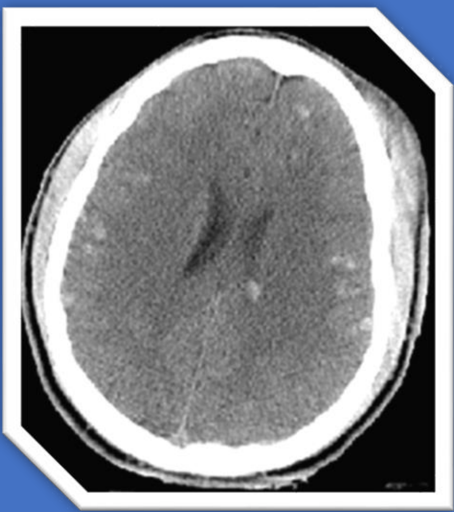
London Major Trauma System

NHS

London Clinical Senate

Traumatic Injury to Brain Across London (TrIBAL) Provisional Report



Abbreviations:

CT	Computer Tomography (CT) Scan
DAI	Diffuse Axonal Injury
DOAC	Direct Acting Oral Anticoagulant
EDH	Extradural Haematoma
IEP	Image Exchange Portal
INR	International Normalised Ratio
MTC	Major Trauma Centre
PCC	Prothrombin Complex Concentrate
SDH	Subdural Haematoma
TBI	Traumatic Brain Injury
TARN	Trauma Audit and research Network
TU	Trauma Unit

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Traumatic Injury to Brain Across London (TrIBAL) Report

INTRODUCTION

The demographics of traumatic brain injury (TBI) are changing. While TBI is still one of the commonest causes of death in the under 40s, the incidence and morbidity in the elderly appears to be increasing[1]. This has been noted both in the UK[1] and internationally. Previous studies have demonstrated that the elderly population are less likely to be transferred to Major Trauma Centres with neurosurgical services[2]. There is an additional group of people who sustain what are often considered "mild" traumatic brain injuries (not requiring neurosurgical intervention) who are similarly not transferred to a neurosurgical centre / MTC. Both these groups tend to remain in local trauma units under the care of a variety of specialities. Brain injury can render previously well patients dependent, requiring community support and potentially long term 24-hour care, the organisation of which can result in long inpatient stays. This group of TBI patients who are not managed in major trauma/neurosurgical centres has traditionally received little focus, but require significant care and resources. Quantifying the epidemiology, patient pathways and outcomes for these patients will enable better care and more effective and efficient service deployment.

METHODS

This prospective audit was commissioned by the London Senate and conducted through the London Major Trauma System. Neurotrauma experts from all of London's Major Trauma Centres and neurosurgical centres that accept traumatic brain injured patients were involved in the design and conduct of this study. The Major Trauma Networks in London comprise the North West London Trauma Network (with the regional MTC at St Mary's), the North East London and Essex Trauma Network (with the regional MTC at the Royal London and a further Neurosurgical Trauma Centre at Queens Romford), the South East London Kent and Medway Network (with the regional MTC at King's College Hospital) and the South West London and Surrey Trauma Network (with the regional MTC at St George's) (figure 1). In North London, Great Ormond Street Hospital advises on and takes children with isolated head injuries.

Inclusion criteria: All patients referred to a neurosurgical centre with acute blood on CT head following trauma were included in this study. Patients with normal CT scans following a TBI including those with "concussion" were excluded. The dates for data collection were from 19th September 2016 to 19th January 2017.

Pre-agreed variables were recorded from the referral registry for patients referred in from non-neurosurgical centres. Retrospectively, these hospitals were subsequently asked about the length of stay of these patients. The subsequent data was assessed, cleaned and were appropriate, clarification was requested. In some regions, a comparison with Trauma Audit Research Network Data was made. For the purposes of reporting, because the Royal London and Queen's Romford act as independent neurosurgical centres within the NELETN, their data is presented separately in this report.

