TARN

THE TRAUMA AUDIT & RESEARCH NETWORK

England & Wales

MAJOR TRAUMA IN OLDER PEOPLE

2017

Major Trauma in Older People (ISS>15)

Contents

Major Trauma in Older People (ISS>15)

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Major Trauma in Older People (ISS>15)

Foreword

Average life expectancy at 65 is already around 18 years for men and 20 for women. By 2030, there will be a projected increase of around 50% in the number of people over 65 in the UK and 100% for those over 85. Those "oldest old" are the fastest growing segment of the population and by that same time people at 65 may expect to live on average to their late 80s.

Health care practitioners training this year are doing so with the youngest group of patients they are likely to encounter in their careers. This should be a cause for celebration. When the NHS was founded in 1948, nearly half the population died before 65 but now this figure is around 12%. And a big part of this gain is the provision of better clinical interventions for people with acute illness or injury.

Older people with trauma who would formerly have been denied surgical intervention or expert care are now more likely to receive it and teams are more prepared to operate. And the sustained focus on joined up, high quality care for older people with hip fracture has led to sustained improvements in care processes and outcomes.

However, this approach needs to extend beyond patients with fractures of the proximal femur to all types of major trauma, including head injury. And although there is some great collaboration between surgeons, anaesthetists, geriatricians and multidisciplinary teams in some centres for surgical care, such approaches are not yet mainstream, as the findings of this audit clearly show.

Increasingly older people, many with frailty, dementia, or multiple long-term conditions are the core business of acute care and account for the biggest spend, activity and variations in care. We must make health and care systems fit for the older people who actually use them. Indeed their equal right to care is enshrined in the NHS constitution and in the 2010 Equality Act duty around age discrimination in public services.

When it comes to older patients with major trauma, there are of course times where differentiation based on their complex medical needs is perfectly appropriate and both legally and morally justifiable. Services with the right specialist skills including access to geriatricians and comprehensive geriatric assessment are crucial. And there are times where it will be appropriate to offer less interventionist or intensive approaches to older people who are unlikely to benefit or risk being harmed.

However, preventable harm can also result from unjustifiable delays in access to treatment for older people with major trauma including head injury. Paradoxically, older patients with less reserve are more likely to suffer harm from delays in accessing evidence-based treatment on specialist units. And for people who are chronologically older but biologically still fit and well, there can be no excuse for discriminatory access to care, based on their age alone.

What this audit does, to a level of detail not seen before in England and Wales, is to provide a comprehensive broad and deep level of detail on current performance of services for older people with all types of major trauma. It describes considerable and unacceptable variation and care gaps and yes, does seem to suggest a degree of unwitting ageism, discrimination or ignorance of older people's ability to benefit from evidence-based best practice.

As such, the audit provides a great basis on which to build improvement efforts and to learn from the highest performing sites. It is especially commendable for being jointly led by a team including emergency and geriatric medicine, general and orthopaedic surgery, critical care and anaesthetics. And the Trauma Audit and Research Network has done a great job co-ordinating and publishing the work.

Current funding and workforce pressures in the NHS mean there are no quick fixes to this problem. We need adequate numbers of skilled staff and adequate general, ICU and specialist beds, imaging capacity and theatre time. But we can only start to improve what we can measure and this audit gives us a degree of measurement of what really matters that could never be available from routine activity data and coding alone. I commend the team and hope that the next round is able to show even modest improvements.

David Oliver

Professor David Oliver is Clinical Vice President of the Royal College of Physicians of London and a practising Consultant in Geriatrics and General Medicine at Royal Berkshire NHS Foundation Trust. In addition to his current roles, Professor Oliver is also Past President of The British Geriatric Society and former National Clinical Director for Older People.

Major Trauma in Older People (ISS>15)

Executive summary

This report from the Trauma Audit and Research Network is the first comprehensive review of major trauma in older people in England & Wales. It shows that our understanding of the demographics of the disease of major trauma is rapidly changing - an older person suffering a fall from standing height is now the commonest type of major trauma in the national database.

Older patients have injuries that are just as severe with similar areas of the body injured, yet there are major differences in the process of care. This includes the pathway along which older patients flow within the Trauma System, as pre-hospital triage does not seem to be working to identify patients for early direct transfer to a Major Trauma Centre. Late identification has a number of adverse consequences; such as less involvement of senior medical staff, longer times to investigation and longer times to treatment.

Older patients have fewer surgical operations, are less likely to be transferred to a Major Trauma Centre and are more likely to die following serious injury. However in survivors there is only a little more disability than in younger patients. There is insufficient information to determine if the differences in process of care are appropriate.

The changes in data reporting that occurred with the reorganisation of major trauma has led to a profound change in our understanding of the way in which major trauma presents to UK Trauma Systems. This report suggests the need for a review of current trauma systems, and further research to define the optimal system for the delivery of high quality care to severely injured older people.

Key points

- The typical major trauma patient in the TARN data has changed from being young and male to being older with a lower degree of male predominance.
- Older major trauma patients have a similar injury severity and distribution of injury to younger patients.
- Traumatic Brain Injury is the commonest cause of death.
- A fall of <2m is the commonest mechanism of injury in older patients, in contrast to the predominance of road traffic collisions in younger patients.
- Current prehospital triage systems are not good at identifying older major trauma patients.
- Lack of early identification means that initial treatment is more likely to be in a Trauma Unit, and to be undertaken by a more junior doctor.
- Older patients are much less likely to be transferred to specialist care and have longer times to both investigation and intervention.
- Older patients are more likely to die, but those who survive do not have a large incidence of disability compared to younger people.
- The death rate increases steeply in older patients from discharge to 1 year – which needs to be taken into account when assessing research outcomes.
- There is little seasonal variation in major trauma in older people.
- Comorbidity (as measured by the Charlson Comorbidity Index) has an adverse effect on outcome, but it is likely that other factors associated with age have a greater effect. Research is needed to determine the effect of frailty.

Major Trauma in Older People (ISS>15)

Introduction

The incremental increase in the number of adults aged 60 and older who present with serious injury is evident from routine data collected by TARN and other health monitoring systems (Figure 1). This age group now accounts for more than 50% of the severely injured patients registered in the Trauma Audit and Research Network database. Understanding the current status of their care and outcome could lead to the implementation of strategies for improvement.

This report looks at the trend in age of major trauma patients over the last 10 years and considers in detail 8176 patients aged 60 and over with Injury Severity Score greater than 15 who were admitted between 1st January and 31st December 2014. There are many different definitions of 'old age', however in the trauma data there seems to be a change in the age / outcome relationship at about 60 years old. We have therefore used age 60 as the starting point for this report (it should be noted that patients with single fractures distal to the elbow or knee or an isolated fractured neck of femur are not included in the TARN dataset even if the patient spends more than 3 days in hospital).

The report summarises the demographic characteristics of these patients, including details regarding geographical location and injury characteristics. It also includes some indicators of the care provided to these patients, such as the seniority of staff that attended them and whether they had surgery for their injuries. Finally, information about their outcome is presented.

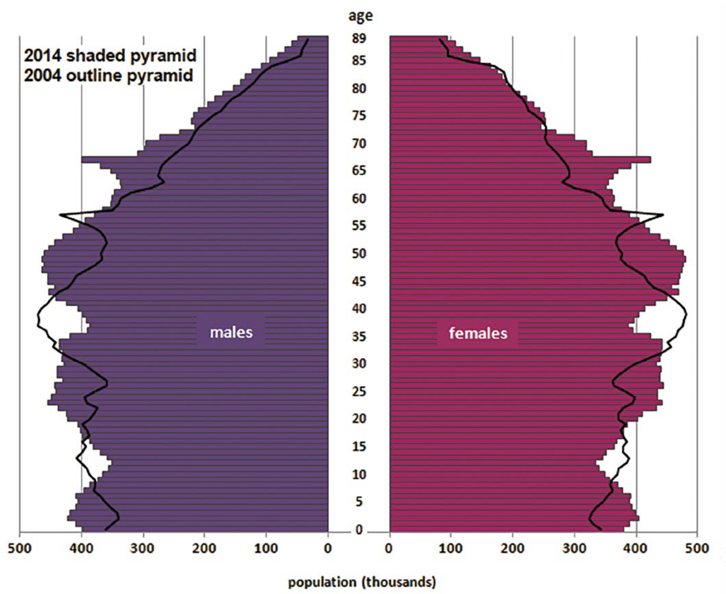

Figure 1: Population pyramid for the UK, mid 2014 (Office for National Statistics)

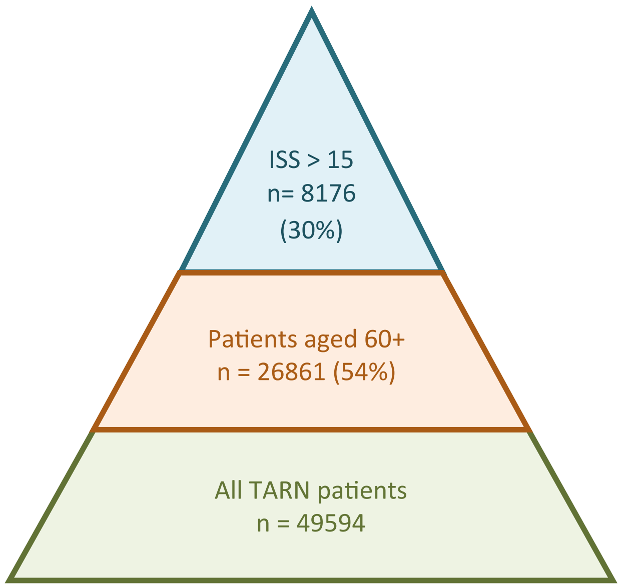

Figure 2: Breakdown of patients

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Demographics

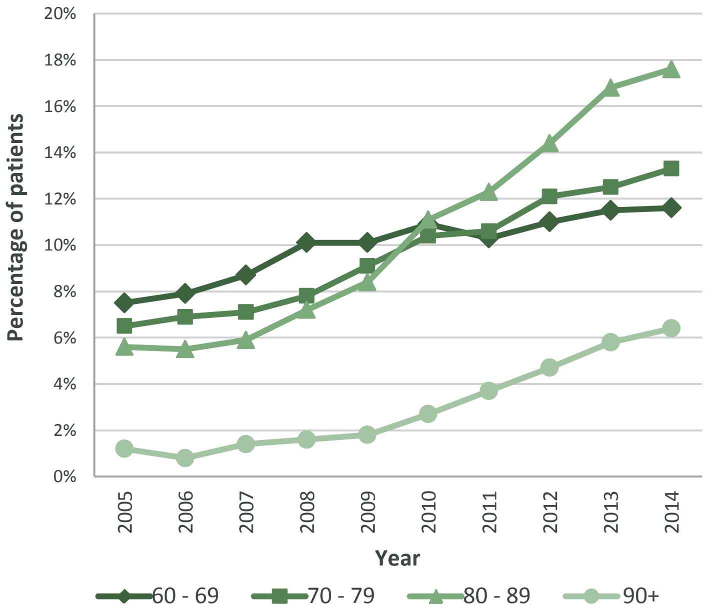

Figure 3a: Severely injured patients since 2005

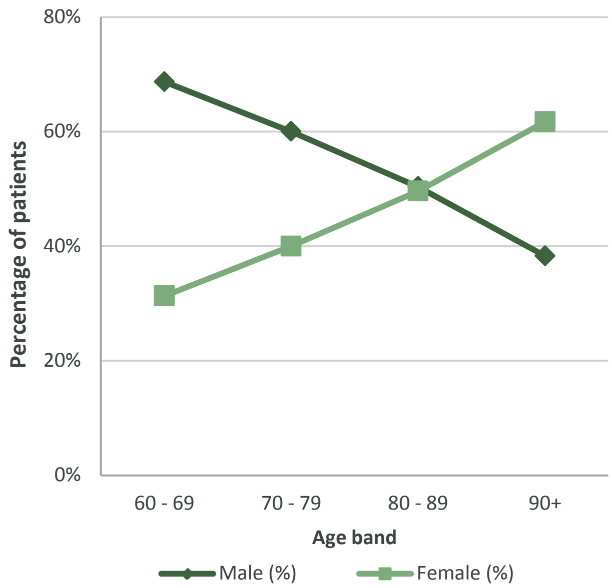

Figure 3b: Gender distribution by age band

(Appendix 2, Table 3)

The age distribution of patients reported to TARN has profoundly changed over the past 10 years (Figure 3a). The largest incremental change is seen in the oldest age groups, and is much higher than would be expected due to demographic changes derived from ONS statistics (Figure 4). These trends suggest that we are revealing previously 'hidden' patients, probably due to (a) the increase in data submissions from Trauma Units over the past 10 years, and (b) the more intensive investigation of older patients following the introduction of the NICE Head Injury Guidelines (National Institute for Health and Care Excellence, 2003).

