Mortality in Adolescent Trauma – A Comparison of Children's, Mixed and Adult Major Trauma Centres

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ABSTRACT

Objective: We aimed to compare adolescent mortality rates between different types of major trauma centre (MTC or Level 1; adult, children's and mixed).

Methods: Data were obtained from TARN (Trauma Audit Research Network) from English sites over a 6-year period (2012-2018), with adolescence defined as 10-24.99 years. Results are presented using descriptive statistics. Patient characteristics were compared using the Kruskal-Wallis test with Dunn's post-hoc analysis for pairwise comparison and chi-square test for categorical variables.

Results: 21,033 cases met inclusion criteria. Trauma-related 30-day crude mortality rates by MTC type were 2.5% (Children's), 4.4% (Mixed), and 4.9% (Adult). Logistic regression accounting for injury severity, mechanism of injury, physiological parameters, and "hospital ID", resulted in adjusted odds of mortality of 2.41 (95% CI 1.31-4.43; p=0.005) and 1.85 (95% CI 1.03-3.35; p=0.041) in adult and mixed MTCs respectively when compared to children's MTCs. In three sub-group analyses the same trend was noted. In adolescents aged 14 to 17.99 years old, those managed in a children's MTC had the lowest mortality rate at 2.5%, compared to 4.9% in adult MTCs and 4.4% in mixed MTCs (no statistical difference between children's and mixed). In cases of major trauma (ISS > 15) the adjusted odds of mortality were also greater in the mixed and adult MTC groups when compared to the children's MTC. Median length of stay (LoS) and ICU LoS were comparable for all MTC types. Patients managed in children's MTCs were less likely to have a CT scan (46.2% vs 62.8% Mixed vs 64% Adult).

Conclusions: Children's MTC have lower crude and adjusted 30-day mortality rates for adolescent trauma. Further research is required in this field to identify the factors that may have influenced these findings.

What is already known on this subject

- Trauma is a leading cause of mortality and morbidity in adolescence
- Adolescent trauma patients may be managed in either a children's, mixed or adult trauma centre
- The current evidence base on outcomes by centre type is inconsistent. Some report a higher mortality in adolescent trauma patients managed in an adult and mixed MTCs when compared to children's, whilst others have reported no difference

What this study adds

- TARN data from English MTCs demonstrates lower crude and adjusted mortality rates for adolescent trauma patients attending a children's MTC
- This association persists in cases of severe trauma (Injury Severity Score >15)
- There was no difference in length of stay between MTC types (children's, mixed or adult), although variation existed in CT rates and time from arrival to CT

INTRODUCTION

In the UK, trauma accounts for six million ED attendances, 720,000 admissions and 17,000 deaths a year. [1] Worldwide, approximately 5.8 million people die each year as a result of trauma, accounting for 10% of the world's deaths [2]. Trauma is the leading cause of death and acquired disability in adolescents, with road traffic collision the most common mechanism. [3] Regional major trauma networks, established in England in 2012 consist of Major Trauma Centres (MTC; equivalent to Level 1 trauma centres) and linked Trauma units (TU; equivalent to Level 2/3 trauma centres). In the current system configuration, the 27 MTCs, which receive the most seriously injured patients, are classified as adult (n=11; patients aged ≥16 years), children's (n=5; patients <16 years), or mixed (n=11).

The WHO and UNICEF define adolescence as the age range 10-19 years, with 'young people' classified as those aged 10-24 years.[4,5] Recent recommendations on the age range for adolescence state this should include those aged 10 to 24 years to better acknowledge '*recognised shifts in events of biological growth and social role transitions*', [6] a stance supported in the UK by the RCPCH. [7] In the US, youth violence prevention strategies are targeted to the 10-24 years age bracket. [8]

Adolescents are a unique cohort in that, dependent on age, they may be managed in either paediatric, adult or mixed trauma services. In England, ambulance services triage and convey patients under 16 years to a Children's MTC and those over 16 years to an Adult MTC. A mixed MTC accepts patients of all ages. In rare circumstances, the age of an unconscious adolescent may be unclear and the patient may be conveyed to the incorrect trauma centre for their age by the ambulance service. While the principles of trauma management overlap between paediatric and adult guidelines, there exist subtle but important differences, including imaging strategies, the role of permissive hypotension, and conservative management of abdominal organ injuries.[9,10]

