in this work was assessing the possibility of incorporating such clinically-derived benchmarks into automated clinical instrumentation systems. We therefore undertook a prospective, questionnaire-based study to compare the predictions made by pre-hospital care providers (PHPs), trauma nurses (RNs), and trauma physicians (MDs) in predicting the need for blood transfusion, fluid bolus, intubation, and surgical interventions in critical and unstable trauma patients in the first 24 h of advanced trauma care.

Approval for this prospective, survey-questionnaire-based study was obtained from the University of Maryland, Baltimore and Air Force Institutional Review Boards (IRBs) prior to commencing the study.

Patients and methods

Procedures

After securing the appropriate approvals from the IRBs, we reviewed study procedures and recording instruments with all relevant personnel. These included the dedicated clinical research personnel deployed in the trauma resuscitation unit (TRU) at all times, trauma critical care providers (trauma attending staff, trauma fellows, and specialist registered nursing staff) at our Level I regional adult trauma referral centre and the Maryland State Emergency Medical System (EMS) with which our centre is associated. Informed consent was secured from all TRU attending staff, fellows, and nursing staff. A waiver of the need to document informed consent was approved by all IRBs for the EMS providers. No unique identifying information was collected on the individual PHP other than their years of experience ($\geq$3 years or $<$3 years) and their status as emergency medical technician (EMT) or paramedic levels of training. Nurses were also asked their years of experience ($\geq$3 or $<$3 years) on the survey.

All such providers involved in the care of adult ($\geq$18 years old) trauma patients eligible for inclusion in two associated studies [15,16] were eligible to participate in this study. Trauma patients were admitted directly from the scene of injury with a pre-hospital abnormal shock index [SI] $\geq$0.62 (SI = heart rate/minute [HR]/systolic blood pressure mmHg [SBP]) called in from the field or who were categorised as Priority 1 (critically ill or injured person requiring immediate attention; or unstable patient with life-threatening injury or illness) with or without pre-hospital vital signs per initial field triage. Participating clinicians who had received casualty demographics (age, sex), vital signs, mechanism of injury, and mode and priority of transport called in by radio from the field pre-hospital providers were asked to record, within 10 min of patient arrival, their clinical judgement of the need for LSI likely to be required by that patient at designated intervals within the next 12 h and for blood transfusion up to 24 h. Clinical judgement was recorded via one of three, single-page, pre-validated, survey forms—PHP, RN, or MD (Figs. 1–3, respectively). Forms were collected immediately by research staff and results recorded in the study database.

To avoid the conflict that both the need for the intervention and instituting the intervention were decided upon by the same person, the nurse survey was completed by an experienced nurse not involved in patient care, the field care providers had no input into the in-hospital treatment or decisions about LSI, and the physicians surveyed were consultant (attending) or fellow level in supervisory positions not related directly with details of LSI implementation (such as fluid bolus) that occurred following Advanced Trauma Life Support® guidelines. Providers evaluated the patient based on initial presentation (vital signs, primary survey and EMS history). Providers were then asked to respond on their respective survey forms in yes/no fashion as to whether they thought that any of 12 LSIs listed would be required within the next 12–24 h. Four main LSIs were assessed: fluid bolus, intubation, transfusion, and surgical interventions. Others included cardiopulmonary resuscitation (CPR), medications, use of tourniquets or inflatable splints, etc. Regarding transfusion, three potential timeframes for the requirement for red blood cell transfusion were queried: $<$1 h, 1–6 h, or 7–24 h. The surgical interventions assessed included emergent surgery to control intra-abdominal haemorrhage, other surgery related to trauma such as pelvic stabilization or other orthopaedic surgery, emergent angiography/embolization, and chest tube insertion. Survey forms were completed by the respective clinicians in separate areas of the TRU and respondents were blinded to the responses of the other subjects.

ONPOINT CLINICAL JUDGMENT SURVEY

CIRCLE Approx time after admission form completed: 0-5 min 5-10 min More than 10 min	CIRCLE EMT Paramedic < 3 yr experience ≥ 3 yr experience	Study ID# TRU Bay

Life Saving Interventions:	Completed in field? Yes	In your judgment, will this patient need the following? Yes	No
CPR	☐	☐	☐
BLOOD / PLASMA			
STAT (unxmatched)		☐	☐
Type & Cross (1-6 hrs)		☐	☐
ICU (7-24 hrs)		☐	☐
INTUBATION	☐	☐	☐
CHEST DECOMPRESSION	☐	☐	☐
CHEST TUBE		☐	☐
EMERGENCY THORACOTOMY		☐	☐
EMERGENCY SURGERY (bleeding control)		☐	☐
PERICARDIOCENTESIS (cardiac tamponade)		☐	☐
TOURNIQUET	☐	☐	☐
PELVIC BINDER	☐	☐	☐
INFLATABLE SPLINTS	☐	☐	☐
FLUID BOLUS (≥1000ml/hr)	☐	☐	☐
CODE MEDS	☐	☐	☐
Do you suspect?			
BLEEDING IN CHEST		☐	☐
BLEEDING IN ABDOMEN		☐	☐
BLEEDING IN HEAD		☐	☐

Fig. 1. Pre-hospital care provider clinical judgement survey form.