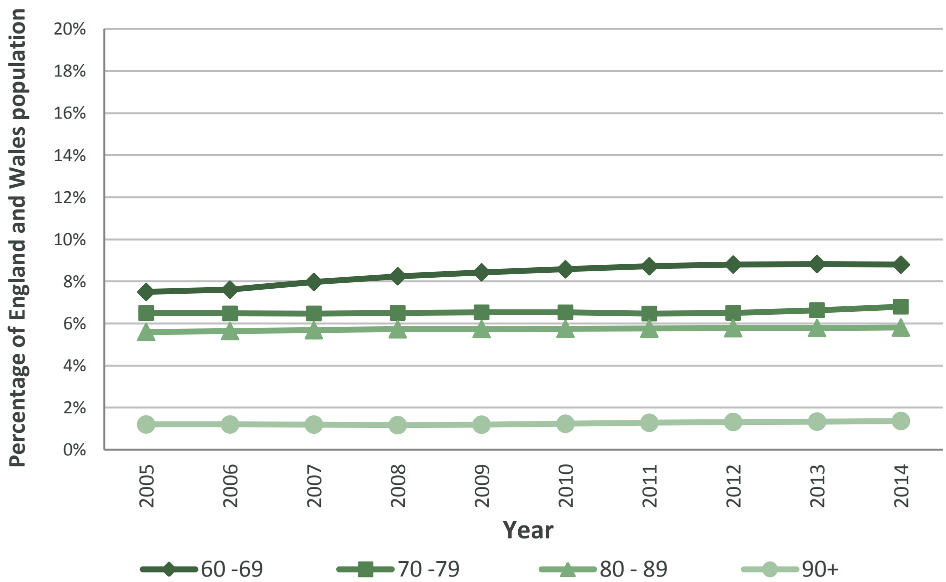

Figure 4: Expected increase in older patients in TARN from 2005 baseline due to population ageing (Appendix 2: Table 4)

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Injury mechanism by age band

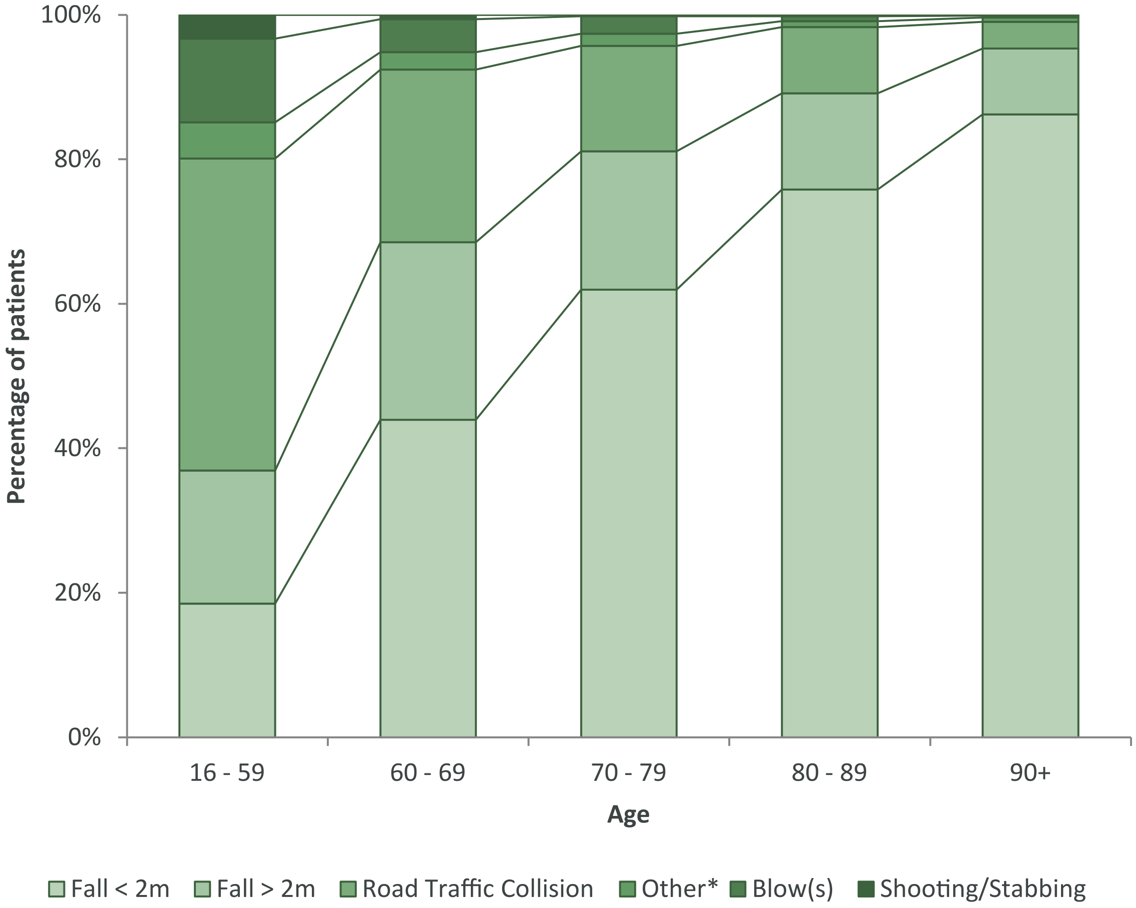

Figure 5: Mechanism of Injury of ISS> 15 patients by age (Appendix 2, Table 5)

Mechanism of injury changes with age. Low falls become a much more common cause of major trauma. A fall of <2m is now the most common mechanism of injury within the TARN database (it should be noted that patients with single fractures distal to the elbow or knee or an isolated fractured neck of femur are not included in the TARN dataset even if the patient spends more than 3 days in hospital; the inclusion of these injuries would further increase the number of patients suffering injuries from falls <2m).

*'Other' includes blast, burn, crush or other mechanisms that are not recorded by TARN separately

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Seasonal variation

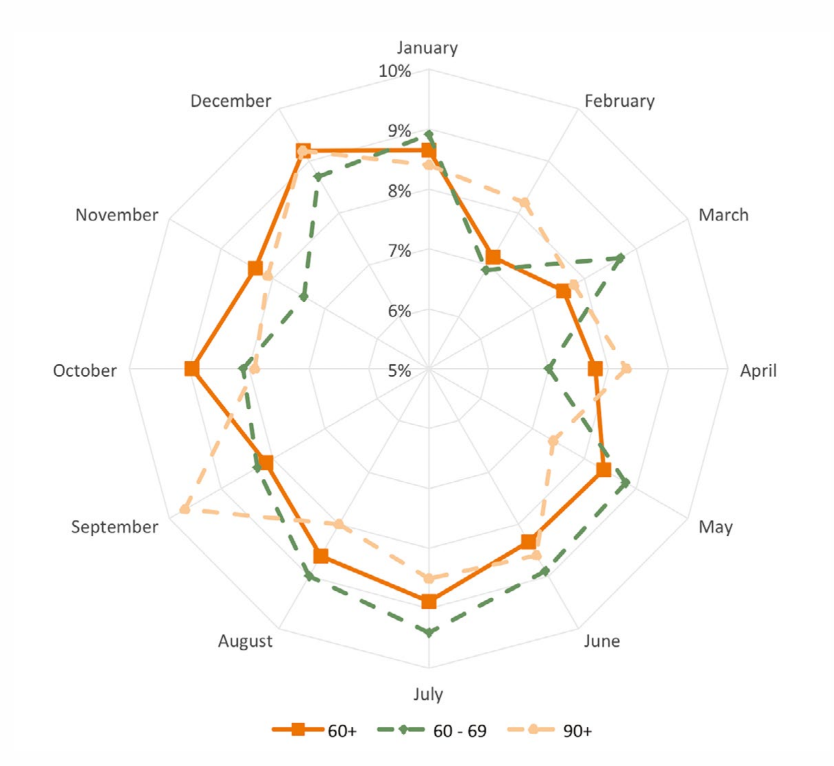

Figure 6: Percentage of injuries in each age band by month (Appendix 2, Table 6)

Contrary to popular belief, there is little seasonal variation in major trauma in older people - it is likely that the perception of seasonality is influenced by the increased prevalence of more minor injuries in the icy conditions of winter. It may be that, as most falls <2m occur in the home, the weather does not have as significant an effect on the rate of injury as previously assumed.

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Location of Incident

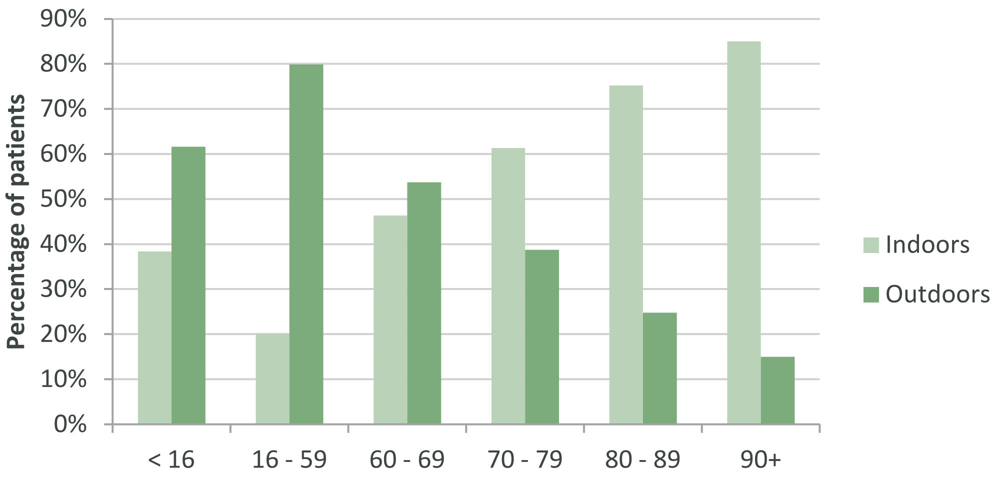

Figure 7: Location of major trauma by age (Appendix 2, Table 7)

The location of incident changes as expected with the predictable alterations in the activity level of the population with age. In younger people most major trauma occurs outside, whereas older people are very much more likely to be injured indoors. This has significant implications for the future targeting of injury prevention efforts, and in particular the prevention of injuries in older people. This data also suggests that a review of accommodation design for older people should be considered to identify, for example, how injuries from falls may be reduced such as looking at designs of floors or other surfaces. In addition the need for further investigation into falls prevention is highlighted by this data.

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Arrival time

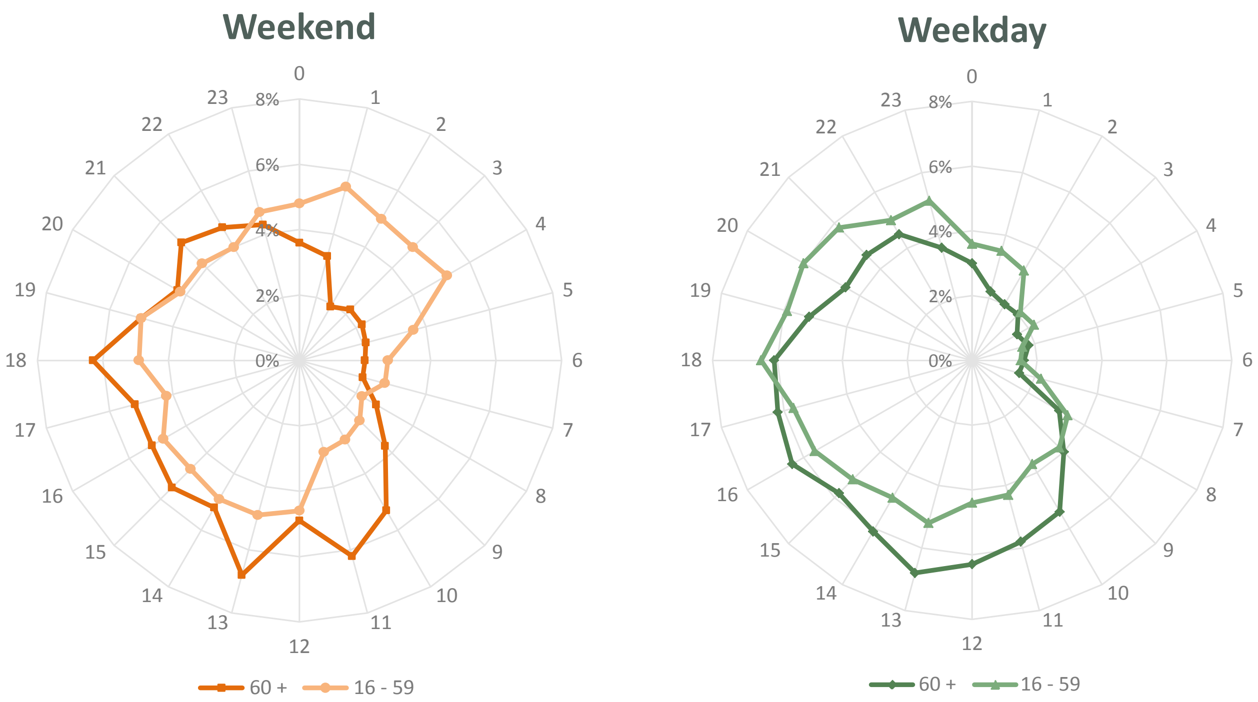

Figure 8: Time of arrival of older and younger patients (Appendix 2, Table 8)

Younger people have an increase in the incidence of major trauma in the early hours at weekends (possibly associated with the night-time economy and alcohol). In contrast, older patients present with major trauma after 09:00. However, this statistic might not reflect the true timing of injury in older people, as there may be a time difference between injury and hospital presentation, as older patients may fall at night, but not be discovered until carers arrive in the morning.

