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Validation of international trauma scoring systems in urban trauma centres in India

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ABSTRACT

Introduction: In the Lower-Middle Income Country setting, we validate trauma severity scoring systems, namely Injury Severity Score (ISS), New Injury Severity Scale (NISS) score, the Kampala Trauma Score (KTS), Revised Trauma Score (RTS) score and the TRauma Injury Severity Score (TRISS) using Indian trauma patients.

Patients and methods: From 1 September 2013 to 28 February 2015, we conducted a prospective multi-centre observational cohort study of trauma patients in four Indian university hospitals, in three megacities, Kolkata, Mumbai and Delhi. All adult patients presenting to the casualty department with a history of injury and who were admitted to inpatient care were included. The primary outcome was in-hospital mortality within 30-days of admission. The sensitivity and specificity of each score to predict inpatient mortality within 30 days was assessed by the areas under the receiver operating characteristic curve (AUC). Model fit for the performance of individual scoring systems was accomplished by using the Akaike Information criterion (AIC).

Results: In a registry of 8791 adult trauma patients, we had a cohort of 7197 patients eligible for the study. 4091 (56.8%)patients had all five scores available and was the sample for a complete case analysis. Over a 30-day period, the scores (AUC) was TRISS (0.82), RTS (0.81), KTS (0.74), NISS (0.65) and ISS (0.62). RTS was the most parsimonious model with the lowest AIC score. Considering overall mortality, both physiologic scores (RTS, KTS) had better discrimination and goodness-of-fit than ISS or NISS. The ability of all Injury scores to predict early mortality (24 h) was better than late mortality (30 day).

Conclusion: On-admission physiological scores outperformed the more expensive anatomy-based ISS and NISS. The retrospective nature of ISS and TRISS score calculations and incomplete imaging in LMICs precludes its use in the casualty department of LMICs. They will remain useful for outcome comparison across trauma centres. Physiological scores like the RTS and KTS will be the practical score to use in casualty departments in the urban Indian setting, to predict early trauma mortality and improve triage.

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Introduction

Lower-middle income countries (LMICs) pay the price of a growing volume of trauma, as collateral damage for development, rapid urbanization and sociodemographic transition [1]. In High Income Countries (HICs), the 30-day fatality criteria (dying within 30 days of injury) as recommended by the Global Road Safety report, is used to compare countries and their commitment to road safety [2]. The current decade of action for road safety (2011–2020), advocates for a 'post-crash response' with appropriate care, including prehospital care, in-hospital care and post-discharge rehabilitation, for individuals who have sustained trauma. In-hospital trauma mortality is proportionally higher in LMICs as compared to HICs [3].

Understanding the factors associated with the observed differences in mortality between patients undergoing in-hospital trauma care in LMIC and HIC presents substantial challenges. The lack of a standard and uniform system for quantification of trauma severity is a drawback for researchers seeking to study systems of trauma care in multiple settings. A standardized measure of trauma severity is needed to ensure a fair and meaningful comparison of outcomes and effectiveness of trauma care among different settings with differing case-mix, within and across countries. Trauma severity scoring systems have been designed to estimate the mortality risk based upon specific combinations of factors associated with patient injuries.

The scoring systems used to quantifying injury severity in HIC settings have historically relied upon anatomical measures of derangement while those predominant in LMICs have relied more heavily on measures of physiological derangement which limits comparability across HIC and LMIC trauma centres [4,5]. The anatomy-based scoring systems rely on imaging technologies, such as Computed Axial Tomography (CT) scans, prehospital care information, access to surgical intervention, quality intraoperative documentation and autopsy reports which may be unavailable in many LMIC trauma care facilities, thereby preventing the accurate calculation of Injury severity scores (ISS).

