

Injured adolescents—should they be treated as big kids or little adults?

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Adolescence, the period of transition between childhood and adulthood, has traditionally been considered ages 10–19 years according to the WHO. However, acknowledging that ongoing physical and psychological development occurs up to mid-20s and that young people now have delayed partnering, parenting and economic independence, many consider that a more suitable modern definition of adolescence includes the ages 10–24 years.

In England in 2012, trauma networks were established with the designation of 11 adult, 5 paediatric and 11 mixed (adult and paediatric) major trauma centres (MTCs). Many of the adult MTCs function as paediatric trauma units, whereas others only provide care for adults. Within these networks, severely injured patients aged under 16 years are triaged to a children's MTC and those 16 years or older are triaged to an adult MTC. Operationally, it can be difficult to accurately estimate the age of unconscious adolescents or a paediatric patient may be too unstable for a transfer to a designated children's hospital, resulting in an adolescent being triaged to the 'wrong' trauma centre for the cut-off age of 16 years. In addition, in multiple casualty incidents, the priority of keeping families together may result in children presenting to a mixed or adult MTC.

In their *EMJ* study, Evans *et al*¹ present data from the Trauma Audit Research Network comparing the outcomes of adolescent trauma patients aged 10–24.99 years who had a primary transfer to a MTC from 2012 to 2018. Of the total 30321 patients, 54% presented to a mixed MTC, 38% to an adult MTC and 8% to a children's MTC. The majority of patients (66.5%) were over 18 years old; 430 patients under 16 years attended an

adult MTC and only 17 patients over 16 years attended a children's MTC.

The primary outcome was mortality within 30 days of injury, and the study found that rates of mortality were higher in mixed (4.4%) and adult MTCs (4.9%) compared with children's MTCs (2.5%, $p < 0.0001$). This was verified when making adjustment for other confounding factors such as Injury Severity Score (ISS), mechanism of injury or physiology. When the different age subgroups were analysed, for those patients who presented to a children's MTC, there was a lower rate of mortality in the 10–15.99 and 14–17.99 age groups and a higher rate of mortality in the 16–24.99 age group (but the number of patients aged above 16 taken to children's MTCs was extremely small, and the result was not of statistical significance). The timing of death within the 30 days after injury was not defined, but understanding whether this was in the first 4 hours, within the first 24 hours or later in the hospital stay may be useful to assess where any improvements in systems could be made. Of note, median length of stay and intensive care length of stay were no different between adult, children and mixed age trauma centres.

The most striking result was the subgroup analysis of patients aged 14–17.99 years whom the study authors felt represented lower and upper age limits that both adult and children's MTCs may be comfortable to accept. The crude OR of mortality was 1.73 ($p = 0.032$) and adjusted 2.77 ($p = 0.030$) in adolescents treated at the adult MTC.

A number of confounding factors exist in this patient group. Resuscitation of children in traumatic cardiac arrest rarely stops at scene, and many of these patients with unsurvivable injuries will have been conveyed to the nearest hospital: this is geographically more likely to be an adult or mixed MTC. The mechanisms of injury are very different in older adolescents associated with new drivers, penetrating trauma, crime and drug/alcohol intoxication. This may impact time from injury to presentation, physiology and unconscious biases in patient care. For patients under 16 years in adult MTCs, those requiring surgery, interventional radiology or paediatric critical care will have needed

transfer to a children's MTC, which may have contributed to delays in definitive care or hazards during transfer. Patients presenting to a children's MTC had fewer comorbidities and a lower injury severity score: there is little in the literature assessing the impact of comorbidities in younger trauma patients.

Why might a children's MTC provide better survival rates for adolescents? It is a long-held mantra, often quoted in paediatrics, that 'children are not little adults', and this can induce fear and anxiety among clinicians in a non-children's MTC when treating a severely injured child. Paediatric major trauma is thankfully relatively uncommon in England, and if cases are managed centrally, trauma teams may become deskilled in non-specialist centres.

Larger numbers of patients still present to non-children's MTCs, and this may contribute to 'trauma alert fatigue' in an adult/mixed centre, whereas a rarer trauma alert may produce a more focused response by staff in a children's emergency department. Children's MTCs may also have a different attendance by specialties for these rarer events, so expert opinion and treatment are available immediately. The recognised life support courses for trauma management (ATLS or European Trauma Course) predominantly focus on adults with a small section on children, and the APLS course has more time focused on medical and cardiac emergencies than trauma: this potentially creates a gap in knowledge and skills. A children's MTC may be more likely to hold focused paediatric trauma simulation and educational sessions to offset this gap, whereas other sites have to cover both adults and paediatric scenarios.

The study identified that patients who attended a children's MTC were less likely to have a consultant present, but potentially the trauma team leaders (TTLs) were more confident with managing indications for rapid sequence intubation, fluid resuscitation and procedures in adolescents. It is also possible that interpreting the physiology of an adolescent with severe traumatic injury is more akin to a child rather than an older adult. Paediatric Emergency Medicine training in the UK is available via both emergency medicine and paediatric routes. There are no data presented on the clinical background of the TTL for each case, and these data would be interesting to compare with outcomes. Of note, within these data, <3.3% of patients were treated by a doctor within their first 4 years of training, but this was most common in adult MTCs where outcomes figures were less favourable.

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There was a significant difference in imaging, with more CT scanning requested in the adult and mixed MTCs. While this was not adjusted for mechanism of injury or physiology on arrival, we know from previous TARN publications that children's MTCs are more likely to follow a conservative approach to imaging following the Royal College of Radiology guidelines for paediatric trauma.² This may mean a more detailed clinical assessment and serial examination to detect subtle evolving injuries in a timely manner. Paediatric surgeons are more likely to manage abdominal injuries conservatively, especially with respect to solid organ injury.³ Mixed and adult MTCs may have adult surgeons operating on younger adolescents rather than dedicated paediatric teams.

Perhaps there are also some subtle differences in trauma management to consider when assessing outcomes. This may include having a parent or carer present during resuscitation and throughout a patient's admission to act as their advocate and draw attention to any changes or concerns. This would be standard practice in a children's MTC but not in an adult MTC and could influence secondary trauma prevention or recognition of evolving complications or deterioration.

In summary, this article raises some important considerations for future management of adolescent trauma. First, if a clear survival benefit was found in the 14–17.99 age group who attended

a children's MTC in a future study with larger numbers, should the cut-off age for triage to a children's MTC be extended from 16 to 18 years? Emergency care systems should ensure that, wherever possible, major trauma patients under 16 years have a primary rather than secondary transfer to a children's MTC. This involves developing prehospital paediatric major trauma triage tools, giving paramedics the education and confidence to transport children longer distances, and to provide clinical support with prehospital critical care teams to the right cases.

Finally, further analysis is required to investigate how children's MTCs differ in their management of adolescent trauma and what can be learnt to improve the resuscitation, surgical management and critical care delivered by other centres. The authors of this commentary (one working at an adult and one at a children's MTC) have found it interesting to compare practice and would define this as a priority for future work to reduce the diversity of systems.

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