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Process

Emergency care

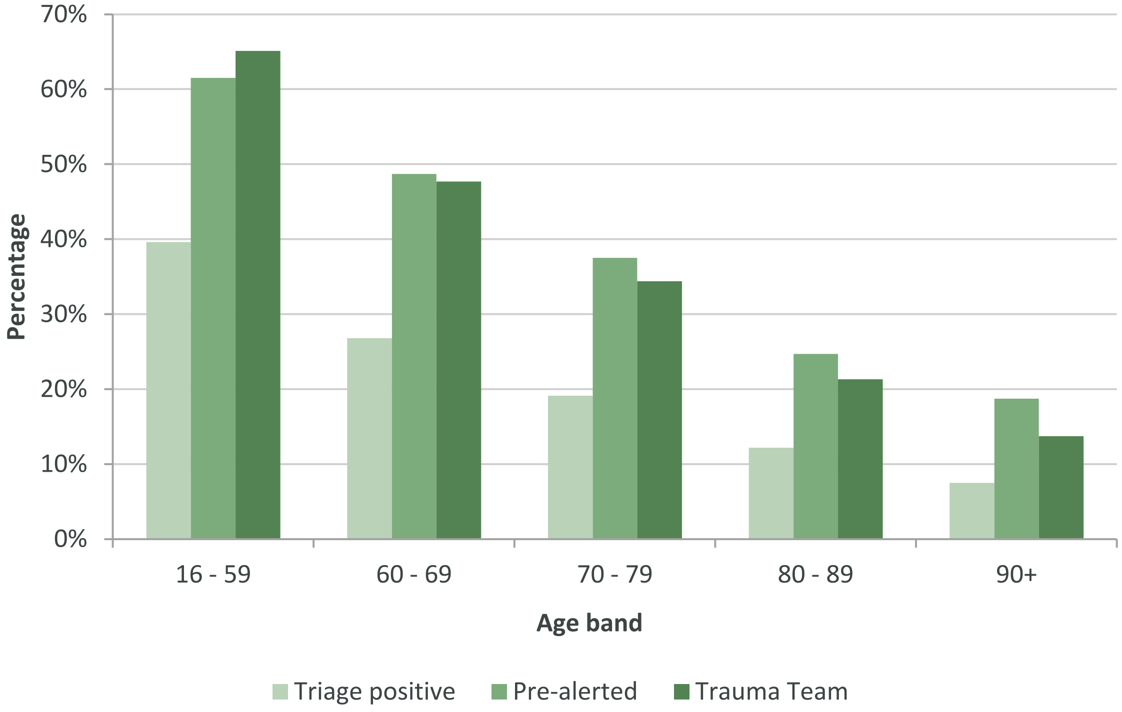

Figure 9: Percentage of patients and triage status (Appendix 2, Table 9)

Pre-hospital triage appears to be far less reliably applied to older people. Few older patients with major trauma are "triage positive" (trigger a primary transfer from the site of injury to a Major Trauma Centre based on the ambulance service tool to identify major trauma patients). In addition, pre-hospital triage status is not recorded in many older patients, possibly because prehospital providers do not always consider major trauma as a potential diagnosis in this group of patients. Much of the teaching on trauma triage emphasises the importance of mechanism of injury, aiming to identify high energy transfer mechanisms. However, this does not apply to older people who can sustain serious injuries from relatively low energy transfer mechanisms. Low levels of positive triage lead to correspondingly low levels of diversion to a Major Trauma Centre, pre-alert to the ED and trauma team activation. These patients are also often treated by more junior staff when they arrive at hospital. Given the poor recognition of major trauma in older people, it is likely that a lower proportion of older patients are assessed in the Resuscitation Room.

The consequence of the above cascade of events is a delay in treatment offered to older people with major trauma. It should be noted, however that there were more pre-alerts than triage positive patients recorded on the TARN database, as 45% of the patients who had a pre-alert did not have a triage score recorded, and it is not known whether the indication for a pre-alert was the injury or other factors. It is also likely that there is a significant amount of missing data for pre-hospital triage.

Nearly all older patients are admitted to hospital through an Emergency Department. However, a small but potentially clinically significant group of patients (3.2% of older major trauma patients) are either admitted directly to a medical ward (1.7%) or sustain their injuries by falling while in hospital (1.3%). Patients admitted directly to a medical ward are often referred for investigation and treatment of the underlying cause of their fall, but may eventually be found to have a significant head or chest injury that was not immediately apparent on initial assessment (Table 9).

Major Trauma in Older People (ISS>15)

Grade of most senior clinician treating patients on arrival

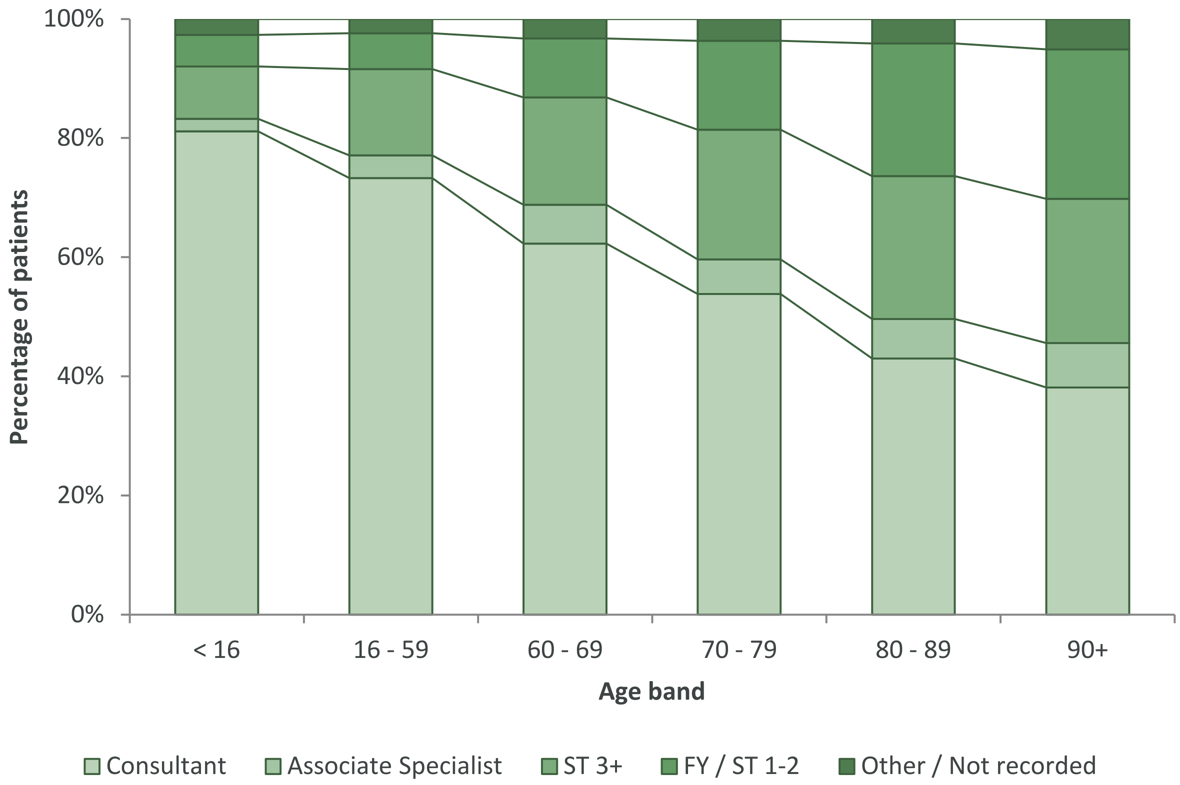

Figure 10: Age and seniority of initial treating clinician (Appendix 2, Table 10)

Half of all older patients directly admitted with major trauma are seen by a consultant on arrival in the Emergency Department (see Table 10). There is a clear trend related to age, with older patients not being identified early (low level of pre-alert) and so being initially treated by more junior doctors. It is likely that a more junior initial assessment leads to delays in investigation and treatment (see later sections).

Consultant led initial care by hour of the day

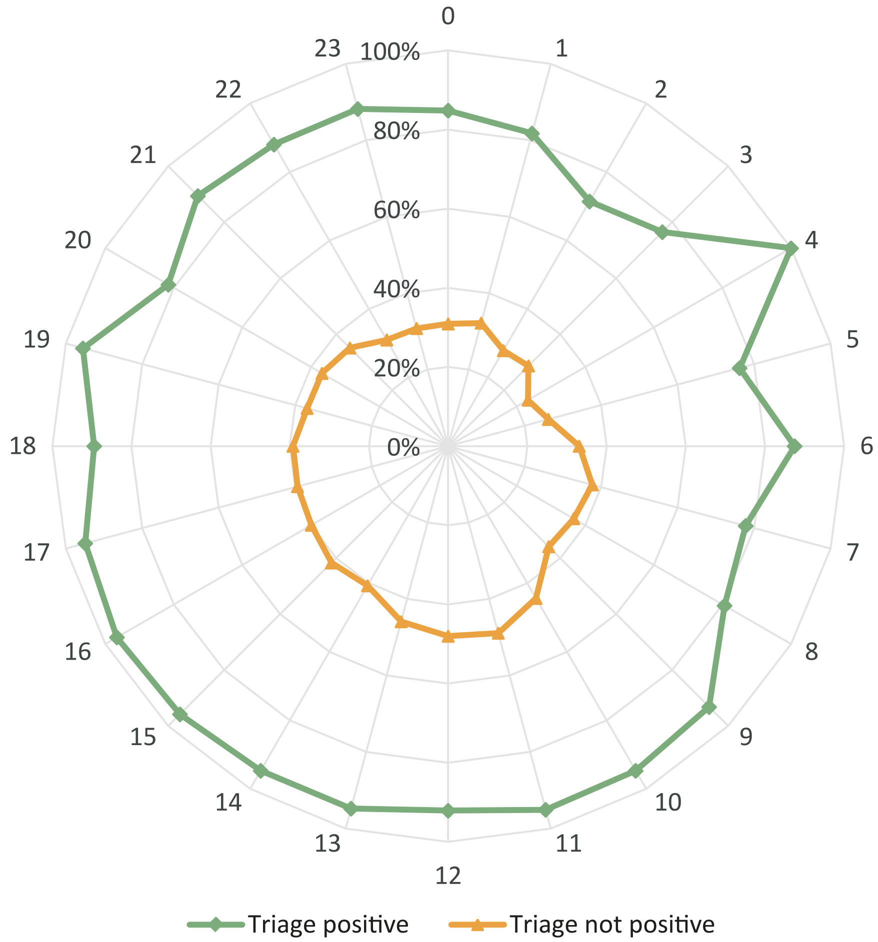

Figure 11: Seniority of initial treating clinician by time of day for older major trauma patients (Appendix 2, Table 11)

The proportion of older patients initially treated by a consultant was near to 100% if they were positive on the prehospital trauma triage tool, whatever the time of injury. Patients in whom pre-hospital triage was either negative or not done were much less likely to be initially treated by a consultant. Approximately 40% of these patients saw a consultant if they were admitted during the day, and this was further reduced to about 30% during the night.

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Time to operation

Table 1: Number of patients having surgical intervention for each body area and time to surgery

		n	n (%) with operation recorded	Median time to surgery	IQR
General operation	**16 - 59**	6837	2549 (37%)	14.8	3.3 - 47.9
	60+	7235	1088 (15%)	25.9	7.7 - 88.6
Head	**16 - 59**	3730	491 (13%)	3.8	1.8 - 15.3
	60+	5389	287 (5%)	14.1	3.8 - 69.9
Abdomen	**16 - 59**	842	282 (33%)	2.9	1.5 - 7.1
	60+	204	50 (25%)	5.8	2.7 - 25.1
Limbs	**16 - 59**	985	345 (35%)	14.5	4.3 - 43.7
	60+	458	184 (40%)	26.8	14 - 82.8
Thorax	**16 - 59**	3178	174 (5%)	3.7	0.8 - 52.2
	60+	1858	72 (4%)	71.8	18.5 - 141.9

Overall, the rate of surgical intervention in older patients is low (Table 1). This more conservative approach may be due to changing risk/benefit ratios for surgical intervention as the risks of surgery and anaesthesia increase with age. However, current data do not contain the information required to judge whether this lower rate of intervention is appropriate or not. There is no information available to judge whether decisions were based on formal risk assessment tools.

The times to surgery in every category are longer for older people, with some categories of surgery happening very much later (for example, time to neurosurgery is more than 3 times as long as for younger patients).
It is uncertain whether this represents the longer time required to assess the patient with co-morbidities, a longer time needed for stabilisation, more ‘conservative’ approach (a trial of non-operative treatment before resorting to surgery), a failure to identify the need for surgery at an early stage, or a lower prioritisation of older patients, in whom surgery may be seen to have less benefit.