It is not known whether these differing strategies impact outcomes in this cohort, or in what age groups differences may exist. There are no national published data comparing outcomes in this configuration for adolescent trauma between MTC types, and there are limited international studies. The majority come from the US, a comparable trauma system to the

UK, but findings are inconsistent. Some report higher mortality in adult and mixed MTCs compared to children's MTCs, while others report no association.[11-13]

The primary aim of this study was to identify mortality rates for severely injured adolescents in England in different MTC types. The secondary aims were to describe length of stay (LoS), number of critical care days (ICU LoS), time to CT, and the most senior clinician present at the initial resuscitation in MTC types.

METHODS

Study design and setting: In this cross sectional study we analysed data collected in the national Trauma and Audit Research Network (TARN) database over a six-year and nine-month period (1st April 2012-31st December 2018), with the commencement date selected to coincide with the implementation of trauma networks in England.[14] The study was limited to English sites as there were no MTCs in Wales or Northern Ireland during the study period, and Scottish trauma data are captured elsewhere (STAG; Scottish Trauma Audit Group).

Study Population: The TARN database includes patients of any age who sustain injury resulting in hospital admission for 3 days or greater, critical care admission, transfer to a tertiary/specialist centre, or in-hospital death within 30 days. Injuries are assigned an Abbreviated Injury Scale (AIS) score, ranging from 1 (minor injury) to 6 (an injury that is thought to be 'incompatible with life') [15]. The Injury Severity Score (ISS), derived by adding the squares of the three highest scoring body regions, ranges from 1 to 75, with major trauma defined as ISS>15.[14] Data are entered into the TARN database by local coordinators, utilising retrospective chart review methodology.

Datasets were included for all adolescent trauma episodes recorded in TARN with initial presentations to any MTC. Adolescence was defined as 10-24.99 years in line with international guidance.[2,16] Pre-hospital deaths are not recorded by TARN. Cases that initially presented to TUs were excluded to reduce confounding from wider heterogeneity in initial management.

Outcomes

The primary outcome measure was mortality within 30 days of traumatic event, with

comparison between children's, adult, and mixed MTCs. Secondary outcomes selected as measures of morbidity included length of stay and number of intensive care bed days. Inter-centre comparison was undertaken for seniority of clinician managing initial management, and time taken for CT scanning where relevant.

Statistical analysis

In this analysis, the null hypothesis was that there was no difference in mortality rates between MTC types. Patient characteristics, when continuous, were compared using the Kruskal-Wallis test with Dunn's post-hoc analysis for pairwise comparison and chi-square test for categorical variables. To allow for variation between sites, a logistic mixed effect (random intercept) regression was used. The logistic regression adjusted for mechanism of injury, Glasgow Coma Scale (GCS), ISS, systolic blood pressure (SBP), pulse rate, comorbidities, and site institution with the inclusion of 'Hospital ID'. This is necessary to take into account the clustering of patients within each hospital to enable analysis of not only unexplained variance between patients but also between hospitals. Hosmer and Lemeshow (H-L) was used to test for goodness-of-fit and the C statistic by means of the area under the receiver operating curve (AROC) to assess the discriminating power of the statistical model. As TARN data are inputted retrospectively, required fields may not be recorded in the clinical notes. Missing data from the covariates were imputed using multiple imputation under the assumption of missingness at random mechanism (MAR) and applying Rubin's rule on the 10 imputed sets. The same statistical analysis was undertaken for all sub-analyses. All the analyses were performed using Stata 14 software (StataCorp. 2015. *Stata Statistical Software: Release 14*. College Station, TX).