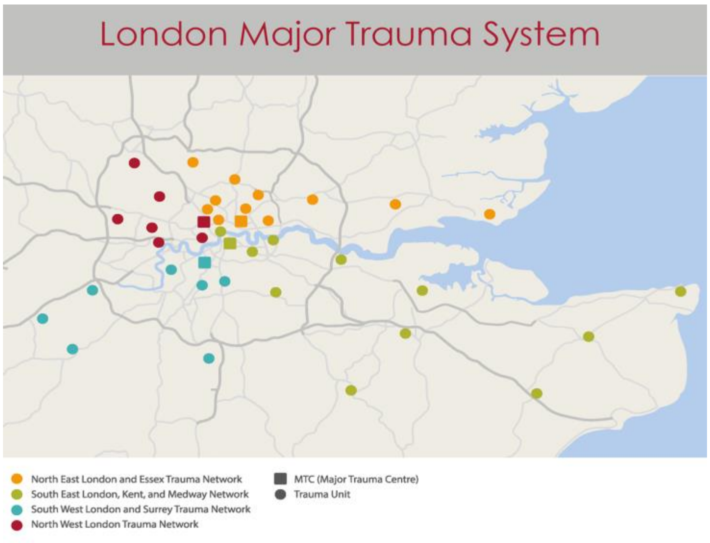


Figure 1) Map of London's Major Trauma Systems – In East London, The Royal London Hospital and Queen's Romford are the main Neurosurgical centres (forming NELETN); The North-West London Trauma Network (NWLTN) utilises St Mary's as its MTC/Neurotrauma centre. The South East London, Kent and Medway Trauma Network (SELKMTN) has King's as its MTC the South West London and Surrey Trauma Network (SWLSTN) has St George's as its MTC. Additionally, in North London, Great Ormond Street receives referrals for paediatric secondary transfers from Trauma Units.

RESULTS

Epidemiology:

During the four-month period of study a total of 1889 traumatic brain injury episodes were referred to or admitted to the MTC / neurosurgical centres across the regions studied.

Neurosurgical Unit	Number Admitted under Neurosurgical Care into MTC	Number referred from TUs (no. transferred)
King's College (SELKM)	155	374 (33)
Romford (NELETN)	33*	244 (33)
Royal London (NELETN)	197	177 (13)
St George's (SWLSTN)	121	283 (7)
St Mary's (NWLTN)	155	205 (23)
Great Ormond Street	3	54 (3)

Table 1: Number of cases reported to and admitted to the neurosurgical units / MTC for each region. Total = 1,889 individual traumatic brain injuries. * Queen's Romford recorded 61 TBI patients as being under other specialities within their hospital. As such, this data is reported here as presented by Queen's, treating the patients under other specialties as if in a separate place (part of the 244). Although they reported 24 admissions directly though from external referrals, it can be seen that 33 were transferred in.

Gender:

Traumatic Brain Injury has traditionally been considered a disease of young men, usually associated with high speed road traffic collisions (RTCs). Figure 2a and 2b demonstrate the actual numbers of male and female patients referred to MTC / Neurosurgical Units and admitted to the MTC / Neurosurgical Units respectively. In the TU population 776 of 1280 (60.6%) were male. In the MTC population 492 of 652 (75.4%) were male. This increase probably reflects more severe / surgically amenable trauma in males.