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Grade of most senior clinician involved in surgery

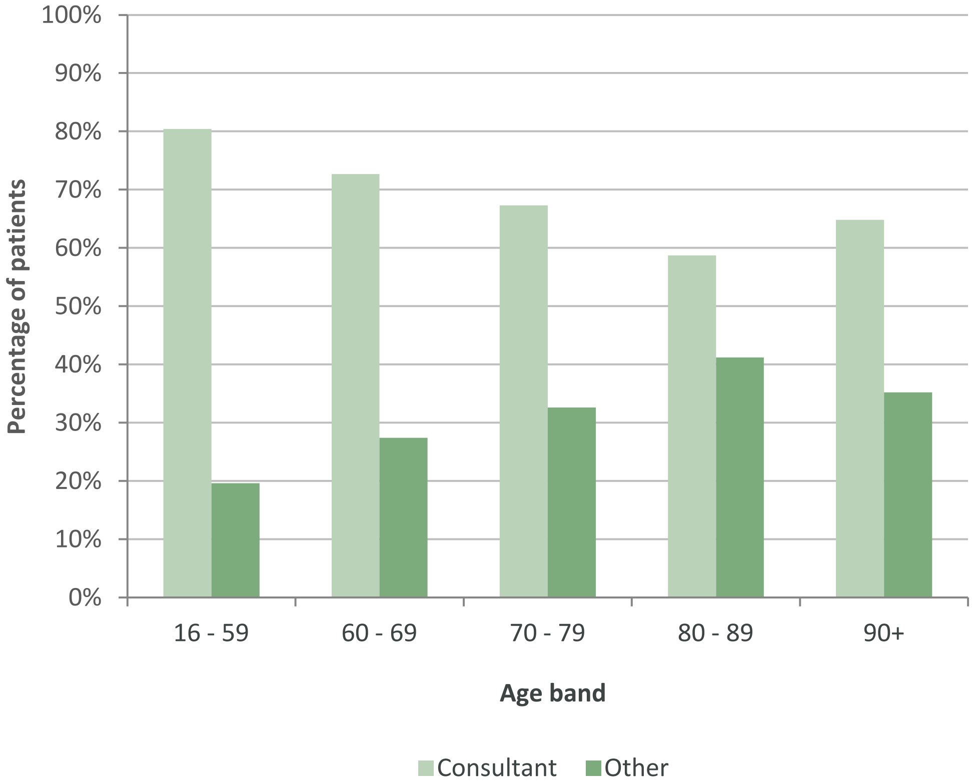

Figure 12: Seniority of operating surgeon by age band (all types of surgery) (Appendix 2,Table 12)

Older patients have fewer operations carried out by a consultant than younger patients. There is either a difference in perception about the appropriate level of surgeon needed to undertake surgery in older people, or there may be difference in the type of surgery needed by older patients (although it seems unlikely that older people have simpler operations after major trauma and thus need less experienced surgeons performing the procedure).

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Length of stay

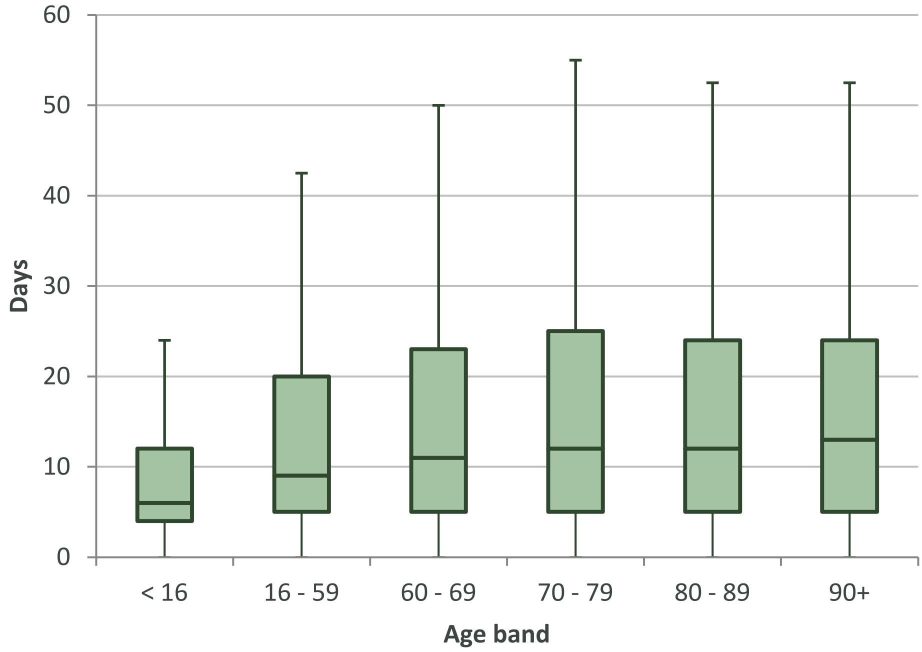

Figure 13: Length of stay in hospital in age bands (Appendix 2, Table 13)

There was little variation in length of hospital stays across the adult age groups.

Length of stay in ICU

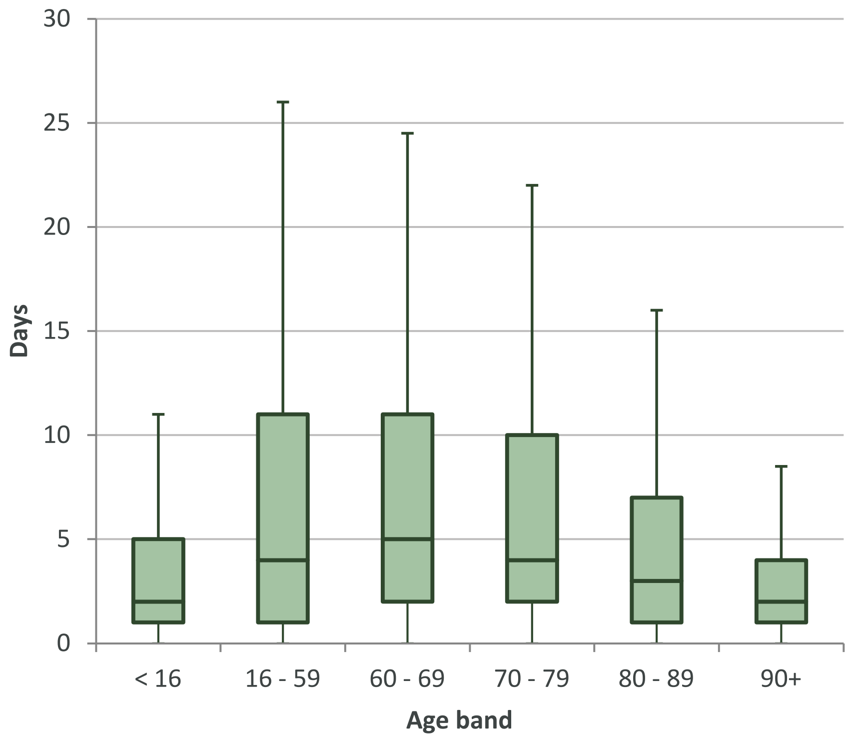

Figure 14: Length of stay in ICU in age bands (Appendix 2, Table 13)

Older trauma patients have shorter lengths of ICU stay. The reasons for this are unclear and require further research.

Major Trauma in Older People (ISS>15)

Injuries

Body area injured

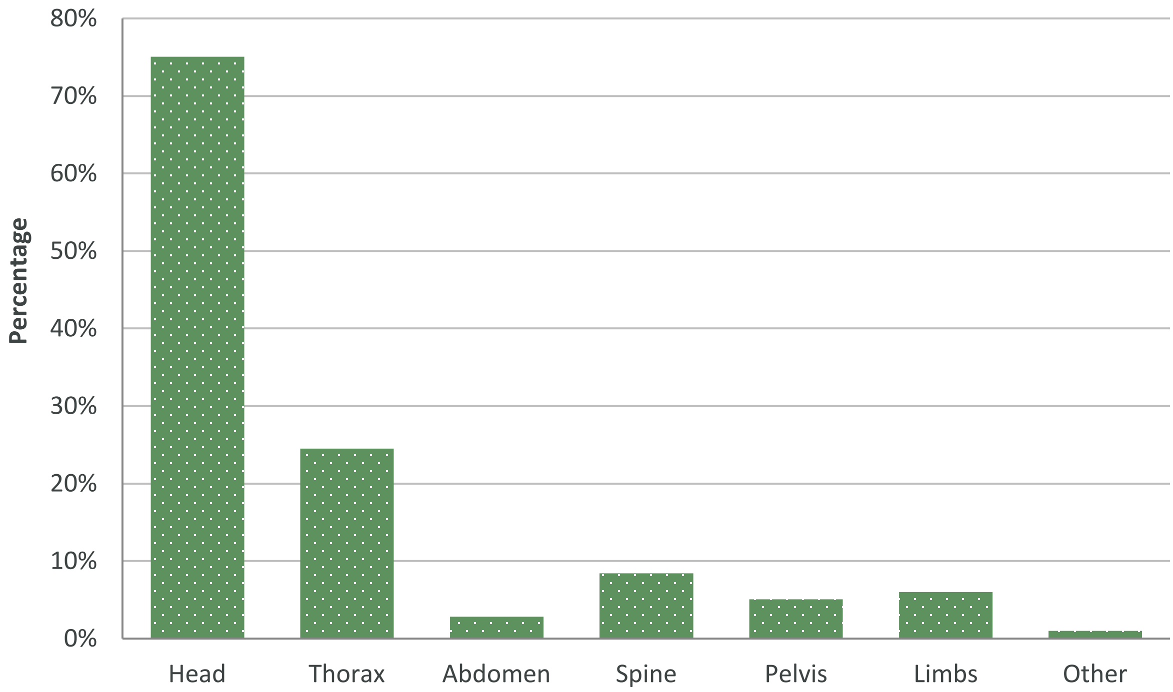

Figure 15: Prevalence of body area injured in 60+ patients (Appendix 2, Table 14)

The AIS ≥ 3 injuries sustained by older people with major injury (ISS > 15) are shown in Figure 15. Patients might have sustained severe injuries in more than one body region and hence categories are not mutually exclusive. "Other" includes face, neck and superficial injuries (for further details please see Table 14).

Traumatic brain injury is by far the commonest type of injury sustained by older people with major trauma. The same pattern is seen in all groups of older patients. The importance of brain injury is again seen in the pattern of injuries in patients who die, especially in the older age groups (it should be noted that patients with single fractures distal to the elbow or knee or an isolated fractured neck of femur are not included in the TARN dataset even if the patient spends more than 3 days in hospital).

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Severity of injury

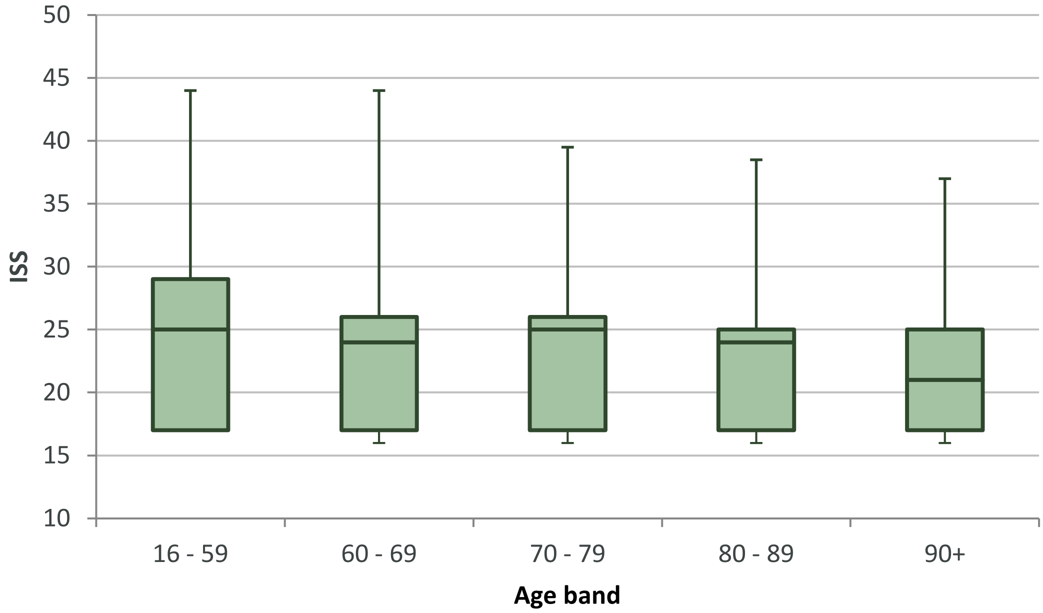

Figure 16: Severity of injury in patients with major trauma (Appendix 2, Table 15)

The distribution of injury severity for major trauma (ISS>15) is similar across age groups with a median ISS of 24 or 25. This suggests that any differences in the process of care or outcomes for older patients is not due to an overall lower severity of injury.