We sub-categorised the study cohort for three planned sub-analyses for which we assessed crude and adjusted mortality comparing outcomes based on MTC centre type (children's, mixed and adult). In the first sub-group analysis, the cohort was split into two age ranges, 10-15.99 years and 16-24.99 years. In assessing trauma outcomes for the breadth of adolescences, from 10-24 years, concerns may be expressed about the validity of comparing trauma in a 10-year-old to a 24-year-old due to potential differences in physiology and mechanism of injury. In restricting the age range, a more homogenous population may be assessed. These age boundaries were selected to account for the cut-off age of 16 years for children's versus adult MTCs. The second sub-analysis focused on all adolescent trauma patients within the age group 14-17.99 years. This age range was selected pragmatically by

consensus of the study team, to represent upper and lower boundaries that paediatric and adult services respectively may feel comfortable accepting, and reflect reasonable presumed age deviations for those making decisions pre-hospital. A further planned sub-analysis assessed patients specifically with major trauma (ISS>15) for the full cohort (age 10 years – 24 years) and those aged 14-17.99 years. The same statistical analyses were performed on these sub-groups to adjust for potential confounders.

Ethical approval

TARN has ethical approval (PIAG section 60) for research on the anonymised data that are stored securely on the University of Manchester server.

Patient and public involvement: Patients or the public were not involved in the design, conduct, reporting, or dissemination plans of this study.

RESULTS

Demographic and injury pattern data

A total of 30,321 adolescent trauma cases were identified of which 21,033 fulfilled eligibility criteria for this analysis. Of these, 11,319 (54%) presented to a mixed MTC, 7,937 (38%) to an adult MTC and 1,777 (8%) to a children's MTC (**Figure 1**). 2,569 (12.2 %) were aged 10 -13.99 years, 4,471 (21.3%) aged 14 – 17.99 years and 13,993 (66.5%) aged 18 – 24.99 years. Patients were predominantly male (77.9%) (**Table 1**).

The initial physiological parameters were similar between groups but did demonstrate statistically significant differences between MTC cohorts. These differences were unlikely to be clinically significant. (**Table 1**). Overall, across all three types of MTC, the most common comorbidities were asthma, mental health conditions, alcohol / drug abuse and epilepsy. In 80% (16,883) of the total cohort, the patient had no comorbidities. Patients presenting to children's MTCs had fewer co-morbidities.

The most common mechanism of injury was road traffic collision (RTC; 52.6%, n=11,058), with falls of any height accounting for 22.2% (4,657). Falls <2m height accounted for a larger proportion of children's MTC cases (20.5%) compared to mixed (10%) and adult (9.5%) MTCs. Stabbings and shootings were less common in children's MTCs (2.8%) and

highest in mixed MTCs (14.5%) (**Table 2**). Patients managed in children's MTCs had a median ISS of 10, whereas those managed in mixed or adult MTCs had a median ISS of 14 and 16 respectively (p<0.001) (**Table 1**). Anatomical regions with significant differences in median highest AIS between MTC types were the face, abdomen, pelvis, and limbs (**Table 2**).

Seniority leading resuscitation, LoS and time to CT

In most cases a consultant was present as the most senior clinician (**Table 1**). Physicians in their first four years of training were the most senior clinician present in only a small proportion (<5%) of cases, but this was most common in adult MTCs. Median LoS and ICU LoS were comparable for all MTC types although differences met statistical significance (**Table 1**).

Patients managed in children's MTCs were less likely to have a CT scan, though the time taken to perform a CT was significantly longer in children's MTCs than other MTC types (**Table 1**).

Mortality

Overall trauma-related crude 30-day mortality was 4.4%, with significant differences in mortality rates between MTC types (Children's 2.5%; Mixed 4.4%; Adult 4.9%; p< 0.0001; **Table 1**). When adjustments were made using logistic regression accounting for ISS, MOI, GCS, SBP, pulse rate, comorbidity, pupil reactivity and the random effect "hospital ID", odds of mortality compared to children's MTCs were 2.41 (95% CI 1.31-4.43; p=0.005) and 1.85 (95% CI 1.03-3.35; p=0.041) in adult and mixed MTCs respectively (**Table 3**). The model showed a good C statistic (area under ROC curve) of 0.980 (95% CI 0.977 - 0.984) and the goodness of fit showed a non-significant H-L test (p=0.55), demonstrating that the model fits the data well.

