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Using population-based critical care data to evaluate trauma outcomes

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ABSTRACT

Background: The analysis of mortality is an integral part of the evaluation of trauma care. When specific data are not available, general prediction models can be used to adjust for case mix. The aim of this study was to evaluate the feasibility of conducting a population-based analysis of trends in trauma mortality, using critical care audit data, and to investigate whether such data could provide a benchmark for the assessment of service reconfiguration.

Methods: Retrospective cohort study of adult trauma patients, requiring admission to a critical care unit in Scotland, 2002–2011, using nationally collected data. Results are presented as standardised mortality ratios of observed mortality divided by APACHE II predicted mortality. Tests for trends in numbers and ratios over time were performed using linear regression.

Findings: 4503 patients were identified. There was a significant increase in the number of trauma patients admitted per year ($p = 0.011$). The median predicted probability of in-hospital death was 7% (interquartile range 1–13%), against an actual mortality was 11.6%. There was no significant change in the standardised mortality ratios of trauma patients ($p = 0.1224$).

Conclusions: This study demonstrated the feasibility of utilising critical care unit audit data for analysing outcomes from trauma care. It also showed the potential of such an approach to establish a baseline against which to compare the impact of future service reconfiguration. In contrast to healthcare systems with regionalised trauma care, there appears to have been little change in the mortality of trauma patients requiring critical care unit admission in Scotland.

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Introduction

Trauma care remains an important public health issue, with best clinical outcomes associated with networked systems of care, delivered by a formal trauma service.[1,2] In states and countries without a trauma system, critical care medicine has a key role in coordinating the care of the most severely injured, regardless of the organ systems involved. The evaluation of risk-adjusted outcomes is an integral part of the assessment of the quality of care provided. Critical care units and networks frequently have established data collection mechanisms, with high case ascertainment. Evaluating temporal trends in this population is therefore potentially feasible and conceptually attractive.

The Scottish Intensive Care Society Audit Group (SICSAG) has been conducting a continuous national audit of patients admitted to critical care units in Scotland since 1995. The SICSAG dataset furthermore provides a complementary method of risk adjustment, using APACHE II (Acute Physiology and Chronic Health Evaluation II), a widely used scoring system and outcome prediction model for critically ill patients, which has also been validated in trauma patients, albeit usually in small series and single-centre studies.[3–7]

Table 1 – Subgroups, by APACHE III diagnostic categories.

Subgroup	APACHE III unit admission diagnostic categories
Isolated head injury	Trauma – head/brain
Other isolated injury	Trauma – spine
	Trauma – face
	Trauma – chest
	Trauma – abdomen
	Trauma – pelvis
	Trauma – extremities
Polytrauma with head injury	Multiple injuries, including head injuries
Polytrauma without head injury	Multiple injuries, without head injuries

The aim of this study was twofold: Firstly, to evaluate the feasibility of a population-based analysis of temporal trends in trauma mortality, using routinely collected and risk-adjusted critical care audit data. Secondly, as Scotland is about to implement a national trauma system, this approach could provide benchmark data with which to compare outcomes post introduction.

Methods

This is a retrospective analysis of a prospectively collected critical care registry. Adult trauma patients, who required admission to a critical care unit in Scotland, between 1 January 2002 and 31 December 2011 were included. Permission for the study was obtained from the Scottish Intensive Care Society Audit Group.

Scotland has a population of approximately 5.2 million. In 2011, there were 26 critical care units. A "critical care unit", for the purpose of this study, was defined as either an intensive care unit, or a combined intensive care/high dependency unit. Stand-alone high dependency units were excluded, because not all of these units contribute data to the SICSAG audit, and because they are heterogeneous in nature.

SICSAG maintains a mandatory national registry, which collates daily returns on all patients in intensive care, and combined intensive care/high dependency units in Scotland. Data from these returns are used to calculate an APACHE II score, by assigning numerical values to twelve clinical and biochemical parameters: Glasgow Coma Scale, temperature, mean arterial pressure, heart rate, respiratory rate, oxygenation, arterial pH, white cell count, and serum sodium, potassium and creatinine. The sum of these individual scores, calculated from the worst values recorded within the first 24 h following hospital admission, comprises the Acute Physiology Score. Points are also assigned for age and the presence of pre-existing illness. Higher scores indicate greater severity of illness, with combined scores below 10 suggesting relatively mild illness, while scores above 15 indicate moderate to severe illness. Higher scores also correspond to a greater risk of

Table 2 – Baseline characteristics of study population and subgroups.

	All		Isolated head injury		Other isolated injury		Polytrauma with head injury		Polytrauma without head injury	
Number of patients (% of total)	4503	(100)	1156	(26)	1752	(39)	805	(18)	790	(18)
Demographics										
Number of male patients (%)	3471	(77)	960	(83)	1291	(74)	589	(73)	631	(80)
Age of patients (years), median (IQR)	40	(25–56)	39	(24–54)	45	(28–62)	35	(22–49)	39	(25–53)
Length of stay										
Length of ICU stay (days), median (IQR)	2	(0–5)	2	(0–5)	2	(0–3)	5	(0–9)	3	(0–7)
Length of Hospital stay (days), median (IQR)	13	(1–26)	10	(0–22)	11	(1–22)	15	(1–29)	20	(6–35)
APACHE II score and probability of death										
APACHE II score, median (IQR)	13	(9–18)	13	(8–19)	12	(8–16)	13	(9–18)	12	(8–16)
APACHE II prob of death, %, median (IQR)	7	(1–13)	12	(3–21)	6	(2–10)	11	(3–19)	6	(3–9)
Mortality										
Unit mortality (actual), n (%)	388	(8.6)	156	(13.5)	78	(4.5)	114	(14.4)	40	(5.0)
Hospital mortality (actual), n (%)	483	(11.6)	182	(17.2)	120	(7.3)	138	(19.2)	43	(5.8)