Traumatic Brain Injuries

Time to Head CT for patients with Traumatic Brain Injury (TBI)

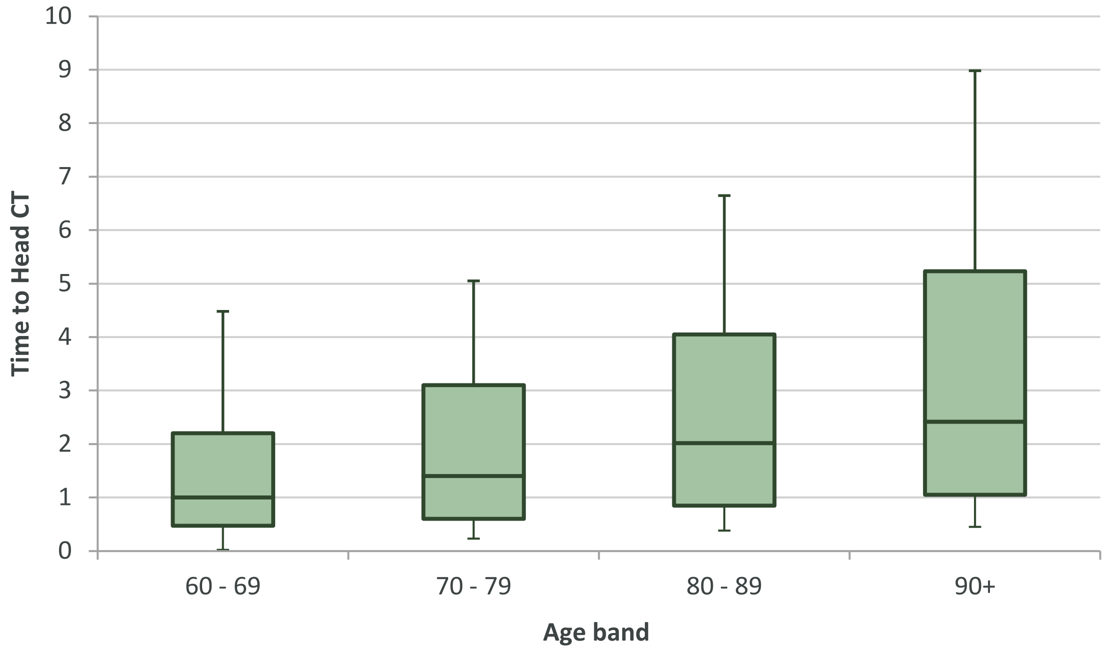

Figure 17: Relationship between age and time to CT head scan (Appendix 2, Table 16)

Time to head scan in older patients with serious TBI (AIS Head 3+) is about 1.5 hours longer than younger patients. This may be due to difficulties in early identification, difficulties in head injury assessment in patients with dementia, a higher proportion of acute on chronic subdural bleeds with a minor mechanism of injury, slower presentation of symptoms as the older cranium has more space to accommodate bleeding, or a lower prioritisation of older patients.

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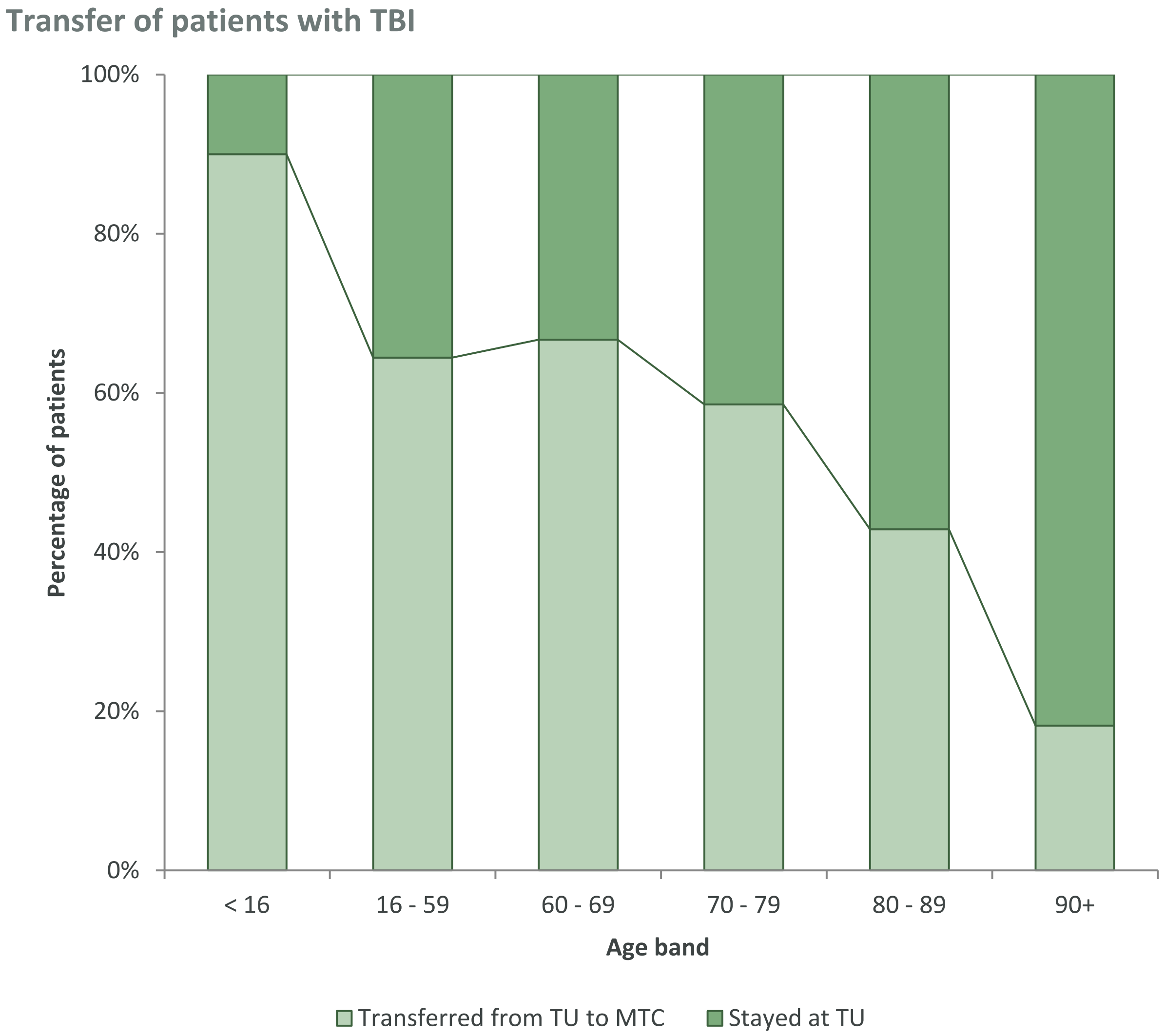

Figure 18: Probability of transfer to a specialist centre for traumatic brain injury by age (Appendix 2, Table 17)

If initially admitted to a Trauma Unit older patients with serious intra-cranial injuries (AIS 3+) are much less likely to be transferred to a specialist centre for treatment. There is no information in the database to assess how transfer decisions are made, whether co-morbidity and the potential for rehabilitation is assessed and whether or not these decisions not to transfer were appropriate.

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Outcome

Glasgow Outcome Score on discharge from acute care

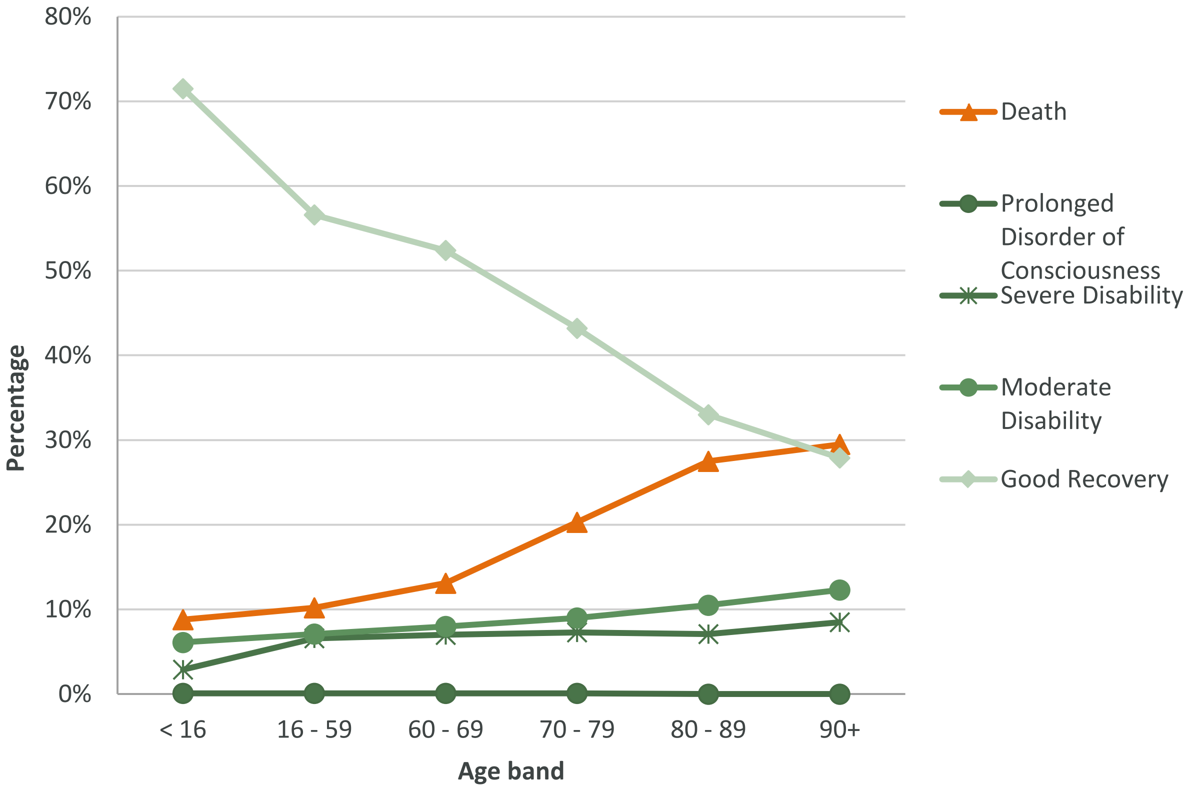

Figure 19: GOS on discharge from hospital by age group (Appendix 2, Table 18)

Following major trauma, mortality increases with age, and there is a corresponding decrease in the number who make a good recovery. However there is relatively little effect of age on the proportion of patients with severe or moderate disability. A similar age effect is seen for interventions such as operative intervention for aortic dissection, urgent thrombolysis, and carotid endarterectomy, which might imply that there are similar underlying causes for these trends in outcome. Older people do worse generally, and are often at increased risk of peri-procedural mortality, although this may relate to a more severe initial illness. However older people, who survive major trauma, have similar outcomes to their younger counterparts.

The relationships between risks and benefits in trauma care are complex. In some circumstances high risk patients have the most to gain from treatment, so the balancing of the risks and benefits of different courses of action is not an exact science. The data presented here illustrate the 'what' but not the 'why' of these relationships.

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Mortality at 30 days and six months from discharge

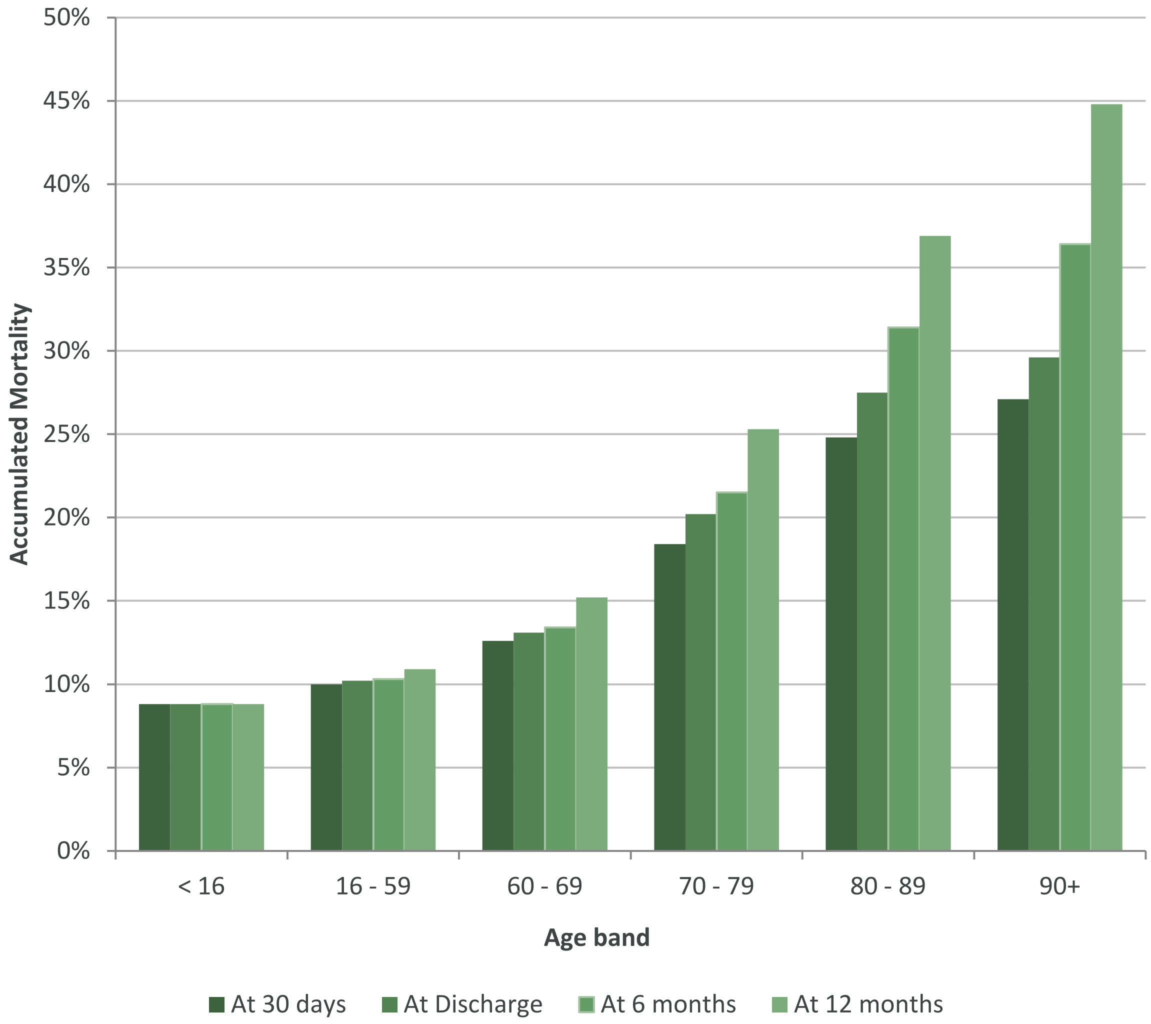

Figure 20: Mortality at different time points by age group (Appendix 2, Table 19)

As expected there is a clear increase in mortality with age following major trauma, combined with a greater proportion of late (>30 day) deaths (the data does not tell whether these late deaths are trauma related or due to other causes associated with normal ageing). This pattern has implications for choosing the endpoint for future trauma research in older people as projects using later mortality endpoints may be confounded by a large number of non-trauma deaths.