Neither consensus-based scoring systems nor data-driven trauma severity scoring systems have been well-researched in the LMIC setting. Therefore, our aim was to validate commonly used trauma severity scoring systems ranging from the purely anatomy-based Injury Severity Score and New Injury Severity Scale (NISS) score, to more physiology-focused scores, including the Kampala Trauma Score (KTS) and the Revised Trauma Score (RTS) score, as well as the combined score TRauma Injury Severity Score (TRISS), both within and across facilities treating substantial numbers of trauma patients in India.

Patients and methods

Study design, context and setting

This prospective multi-centre observational cohort study was conducted under the guidance of the collaborative research consortium "Towards improving trauma care outcomes" (TITCO-India) [6] from 1 September 2013 to 28 February 2015 in four Indian teaching and referral hospitals, each of which operate trauma units that receive citywide referral of trauma patients. The megacities (populations of more than 10 million) were geographically representative of urban India, namely Kolkata, Mumbai (2-centres) and Delhi. The centres were the Apex Trauma Centre of the All-India Institute of Medical Sciences (AIIMS), New Delhi; Lokmanya Tilak Municipal General Hospital (LTMGH), Mumbai; KEM hospital, Mumbai; and the Seth Sukhlal Karnani Memorial Hospital (SSKM), Kolkata. The Apex trauma centre in Delhi is a standalone trauma-care facility while the other three centres operate trauma-specific units providing trauma services as a part of a general hospital. All facilities were classified as 'free-to-public' indicating nominal fees to users facilitating access to care to the lower socio-economic strata of the population.

Eligibility criteria

All adult patients ($\geq$ 15 years of age) presenting to the casualty department during the study period with a history of injury associated with a mechanism of road traffic, railway, fall, assault or burns and who were admitted to inpatient care at the index hospital were included. Patients who were dead on arrival were not included.

Dependent and independent variables

The primary outcome of interest was in-hospital mortality within 30-days of admission [7]. The secondary outcomes were 1. Mortality within 24-h, 2. Mortality between 24 h and 7 days, 3. Mortality between 7 and 30 days. For each included individual, patient-specific demographic factors including age and sex, as well as injury and pre-hospital treatment factors such as transfer status, mode of transport, and mechanism of injury were collected. Physiological measures at the time of initial assessment were recorded, including Systolic Blood Pressure (SBP), Glasgow Coma Scale (GCS) score, respiratory rate (RR), heart rate (HR) and oxygen saturation.

Data

To ensure consistency in data quality at each participating site, one data collector prospectively gathered data during the initial assessment using a standardized intake form for eight hours per day by directly observing the providers who were delivering trauma care and recording vital signs. This data collector served only as an observer and was not involved in patient care. At each site, the data collector, who was funded externally by TITCO-India, rotated through all 8-h shifts (morning, evening, night), and also on public holidays. For patients admitted outside of the 8-h 'directly observed' shift, data were retrieved from patient case records within days of initial presentation. Collected data were uploaded to a central database on a weekly basis and the authors (NR, MG, VK, MK) conducted weekly data review meetings. All data collectors had at minimum a health science master degree and were continuously trained and supervised throughout the study period.

Injury severity scores

Baker et al., in 1974 [8], proposed ISS as an anatomical score that incorporates Abbreviated Injury Scale (AIS) in six body regions. In our study a single surgeon (DKV) accredited by the Association for the Advancement of Automotive Medicine (AAAM) calculated the ISS. The ISS has the advantage of converting all injuries in a trauma patient into a single number. However, though ISS appears to be a continuous variable (0–75), due to its sum of squares calculation formula, some integers are mathematically not possible. The impossible integers are 7, 15, 23, 28, 31, 37, 39, 40, 44, 46, 47, 49, 52, 53, 55, 56, 58, 60–65, 67–74 [9]. The NISS, a modification of ISS, was computed from the three worst injuries, regardless of the body region in which they occurred.

The Revised Trauma Score (RTS), is a physiologic score that a patient's systemic response to injury measured through GCS, SBP and RR. It is the current standard physiologic scoring system used in trauma research and quality improvement in both high-income countries and low- and middle-income countries. The TRISS

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