Sub-group analysis: 10 to 15.99 years

In the subgroup analysis of the 10 to 15.99 years old, those managed in a children's MTC had the lowest mortality rate at 2.3**%,** compared to 3.5**%** in adult MTCs and 3.8**%** in mixed MTCs. In the adjusted analysis, the odds ratio for mortality was higher in the mixed and adult MTCs in comparison to children's MTCs (statistically significant for mixed only). (**Table 3**).

Sub-group analysis: 16 to 24.99 years

In the subgroup analysis of the 16 to 24.99 years old cohort, there was significant variation in participants number between MTC's (children's MTC n = 17, mixed MTC n = 9,153 and adult MTC n=7,507. **Table 5**). Those managed in a children's MTC had the highest mortality rate at 17.7%, compared to 5% in adult MTCs and 4.6% in mixed MTCs. In the adjusted analysis, the odds ratio for mortality was higher in adult and mixed MTC's compared to children's MTCs, but this did not meet statistical significance. (**Table 3**).

Sub-group analysis: 14 to 17.99 years

In the subgroup analysis of the 14 to 17.99 years old, those managed in a children's MTC had the lowest mortality rate at 2.5%, compared to 4.9% in adult MTCs and 4.4% in mixed MTCs. In the adjusted analysis, the odds ratio for mortality was significantly higher in adult MTCs in comparison to children's MTCs. There was no statistically significant difference between mixed MTCs in comparison to children's MTCs (**Table 3**).

Sub-group analysis: ISS>15 (Major Trauma) in adolescents (10-24.99 years)

Table 4 displays the 30-day crude and adjusted odds of mortality for major trauma (ISS > 15). The adjusted odds of mortality are greater in the mixed and adult MTC groups when compared to the children's MTC. This association is replicated in the 14 to 17.99 years subgroup for major trauma (**Table 4**).

DISCUSSION

Using English trauma registry data, we have demonstrated lower 30-day crude mortality rates for adolescent trauma patients (10-24.99 years) attending children's MTCs in comparison to adult or mixed MTCs. This association persisted after adjustment for potential confounding factors, and in sub-group analyses comparing outcomes for those with major trauma (ISS>15) and those aged 14-17.99 years (with or without major trauma).

When the cohort was divided into young (10-15.99 years) and older adolescence (16-24.99 years), the trend for an adjusted improved mortality rate in those attending children's MTCs remained. In the young adolescent group (10-15.99 years), the adjusted odds of mortality

were 2.2 times higher for those who attended a mixed MTC compared to a children's MTC, which was statically significant. In the comparison of adult MTCs to children's MTCs for the 10-15.99 years age group, the adjusted odds of mortality was 2.9, although this was not statically significant.

For the older adolescent cohort (16-24.99 years) those managed in a children's MTC had the highest mortality rate at 17.7%, compared to 5% in adult MTCs and 4.6% in mixed MTCs. The adjusted odds of mortality however continue to favour children's MTCs although this did not meet statistical significance. These data should be interpreted with caution due the variation in case numbers attending each MTC types (children's MTC n = 17, mixed MTC n = 9,153 and adult MTC n=7,507).

Some young adolescents (10-15.99) and some old adolescents (16-24.99) presented to non-designated centres (in accordance to English hospital set up of adult and children's MTCs), with 430 patients under 16 years of age treated in adult MTCs (9.9% of all aged <16 years) and 17 patients over 16 years attending a children's MTC (0.1% of all aged 16-24.99 years). We hypothesis that this variation in protocol is multi-factorial, including errors in estimating the age in the prehospital setting. In some instances, including in cases of extremis, pre-hospital teams may divert from protocol to the nearest unit for life saving interventions. In those under 16 years deemed too unstable for safe transfer the prehospital team may attend the nearest children's TU (which may also be an adult MTC).