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Modified Charlson Comorbidity Index and outcome

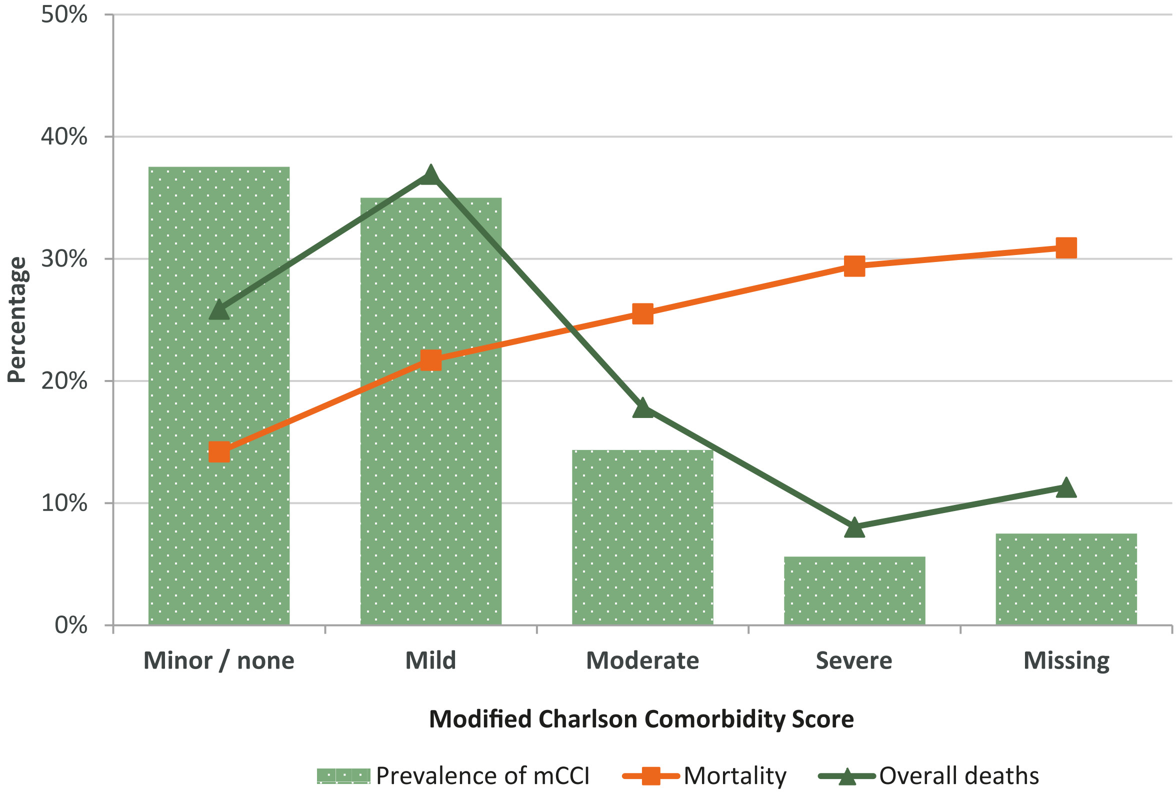

Figure 21: Relation between the prevalence of Modified Charlson Comorbidity index and outcome (Appendix 2, Table 20)

There were relatively few patients (20%) with moderate or severe comorbidities. There was the expected increase in mortality with more severe co-morbidity (this factor has been included in the TARN outcome prediction model since 2015). However, the vast majority of the deaths were in older patients with mild, minor or no co-morbidities and the effect of co-morbidity on mortality was not as strong as expected. This might imply that co-morbidity is not capturing what we need to in this population - it may be that frailty is an important additional factor that should be measured. Further research is required to better understand the interactions between age, co-morbidity and frailty. The impact of frailty in major trauma is currently an important new area of investigation for TARN.

Major Trauma in Older People (ISS>15)

Injuries in patients who died

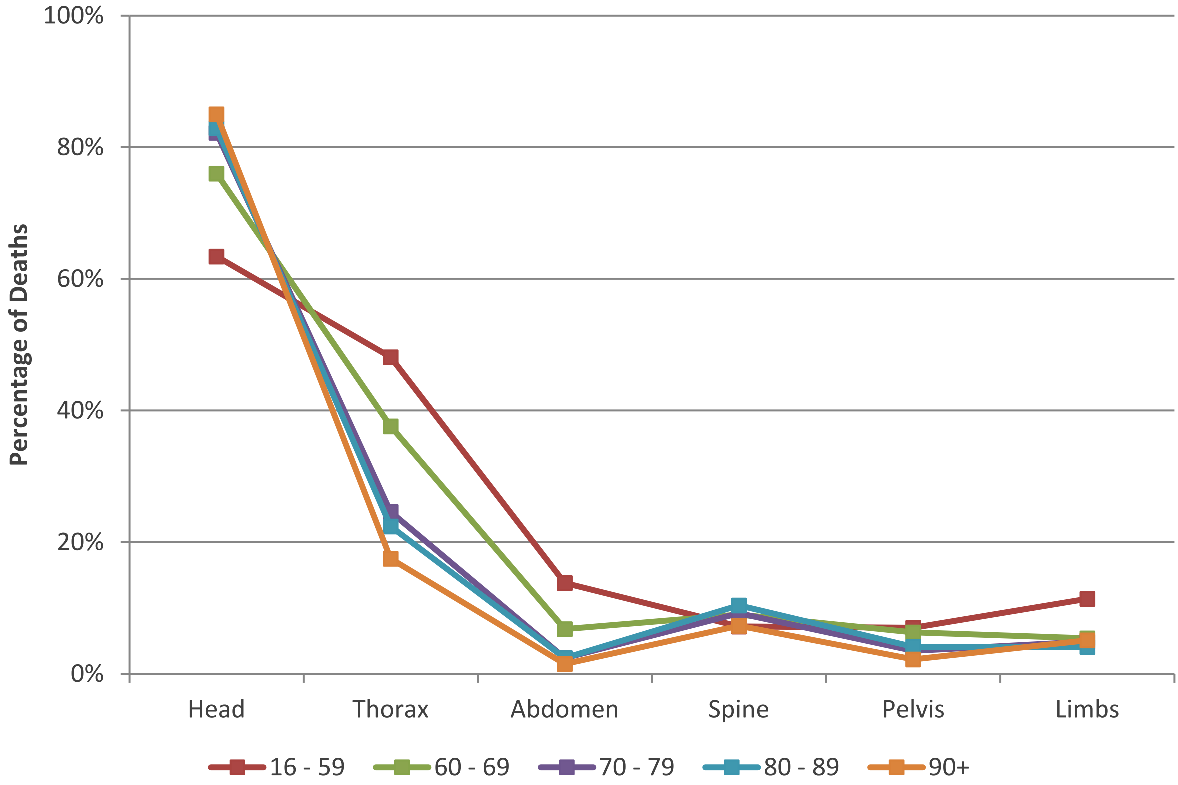

Figure 22: Body area injured in different age groups (Appendix 2, Table 21)

Overall the similarity of body area injured in fatal cases across age bands suggests that any differences in the process of care or outcomes for older patients are not due to differences in the anatomical area injured. There is a greater preponderance of severe head injury in older patients who die.

Major Trauma in Older People (ISS>15)

Prevalence of deaths by injury mechanism

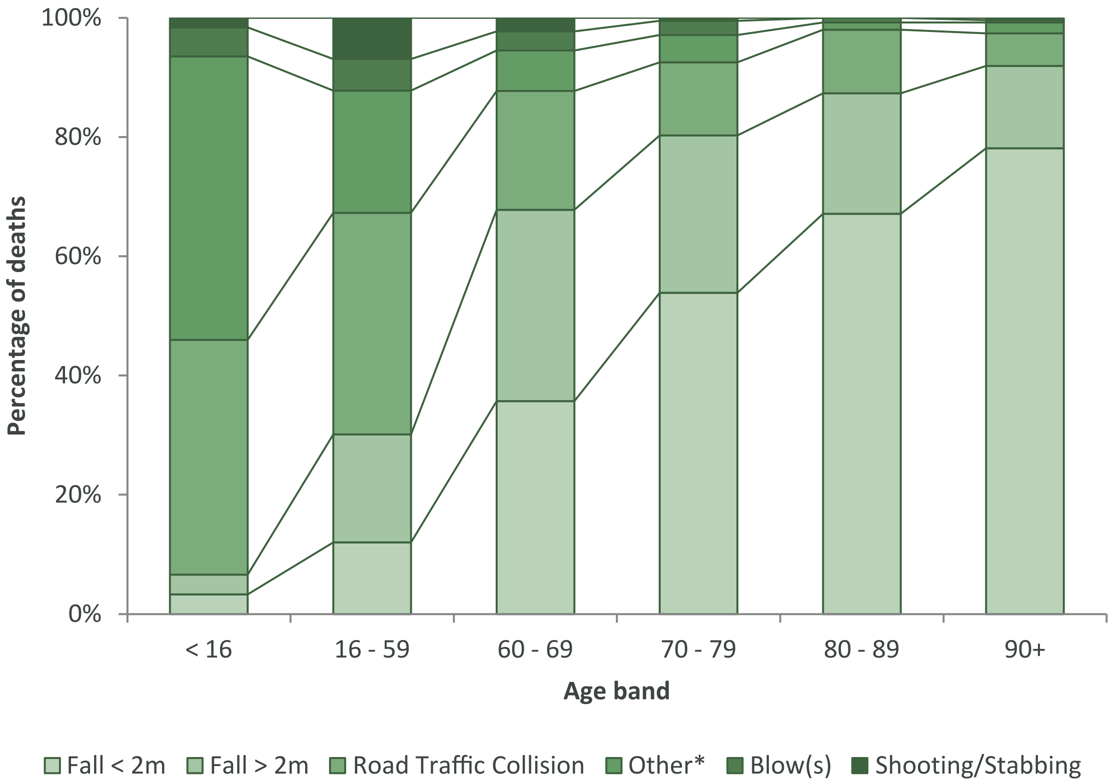

Figure 23: Injury mechanisms associated with death (Appendix 2, Table 22)

The injury mechanism in patients who die from major trauma shows a dramatic change with age. In older patients low falls (<2m) become increasingly dominant and road traffic collisions account for a much smaller proportion of deaths. This gives a significant injury prevention problem in older people, as even the best falls prevention programmes have only had a modest effect on the number of falls that occur.

*'Other' includes blast, burn, crush or other mechanisms that are not recorded separately by TARN.

Conclusion

This report is the most comprehensive published description of major trauma in older people. There has been a dramatic change in the demographics of major trauma reported to the national database over the last 10 years, with a large increase in the number of older patients due to the inclusion in the national dataset of a previously hidden group of patients, increased CT head scanning and demographic change. The numerical importance of this group in trauma care will continue to gradually increase as the population ages.

The most important underlying finding of this report is the difficulty that current systems appear to have in the early identification of older patients with major trauma, probably because current trauma triage is directed to identifying high energy transfer trauma (where the potential for major injury is usually obvious from the accident scene). The difficulty in the early identification of older patients may be caused by low energy transfer mechanisms of injury; co-morbidities which make the presentation less obvious; and signs of significant injury may take longer to manifest.

Whatever the underlying cause, shortcomings in the early identification of major trauma in older people leads to a low rate of positive prehospital triage with low rates of bypass to a Major Trauma Centre (MTC); low levels of pre-alert; low levels of trauma team activation and initial management by relatively junior doctors. This lower level of early activation of the trauma care system seems to lead to delays in both investigation and management.

The commonest mechanism of major trauma in older people is a fall of less than 2 metres (e.g. a fall from standing). However, this is an extremely common occurrence among this patient group, and the vast majority do not sustain severe injuries. There is therefore a ‘needle in a haystack’ problem for the trauma system – as the vast majority of low falls in older people do not result in major trauma, clinicians tend to look for single site injuries (such as a fracture neck of femur) in these patients, rather than to think ‘major trauma’. Given the prevalence of low falls in older people, it would not be possible to activate the major trauma protocol for all of these incidents. However, current trauma triage protocols (which were primarily designed for much younger patient populations) are not working well for older people and do not reliably distinguish older patients with low falls who have sustained serious injuries from those who have not. Further research is undoubtedly required in this area.

The overall injury severity is just as high in older patients, despite very different (low rather than high energy transfer) mechanisms of injury.

Rehabilitation is a key part of major trauma management and, although the evidence is poor, it is likely to be a key determinate of outcome in older people. In deciding whether or not to perform interventions the concept of ‘rehabilitation potential’ is often used. This is a subjective measure that is vulnerable to clinicians’ personal biases and is not part of the current trauma dataset, as it cannot be measured. However, it probably has a large influence on outcome. The recent inclusion of some basic questions about rehabilitation in the TARN dataset might in future shed more light on this area.

As early identification of major trauma in older people is difficult, it is likely that in future trauma systems it will be increasingly normal to have late identification of patients, with initial treatment in a Trauma Unit and initial treatment by junior doctors. This is not the situation that current trauma care systems are designed for, as prehospital triage to a MTC is the foundation of the system. Trauma systems will need to adapt to anticipate increasing numbers of older trauma patients presenting to TUs with late identification, yet still allow for rapid initiation of major trauma protocols wherever the patient is identified (prehospital, emergency department or ward), with rapid movement to a Major Trauma Centre as required. The change in our understanding of the demographics of major trauma outlined in this report should lead to a profound change in the way in which major trauma is managed by UK Trauma Systems. There are two distinct types of major trauma - high energy transfer trauma in younger patients and low energy transfer trauma in older patients. Each of these types account for about half of major trauma cases. This report suggests the need for both a review of the current arrangements and further research to define the optimal system for the delivery of high quality care to the severely injured older person.

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Glossary

AIS	Abbreviated Injury Scale score. A value between 1 (minor) and 6 (fatal) is assigned to each injury
AIS 3+	Injuries with an AIS severity score of 3 or more. This denotes moderate to major injury
Charlson Comorbidity Index	The Charlson Comorbidity Index is a method that measures the risk to life from pre-existing diseases. Examples of these include cancers, diabetes and heart disease.
GOS	The Glasgow Outcome Score applies to patients with a brain injury and allows an assessment of their recovery in five categories ranging from death to good recovery with resumption of normal activities although there may be minor neurological or psychological deficits.
Injury Severity Score (ISS)	A score ranging from 1, (minor) to 75 (severe injuries that are likely to result in death). An ISS between 9 and 15 is considered moderate. An ISS of 16 or more is considered severe. ISS is calculated using the Abbreviated Injury Scale (AIS).
ONS	Office for National Statistics
Triage positive	Patients are assessed at scene using a flow chart triage system and, if deemed to meet the Major Trauma Centre criteria for direct transfer, recorded as Positive
Pre-alert	The Pre-Hospital Care Provider (e.g. Paramedic, Doctor) alerted the ED prior to the arrival of the patient, stating ETA, summary of injuries and resources required on arrival.
TARN	The Trauma Audit & Research Network
TBI	Traumatic Brain Injury

Grades of Doctor

Consultant	Consultant
Associate Specialist	Associate Specialist
ST 3+	Specialist Registrar, Specialist Trainee, Clinical Fellow, Senior Registrar, Specialist Doctor
FY/ST 1-2	Foundation Year, Speciality Trainee 1-2, Senior house officer, House Officer, Core Trainee, Speciality Trainee year 1 and 2
Other/Not recorded	Not known/not recorded, Nurse Consultant, Advanced Practitioner

Appendix 1: Data Completeness

Table 2: Data completeness

	n	HES	Completion %
All submissions	54348	74240	73.2
Deaths	*3364*	*5596*	*60.1*
Older than 60 years	28736	47561	60.4

Hospitals: England and Wales

This is displayed as a percentage and represents the number of patients submitted to TARN compared to the number of patients expected based on the 2014 Hospital Episode Statistics (HES) dataset. The HES dataset is used as a general baseline.

This data refers to submissions to TARN, however the same patient may be submitted more than once if they undergo an inter-hospital transfer. Reducing the dataset to individual cases results in 49600 patients who met the TARN entry criteria admitted to hospitals in the area covered by this report.

Appendix 2: Additional Tables and Figures

Table 3: Number of severely injured patients admitted since 2005 by age band and gender distribution

Year	All admitted	Age			
		60 -69	70 -79	80 - 89	90+
2005	2858	213 (7.5%)	187 (6.5%)	159 (5.6%)	35 (1.2%)
2006	2519	200 (7.9%)	173 (6.9%)	138 (5.5%)	19 (0.8%)
2007	3528	307 (8.7%)	251 (7.1%)	208 (5.9%)	49 (1.4%)
2008	4144	420 (10.1%)	323 (7.8%)	297 (7.2%)	68 (1.6%)
2009	5859	592 (10.1%)	533 (9.1%)	493 (8.4%)	107 (1.8%)
2010	8241	897 (10.9%)	860 (10.4%)	914 (11.1%)	226 (2.7%)
2011	10749	1108 (10.3%)	1139 (10.6%)	1318 (12.3%)	395 (3.7%)
2012	12592	1379 (11%)	1520 (12.1%)	1815 (14.4%)	598 (4.7%)
2013	15008	1723 (11.5%)	1874 (12.5%)	2522 (16.8%)	869 (5.8%)
2014	16673	1942 (11.6%)	2224 (13.3%)	2927 (17.6%)	1062 (6.4%)
Gender					
Male	56789	6027 (69%)	5449 (60%)	5434 (50%)	1312 (38%)
Female	25382	2752 (31%)	3635 (40%)	5357 (50%)	2116 (62%)

Percentage out of the total number of admitted patients

Table 4: Age population since 2005

Year	England and Wales population	Age[2]			
		60 -69	70 -79	80 - 89	90+
2005[1]	2,858	7.5%	6.5%	5.6%	1.2%
2005	53,575,343	7.5%	6.5%	5.6%	1.2%
2006	53,950,854	7.6%	6.5%	5.6%	1.2%
2007	54,387,392	8.0%	6.5%	5.7%	1.2%
2008	54,841,720	8.2%	6.5%	5.7%	1.2%
2009	55,235,253	8.4%	6.5%	5.7%	1.2%
2010	55,692,423	8.6%	6.5%	5.8%	1.2%
2011	56,170,927	8.7%	6.5%	5.8%	1.3%
2012	56,567,796	8.8%	6.5%	5.8%	1.3%
2013	56,948,229	8.8%	6.6%	5.8%	1.3%
2014	57,408,654	8.8%	6.8%	5.8%	1.4%

[1] TARN baseline population

[2] Adjusted percentage, applying proportional ONS change in each year to the 2005 baseline population in TARN (Office for National Statistics)

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Table 5: Injury mechanism by age band

	Age band (years)				
	16 - 59	60 - 69	70 - 79	80 - 89	90+
Fall < 2m	1446 (18.5%)	857 (44%)	1383 (61.9%)	2226 (75.9%)	917 (86.3%)
Fall > 2m	1436 (18.4%)	479 (24.6%)	427 (19.1%)	389 (13.3%)	97 (9.1%)
Road Traffic Collision	3365 (43.2%)	465 (23.9%)	327 (14.6%)	270 (9.2%)	39 (3.7%)
Other	387 (5%)	46 (2.4%)	39 (1.7%)	22 (0.8%)	6 (0.6%)
Blow(s)	904 (11.6%)	90 (4.6%)	53 (2.4%)	20 (0.7%)	3 (0.3%)
Shooting/Stabbing	258 (3.3%)	11 (0.6%)	4 (0.2%)	5 (0.2%)	1 (0.1%)

Number (%)

Table 6: Seasonal variation

Month	**Age band**			
	60 - 69	**70 - 79**	**80 - 89**	**90+**
January	173 (8.9%)	191 (8.6%)	254 (8.7%)	89 (8.4%)
February	134 (6.9%)	148 (6.6%)	215 (7.3%)	87 (8.2%)
March	169 (8.7%)	162 (7.3%)	207 (7.1%)	83 (7.8%)
April	137 (7%)	185 (8.3%)	226 (7.7%)	88 (8.3%)
May	171 (8.8%)	177 (7.9%)	258 (8.8%)	79 (7.4%)
June	174 (8.9%)	172 (7.7%)	244 (8.3%)	91 (8.6%)
July	183 (9.4%)	201 (9%)	252 (8.6%)	90 (8.5%)
August	175 (9%)	195 (8.7%)	249 (8.5%)	85 (8%)
September	161 (8.3%)	185 (8.3%)	217 (7.4%)	103 (9.7%)
October	157 (8.1%)	212 (9.5%)	279 (9.5%)	84 (7.9%)
November	145 (7.4%)	200 (9%)	251 (8.6%)	86 (8.1%)
December	169 (8.7%)	205 (9.2%)	280 (9.5%)	98 (9.2%)

Number (%)

Table 7: Location of incident by age group

Location	**Age band**					
	< 16	**16 - 59**	**60 - 69**	**70 - 79**	**80 - 89**	**90+**
Indoors	286 (38%)	1566 (20%)	901 (46%)	1368 (61%)	2204 (75%)	904 (85%)
Outdoors	459 (62%)	6228 (80%)	1047 (54%)	864 (39%)	728 (25%)	160 (15%)

Number (%)

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Table 8: Hour of arrival

Hour of arrival	16 - 59			60 +		
	All	Day of the week		All	Day of the week	
		Weekday	Weekend		Weekday	Weekend
0	314 (4.1%)	179 (3.6%)	135 (4.8%)	253 (3.1%)	174 (3%)	79 (3.6%)
1	326 (4.2%)	170 (3.5%)	156 (5.5%)	205 (2.5%)	132 (2.2%)	73 (3.3%)
2	299 (3.9%)	157 (3.2%)	142 (5%)	161 (2%)	120 (2%)	41 (1.9%)
3	239 (3.1%)	102 (2.1%)	137 (4.9%)	167 (2.1%)	118 (2%)	49 (2.2%)
4	251 (3.2%)	106 (2.2%)	145 (5.2%)	143 (1.8%)	94 (1.6%)	49 (2.2%)
5	178 (2.3%)	77 (1.6%)	101 (3.6%)	151 (1.9%)	106 (1.8%)	45 (2.1%)
6	149 (1.9%)	74 (1.5%)	75 (2.7%)	136 (1.7%)	92 (1.6%)	44 (2%)
7	181 (2.3%)	106 (2.2%)	75 (2.7%)	131 (1.6%)	87 (1.5%)	44 (2%)
8	226 (2.9%)	165 (3.4%)	61 (2.2%)	244 (3%)	184 (3.1%)	60 (2.7%)
9	260 (3.4%)	188 (3.8%)	72 (2.6%)	316 (3.9%)	234 (4%)	82 (3.7%)
10	260 (3.4%)	180 (3.7%)	80 (2.8%)	433 (5.4%)	316 (5.4%)	117 (5.3%)
11	292 (3.8%)	210 (4.3%)	82 (2.9%)	475 (5.9%)	340 (5.8%)	135 (6.2%)
12	344 (4.4%)	215 (4.4%)	129 (4.6%)	481 (5.9%)	373 (6.3%)	108 (4.9%)
13	393 (5.1%)	256 (5.2%)	137 (4.9%)	550 (6.8%)	402 (6.8%)	148 (6.8%)
14	379 (4.9%)	240 (4.9%)	139 (4.9%)	472 (5.8%)	357 (6.1%)	115 (5.2%)
15	387 (5%)	254 (5.2%)	133 (4.7%)	462 (5.7%)	341 (5.8%)	121 (5.5%)
16	410 (5.3%)	274 (5.6%)	136 (4.8%)	491 (6.1%)	377 (6.4%)	114 (5.2%)
17	400 (5.2%)	281 (5.7%)	119 (4.2%)	483 (6%)	368 (6.2%)	115 (5.2%)
18	457 (5.9%)	319 (6.5%)	138 (4.9%)	501 (6.2%)	362 (6.1%)	139 (6.3%)
19	430 (5.6%)	290 (5.9%)	140 (5%)	417 (5.2%)	307 (5.2%)	110 (5%)
20	414 (5.4%)	296 (6%)	118 (4.2%)	359 (4.4%)	264 (4.5%)	95 (4.3%)
21	403 (5.2%)	285 (5.8%)	118 (4.2%)	383 (4.7%)	272 (4.6%)	111 (5.1%)
22	358 (4.6%)	246 (5%)	112 (4%)	366 (4.5%)	263 (4.5%)	103 (4.7%)
23	383 (5%)	251 (5.1%)	132 (4.7%)	307 (3.8%)	212 (3.6%)	95 (4.3%)

Number (%)

Table 9: Admissions to ED

	Age bands (years)				
	16 - 59	60 - 69	70 - 79	80 - 89	90+
Went to ED	6798 (99%)	1643 (98%)	1855 (97%)	2534 (96%)	973 (97%)
Triage positive	2690 (40%)	440 (27%)	355 (19%)	310 (12%)	73 (8%)
Pre-alerted	4182 (62%)	800 (49%)	696 (38%)	625 (25%)	182 (19%)
Trauma Team	4423 (65%)	783 (48%)	638 (34%)	541 (21%)	133 (14%)

Number (%)

3.2% of 60 years old and older were not admitted by ED, 1.7% were admitted directly to a ward and 1.3% were inpatients in the hospital at the moment of the incident and the rest to surgery or transferred to other hospital.