Existing literature describing adolescent mortality secondary to trauma is predominantly from the US, and outcomes appear contradictory across studies. A 2016 study which accessed the US National Trauma Data Bank described higher adjusted odds of mortality in adult MTCs (odds ratio, 4.19; 95% CI, 1.30-13.51) and mixed MTCs (odds ratio, 6.68; 95% CI, 2.03-21.99) compared with children's MTCs.[4] Other studies have reported no difference in mortality between centres for either penetrating or blunt trauma [13], lower crude mortality (but not adjusted mortality) in a children's trauma centre compared to an adult trauma centre [17], and no difference in mortality by centre but a reduction in imaging, invasive procedures, and ICU LoS, and improved discharge to home in children's trauma centres. [18] One further study of patients with penetrating injuries (predominantly stabbing and gunshot wounds) performed a sub-group analysis on adolescents (defined as >12 years), finding no difference

in mortality. This same study reported those <5 years old may have superior functional outcomes when treated at a paediatric trauma centre.[19]

Adolescents (10-24.99 years) who presented to a children's MTC had a lower ISS compared to adult and mixed MTCs. Previous trauma studies report a correlation between an increasing ISS and higher mortality.[20] In acknowledgement of this, we undertook statistical adjustments to account for the variation in ISS and also performed a sub-group analysis for those with major trauma (ISS>15). In both, the trend for a lower mortality rate in the children's MTC remained, supporting the view that children's MTCs manage adolescent trauma with good outcomes despite seeing a lower volume of cases. This is in contrast to evidence suggesting improved trauma outcomes in institutions with higher case volumes.[21,22]

Between groups, there were statistically significant differences in baseline physiological observations. However, there was no clinical significance to these differences, and this finding likely represents the slight variations in normal values that one would expect over the age range of this cohort.

There was some variation in practice between trauma centres. Those that attended a children's MTC were less likely to have a consultant present. We hypothesise that this variation may be a consequence of differing patterns of conveyance to children's MTCs rather than system configuration. Up to a third of major paediatric trauma cases are more likely to 'self-present' via parental transport rather than via ambulance, removing the pre-alert trauma call [23]. Regarding imaging, trauma cases were less likely to have a CT if they presented to a children's MTC, and if they had a CT, it took longer to perform when compared to other MTC types. This reduction in imaging is in keeping with other studies, with an assumption that the difference is a result of adherence to adult imaging principles.[8,11] Studies have noted no difference in mortality when targeted imaging is undertaken when compared to whole body CT.[24] One would assume that these secondary outcomes would potentially increase mortality in children's MTCs and are unlikely to explain the variation in mortality outcomes that we noted.

There were some limitations to this study. TARN is the national trauma registry for the UK, with any analysis limited to prespecified fields. Adolescent trauma cases that do not meet TARN inclusion criteria but may have significant injuries were not captured for this analysis,

potentially creating a skewed data set. The decision to exclude TUs and transfers from a TU to a MTC was taken pragmatically as the authors felt this question would be more appropriately explored separately, and because the accuracy and completeness of data may be lower than that submitted from MTCs. Thus a considerable proportion of trauma cases were not included, and although it is assumed that MTCs would have better outcomes, it is not inconceivable that TUs may have the lowest mortality. There was considerable variation in the number of cases that attended each centre type, with the lowest volume in the children's MTCs. Although this variation was accounted for in the analysis it may have impacted on the results. The chosen age range of 10-24 years is consistent with the current adolescent literature, though comparisons of trauma between a 10-year-old and a 24-year-old may be challenging given variations in mechanism of injury and physiology. To address this, we undertook adjusted and sub-group analysis with a smaller age range (14-17.99-years) but there is the potential that other variables have not been considered that may have impacted our findings.

Further research is required in this field to identify the factors that may have influenced these results. These should be explored qualitatively through engagement with clinicians and adolescent representatives, and quantitatively with richer interrogation of existing data on the contribution of factors such as type of injury and resulting interventions. There may also be benefit in a larger prospective study, in which all adolescent trauma cases attending EDs (not just MTCs) are collated to facilitate more comprehensive analysis.

In summary we have demonstrated that in England, children's MTCs have lower 30-day mortality rates for adolescent trauma than adult or mixed MTCs, and that this association remains following adjustment for potential confounding variables including severity of injury. Further research is required to understand factors influencing disparities in trauma-related mortality among adolescents who are cared for in non-children's MTCs. We hope that the results of this study will play a part to highlight where adolescent trauma patients are best managed, inspire further work in this field and therefore impact on future health policy for this frequently overlooked demographic group.