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Table 10: Most senior doctor on arrival by age group

	Age band (years)					
	< 16	16 - 59	60 - 69	70 - 79	80 - 89	90+
Consultant	458 (81.1%)	4986 (73.3%)	1024 (62.3%)	998 (53.8%)	1089 (43%)	371 (38.1%)
Associate Specialist	12 (2.1%)	257 (3.8%)	106 (6.5%)	107 (5.8%)	166 (6.6%)	73 (7.5%)
ST 3+	50 (8.8%)	987 (14.5%)	296 (18%)	405 (21.8%)	609 (24%)	235 (24.2%)
FY / ST 1-2	30 (5.3%)	407 (6%)	162 (9.9%)	277 (14.9%)	566 (22.3%)	244 (25.1%)
Other / Not recorded	15 (2.7%)	161 (2.4%)	55 (3.3%)	68 (3.7%)	104 (4.1%)	50 (5.1%)

Number (%)

Table 11: Presence of consultant by Triage Tool option

Hour of arrival	Triage positive		Triage not positive	
	Consultant	Other	Consultant	Other
0	39 (84.8%)	7 (15.2%)	64 (30.9%)	143 (69.1%)
1	18 (81.8%)	4 (18.2%)	59 (32.2%)	124 (67.8%)
2	10 (71.4%)	4 (28.6%)	41 (27.9%)	106 (72.1%)
3	13 (76.5%)	4 (23.5%)	43 (28.7%)	107 (71.3%)
4	10 (100%)	0 (0%)	31 (23.3%)	102 (76.7%)
5	16 (76.2%)	5 (23.8%)	34 (26.2%)	96 (73.8%)
6	7 (87.5%)	1 (12.5%)	42 (33.1%)	85 (66.9%)
7	7 (77.8%)	2 (22.2%)	46 (37.7%)	76 (62.3%)
8	25 (80.6%)	6 (19.4%)	78 (36.6%)	135 (63.4%)
9	41 (93.2%)	3 (6.8%)	98 (35.9%)	175 (64.1%)
10	54 (94.7%)	3 (5.3%)	167 (44.4%)	209 (55.6%)
11	78 (95.1%)	4 (4.9%)	192 (48.9%)	201 (51.1%)
12	82 (92.1%)	7 (7.9%)	188 (48%)	204 (52%)
13	92 (94.8%)	5 (5.2%)	208 (45.9%)	245 (54.1%)
14	72 (94.7%)	4 (5.3%)	161 (40.7%)	235 (59.3%)
15	68 (95.8%)	3 (4.2%)	163 (41.7%)	228 (58.3%)
16	84 (96.6%)	3 (3.4%)	161 (39.9%)	243 (60.1%)
17	75 (94.9%)	4 (5.1%)	159 (39.4%)	245 (60.6%)
18	76 (89.4%)	9 (10.6%)	163 (39.2%)	253 (60.8%)
19	64 (95.5%)	3 (4.5%)	129 (36.9%)	221 (63.1%)
20	31 (81.6%)	7 (18.4%)	118 (36.8%)	203 (63.2%)
21	42 (89.4%)	5 (10.6%)	118 (35.1%)	218 (64.9%)
22	44 (88%)	6 (12%)	98 (31%)	218 (69%)
23	30 (88.2%)	4 (11.8%)	84 (30.8%)	189 (69.2%)

Number (%)

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Table 12: Grade of most senior clinician involved in surgery

	Age band (years)				
	16 - 59	**60 - 69**	**70 - 79**	**80 - 89**	**90+**
Total	3911	755	712	668	128
Consultant	3145 (80.4%)	549 (72.7%)	479 (67.3%)	392 (58.7%)	83 (64.8%)
Associate Specialist	29 (0.7%)	8 (1.1%)	7 (1%)	9 (1.3%)	3 (2.3%)
ST 3+	645 (16.5%)	179 (23.7%)	203 (28.5%)	241 (36.1%)	39 (30.5%)
FY / ST 1-2	47 (1.2%)	14 (1.9%)	11 (1.5%)	17 (2.5%)	1 (0.8%)
Not Known	45 (1.2%)	5 (0.7%)	11 (1.5%)	9 (1.3%)	2 (1.6%)
Other / Not recorded	0 (0%)	0 (0%)	1 (0.1%)	0 (0%)	0 (0%)

Number (%)

Table 13: Length of stay, overall and in critical care, by age group

Age	n	Median length of stay (IQR)*			Patients in critical care	Median length of stay in critical care (IQR)*		
		Total	**Alive**	**Dead**		**Total**	**Alive**	**Dead**
< 16	691	6 (4-12)	7 (4 - 13)	1 (1 - 2)	363	2 (1-5)	2 (1 - 6)	1 (1 - 3)
16 - 59	7143	9 (5-20)	10 (6 - 22)	1 (1 - 4)	3375	4 (1-11)	4 (2 - 12)	2 (1 - 6)
60 - 69	1754	11 (5-23)	12 (6 - 26)	3 (1 - 9)	676	5 (2-11)	5 (2 - 12)	5 (1 - 8)
70 - 79	1997	12 (5-25)	14 (7 - 30)	3 (1 - 9)	607	4 (2-10)	5 (2 - 12)	3 (1 - 6)
80 - 89	2684	12 (5-24)	15 (8 - 30)	4 (1 - 11)	398	3 (1-7)	3 (1 - 8)	3 (1 - 6)
90+	1014	13 (5-24)	17 (8 - 30)	4 (2 - 11)	55	2 (1-4)	2 (1 - 5)	3 (1 - 4)

* days

Table 14: Body region injured by age group

	Age band (years)					
	< 16	16 - 59	60 - 69	70 - 79	80 - 89	90+
Head	550 (73.8%)	4379 (56.2%)	1258 (64.6%)	1640 (73.5%)	2352 (80.2%)	889 (83.6%)
Thorax	153 (20.5%)	3446 (44.2%)	715 (36.7%)	572 (25.6%)	555 (18.9%)	163 (15.3%)
Abdomen	97 (13%)	918 (11.8%)	97 (5%)	76 (3.4%)	48 (1.6%)	11 (1%)
Spine	40 (5.4%)	766 (9.8%)	182 (9.3%)	219 (9.8%)	224 (7.6%)	65 (6.1%)
Pelvis	35 (4.7%)	848 (10.9%)	144 (7.4%)	120 (5.4%)	119 (4.1%)	34 (3.2%)
Limbs	66 (8.9%)	1068 (13.7%)	137 (7%)	126 (5.6%)	161 (5.5%)	70 (6.6%)
Other	54 (7.2%)	343 (4.4%)	30 (1.5%)	32 (1.4%)	18 (0.6%)	4 (0.4%)
Polytrauma	181 (24.3%)	2909 (37.3%)	491 (25.2%)	460 (20.6%)	480 (16.4%)	152 (14.3%)

Number (%)

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Table 15: Injury Severity Score by age group

Age band	Median ISS	Interquartile Range
< 16	24	(16 - 26)
16 - 59	25	(17 - 29)
60 - 69	24	(17 - 26)
70 - 79	25	(17 - 26)
80 - 89	24	(17 - 25)
90+	21	(17 - 25)

Table 16: Time to Head CT

Age	TBI	Had CT scan?	Median (IQR)	Triage positive		Triage negative	
				Had CT scan?*	Median (IQR)	Had CT scan?*	Median (IQR)
60 - 69	1056	1018 (96%)	1 (0.5 - 2.2)	258 (97%)	0.5 (0.3-0.7)	230 (97%)	1.7 (0.9-3.1)
70 - 79	1383	1333 (96%)	1.4 (0.6 - 3.1)	213 (96%)	0.4 (0.3-0.7)	356 (98%)	1.9 (1-3.3)
80 - 89	2114	2046 (97%)	2 (0.9 - 4.1)	206 (97%)	0.5 (0.3-0.8)	608 (98%)	2.2 (1-3.9)
90+	836	817 (98%)	2.4 (1.1 - 5.2)	51 (100%)	0.5 (0.4-0.8)	227 (98%)	2.6 (1.2-4.6)

* % out of the number of Triage positive/negative patients with head injuries

Table 17: Patients with TBI initially admitted to TU

	Age band (years)					
	< 16	16 - 59	60 - 69	70 - 79	80 - 89	90+
Stayed at TU	1 (7.1%)	90 (35%)	37 (43%)	52 (43%)	80 (64%)	27 (84.4%)
Transferred from TU to MTC	13 (92.9%)	167 (65%)	49 (57%)	69 (57%)	45 (36%)	5 (15.6%)

Table 18: Glasgow Outcome Scale on discharge

	Age band (years)					
	< 16	16 - 59	60 - 69	70 - 79	80 - 89	90+
Death	**61 (8.8%)**	**729 (10.2%)**	**229 (13.1%)**	**405 (20.3%)**	**737 (27.5%)**	**299 (29.5%)**
Survivors	**630 (91.2%)**	**6415 (89.8%)**	**1525 (86.9%)**	**1593 (79.7%)**	**1947 (72.5%)**	**714 (70.4%)**
Good Recovery	494 (78.4%)	4043 (63%)	919 (60.3%)	864 (54.2%)	886 (45.5%)	283 (39.6%)
Severe Disability	20 (3.2%)	471 (7.3%)	123 (8.1%)	146 (9.2%)	190 (9.8%)	86 (12%)
Moderate Disability	42 (6.7%)	509 (7.9%)	140 (9.2%)	180 (11.3%)	283 (14.5%)	125 (17.5%)
Prolonged Disorder of Consciousness	1 (0.2%)	9 (0.1%)	2 (0.1%)	1 (0.1%)	1 (0.1%)	0 (0%)
Not available	73 (11.6%)	1383 (21.6%)	341 (22.4%)	402 (25.2%)	587 (30.1%)	220 (30.8%)

Number (%)

Major Trauma in Older People (ISS>15)

Table 19: Accumulated mortality

Accumulated Mortality	Age band (years)					
	< 16	16 - 59	60 - 69	70 - 79	80 - 89	90+
n	691	7143	1754	1997	2684	1014
At 30 days	61 (8.8%)	711 (10%)	221 (12.6%)	368 (18.4%)	665 (24.8%)	275 (27.1%)
At Discharge	61 (8.8%)	729 (10.2%)	229 (13.1%)	403 (20.2%)	737 (27.5%)	300 (29.6%)
At 6 months	61 (8.8%)	737 (10.3%)	235 (13.4%)	430 (21.5%)	844 (31.4%)	645 (63.6%)
At 12 months	61 (8.8%)	779 (10.9%)	267 (15.2%)	505 (25.3%)	991 (36.9%)	454 (44.8%)

Number (%)

Table 20: Relation between the prevalence of Modified Charlson Comorbidity index and outcome

mCCI	Alive	Dead	Total
Minor / none	2399 (85.8%)	396 (14.2%)	2795 (37.5%)
Mild	2043 (78.3%)	565 (21.7%)	2608 (35%)
Moderate	796 (74.5%)	273 (25.5%)	1069 (14.4%)
Severe	295 (70.6%)	123 (29.4%)	418 (5.6%)
Missing data	386 (69.1%)	173 (30.9%)	559 (7.5%)

Table 21: Injuries associated with death

Body region	Age band (years)				
	16 - 59	60 - 69	70 - 79	80 - 89	90+
Head	451 (63.4%)	168 (76%)	304 (82.2%)	551 (82.9%)	233 (85%)
Thorax	342 (48.1%)	83 (37.6%)	91 (24.6%)	149 (22.4%)	48 (17.5%)
Abdomen	98 (13.8%)	15 (6.8%)	9 (2.4%)	16 (2.4%)	4 (1.5%)
Spine	51 (7.2%)	20 (9%)	34 (9.2%)	69 (10.4%)	20 (7.3%)
Pelvis	50 (7%)	14 (6.3%)	13 (3.5%)	27 (4.1%)	6 (2.2%)
Limbs	81 (11.4%)	12 (5.4%)	18 (4.9%)	27 (4.1%)	14 (5.1%)

Number (%)

Table 22: Injury mechanism associated with death

Injury Mechanism	Age band (years)					
	< 16	16 - 59	60 - 69	70 - 79	80 - 89	90+
Fall < 2m	2 (3.3%)	85 (12%)	79 (35.7%)	198 (53.8%)	447 (67.2%)	215 (78.2%)
Fall > 2m	2 (3.3%)	129 (18.1%)	71 (32.1%)	97 (26.4%)	134 (20.2%)	38 (13.8%)
Road Traffic Collision	24 (39.3%)	264 (37.1%)	44 (19.9%)	45 (12.2%)	71 (10.7%)	15 (5.5%)
Other	29 (47.5%)	146 (20.5%)	15 (6.8%)	17 (4.6%)	8 (1.2%)	5 (1.8%)
Blow(s)	3 (4.9%)	38 (5.3%)	7 (3.2%)	9 (2.4%)	5 (0.8%)	1 (0.4%)
Shooting/Stabbing	1 (1.6%)	49 (6.9%)	5 (2.3%)	2 (0.5%)	0 (0%)	1 (0.4%)

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