Table 1. Demographic and outcome data for adolescent trauma cases coded by TARN

	Children's MTC	Mixed MTC	Adult MTC	Total	p-value
Total number (%)	1777 (8.4%)	11319 (53.8%)	7937 (37.7%)	21033	
Age in Years *Median (IQR)*	13.3 (11.8-14.8)	19.8 (16.9-22.3)	20.7 (18.8-22.8)	19.8 (16.7-22.3)	<0.0001
Male *n (%)*	1260 (70.9)	8885 (78.5)	6247 (78.7)	16392 (77.9)	<0.0001
Female *n (%)*	517 (29.1)	2434 (21.5)	1690 (21.3)	4641 (22.1)	
Physiological parameters at presentation *Median (IQR)*					
GCS *	15 (14-15)	15 (14-15)	15 (14-15)	15 (14-15)	0.999
Pulse	90 (79-106)	88 (75-102)	88 (75-103)	88 (75-103)	<0.0001
SBP mmHg	118 (109-127)	126 (114-139)	129 (116 – 142)	126 (114 – 139)	<0.0001
Comorbidity (Charlson Index) *n (%)*					
0	1572 (88.5)	8929 (78.9)	6382 (80.4)	16883 (80.3)	
1-5	113 (6.4)	1233 (10.9)	1024 (12.9)	2370 (11.3)	<0.0001
6-10	2 (0.1)	26 (0.2)	14 (0.2)	42 (0.2)	
>10	1 (0.06)	3 (0.03)	3 (0.04)	7 (0.03)	
Most Senior Clinician *n (%)*					
Consultant	1207 (67.9)	9214 (81.4)	5858 (73.8)	16279 (77.4)	
Associate Spec.	24 (1.4)	51 (0.5)	140 (1.8)	215 (1.0)	
ST3 +	238 (13.4)	535 (4.7)	655 (8.3)	1428 (6.8)	<0.0001
FP / ST 1-2	48 (2.7)	295 (2.6)	343 (4.3)	686 (3.3)	
Other	260 (14.6)	1224 (10.8)	941 (11.9)	2425 (11.5)	
Mortality *n (%)*	44 (2.5%)	501 (4.4%)	387 (4.9%)	932 (4.4%)	<0.0001
Length of Stay					
LoS in days *Median (IQR)*	6 (4-11)	6 (4-12)	7 (4-12)	6 (4-12)	0.0003
ICU LoS in days *Median (IQR)*	2 (1-5)	2 (1-6)	3(1-8)	2 (1-6)	<0.0001
CT					
CT performed *n* (%)	821 (46.2)	7105 (62.8)	5080 (64)	13006 (61.8)	<0.0001
Time to CT Minutes *Median (IQR)*	40 (26-55)	28 (19-44)	23 (14-36)	27 (17-42)	<0.0001

sub-categorised by MTC type.

*Denotes no statistical difference between sub-categorisation of MTC (only applicable to GCS).

FP= Foundation Programme trainee, ST = Specialty Trainee, GCS =Glasgow Coma Scale; SBP =Systolic Blood Pressure; LoS =Length of Stay

Table 2. Mechanism of injury, ISS and AIS for adolescent patients coded by TARN sub-categorised by MTC type.

	Children's MTC	Mixed MTC	Adult MTC	Total	p-value
Mechanism of Injury (MOI) n (%)					
RTC	931 (52.4)	5809 (51.3)	4318 (54.4)	11058 (52.6)	<0.0001
Fall>2m*	191 (10.7)	1335 (11.8)	883 (11.1)	2409 (11.5)	0.222
Fall<2m	364 (20.5)	1130 (10.0)	754 (9.5)	2248 (10.7)	<0.0001
Shooting/Stabbing	50 (2.8)	1638 (14.5)	689 (8.7)	2377 (11.3)	<0.0001
Blast/Blow(s)	170 (9.6)	1091 (9.6)	1066 (13.4)	2327 (11.1)	<0.0001
Other	71 (4.0)	316 (2.8)	227 (2.9)	614 (2.9)	0.018
Injury Severity Score (ISS)					
Median (IQR)	10 (9-20)	14 (9-25)	16 (9-25)	14 (9-25)	<0.0001
Abbreviated Injury Scale (AIS) – Median (IQR) for highest AIS in anatomical regions					
Head*	4 (3-5)	4 (3-5)	4 (3-5)	4 (3-5)	0.126
Face	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	<0.0001
Thorax*	3 (3-4)	3 (3-4)	3 (3-4)	3 (3-4)	0.069
Abdomen	3 (2-4)	3 (2-4)	3 (2-3)	3 (2-4)	0.017
Spine*	2 (2-3)	2 (2-3)	2 (2-3)	2 (2-3)	0.801
Pelvic	2 (2-2)	2 (2-4)	2 (2-4)	2 (2-4)	0.0003
Limb	3 (2-3)	3 (2-3)	3 (2-3)	3 (2-3)	<0.0001
Other*	1 (1-2)	1 (1-2)	1 (1-2)	1 (1-2)	0.825

* denotes no statistically significant difference

Table 3: Odds of mortality by MTC centre type for adolescent trauma patients (aged

10 – 24.99 years). Subgroup analysis of those aged 14 – 17.99 years, 10 –15.99 years and 16 –24.99 years also displayed. *(crude and adjusted OR presented)*

Centre of Treatment	*Crude*		*Adjusted*	
Centre of Treatment	**Odds ratio (95% CI)**	**p Value**	**Odds Ratio (95% CI)**	**p-value**
Odds of mortality for those aged 10 – 24.99 years				
Children's MTC (reference)	1		1	
Adult MTC	2.02 (1.47 – 2.77	<0.0001	2.41 (1.31 – 1.43)	0.005
Mixed MTC	1.82 (1.33 – 2.49)	<0.0001	1.85 (1.03 – 3.35)	0.041
Odds of mortality for those aged 14 – 17.99 years				
Children's MTC (reference)	1		1	
Adult's MTC	1.73 (1.05 – 2.86)	0.032	2.77 (1.11- 6.94)	0.030
Mixed MTC	1.52 (0.95 – 2.44)	0.083	1.92 (0.84 – 4.42)	0.121
Odds of mortality for those aged 10 – 15.99 years				
Children's MTC (reference)	1		1	
Adult's MTC	1.52 (0.83 – 2.76)	0.175	2.87 (0.79 - 10.38)	0.108
Mixed MTC	1.65 (1.13 – 2.41)	0.01	2.22 (1.1 - 4.51)	0.027
Odds of mortality for those aged 16 – 24.99 years				
Children's MTC (reference)	1		1	
Adult's MTC	0.24 (0.07 - 0.86)	0.03	3.12 (0.21 - 47.5)	0.21
Mixed MTC	0.22 (0.06 - 0.79)	0.02	2.36 (0.16 - 35.8)	0.16

Table 4: Odds of mortality for adolescent trauma patients (aged 10 – 24.99 years) with an ISS >15. Subgroup analysis of those aged 14 years – 17.99 years also displayed.
(crude and adjusted OR presented)

	Crude		*Adjusted*	
	Odds Ratio (95% CI)	**p Value**	**Odds Ratio (95 % CI)**	**p-value**
Odds of mortality for those with an ISS >15 (10 – 24.99 years)				
Children's MTC	1		1	
Mixed MTC	1.51 (1.10 – 2.08)	0.011	1.80 (1.04 – 3.09)	0.035
Adult MTC	1.61 (1.17 – 2.23)	0.004	2.31 (1.33 – 4.00)	0.003
Odds of mortality sub-analysis for ISS >15 in age group 14 – 17.99 years				
Children's MTC	1		1	
Mixed MTC	1.56 (0.88 – 2.78)	0.132	2.01 (0.92 – 4.37)	0.08
Adult MTC	2.73 (1.23 – 6.07)	0.014	2.99 (1.31 – 6.82)	0.009

Table 5. Number of patients attending each MTC type for age ranges 10-15.99 and 16-24.99. *n (%)*

Age group	Children's MTC	Mixed MTC	Adult MTC	Total
10 - 15.99	1,760 (99.0%)	2,166 (19.1%)	430 (5.4%)	4,356 (20.7%)
16 - 24.99	17 (1.0%)	9,153 (80.9%)	7,507 (94.6%)	16,677 (79.3%)
Total	1,777	11,319	7,937	21,033

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