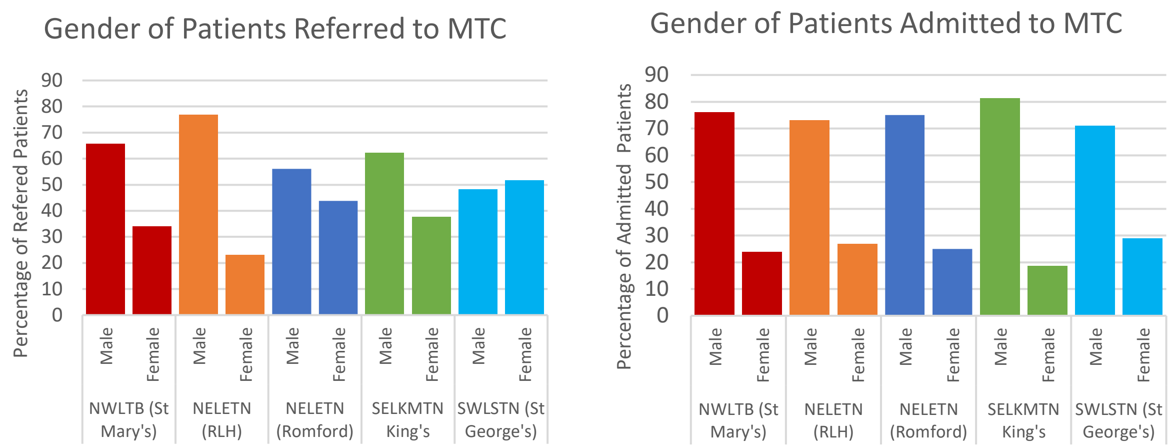
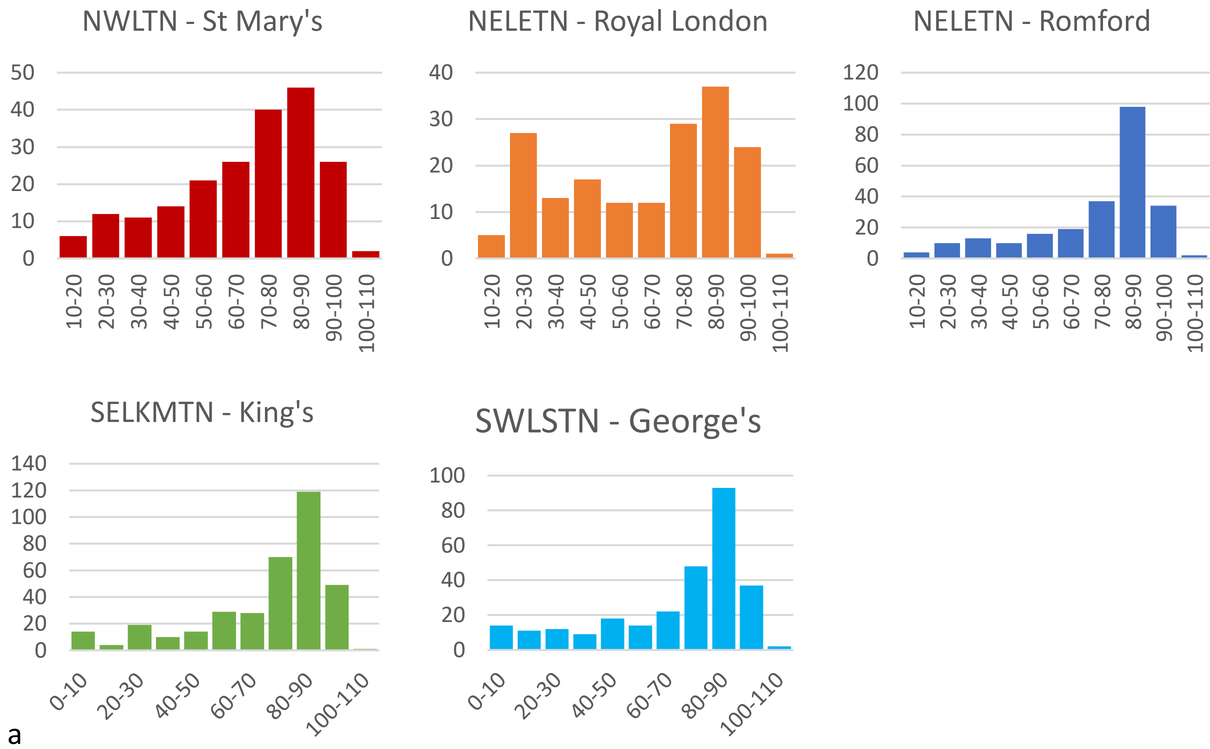


Figure 2: Graphical representation of genders of patients referred with network (a) and admitted to MTC / Neurosurgical Centre (b).

Age:

The mean age of those who presented to a TU was 69.0, while of those admitted to an MTC was 53.2. Figure 3 and 4 represents the distribution of this data graphically.



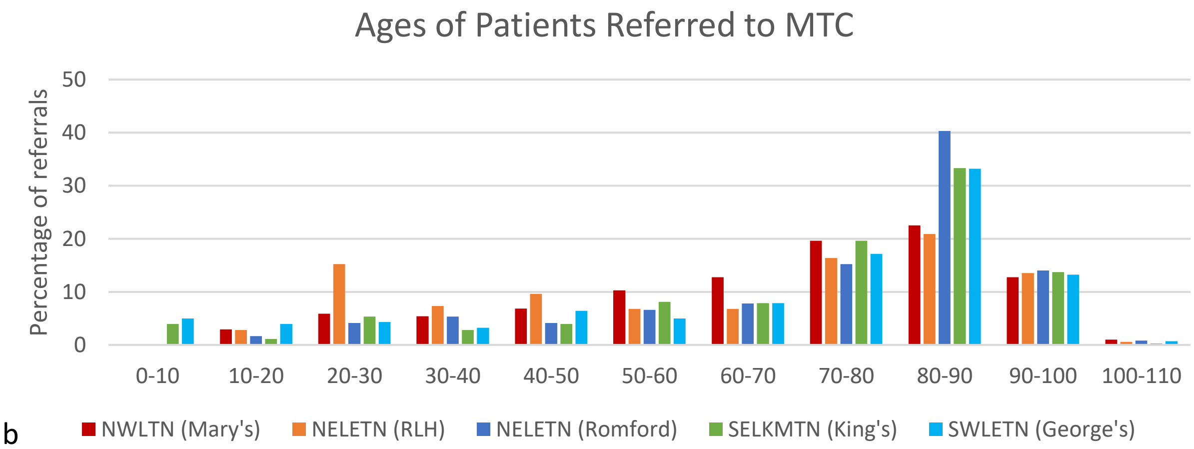


Figure 3) Age distributions of patients referred in each network (a) and combined (b). X axis are age ranges, Y axis are actual numbers of patients in a, percentages in b.

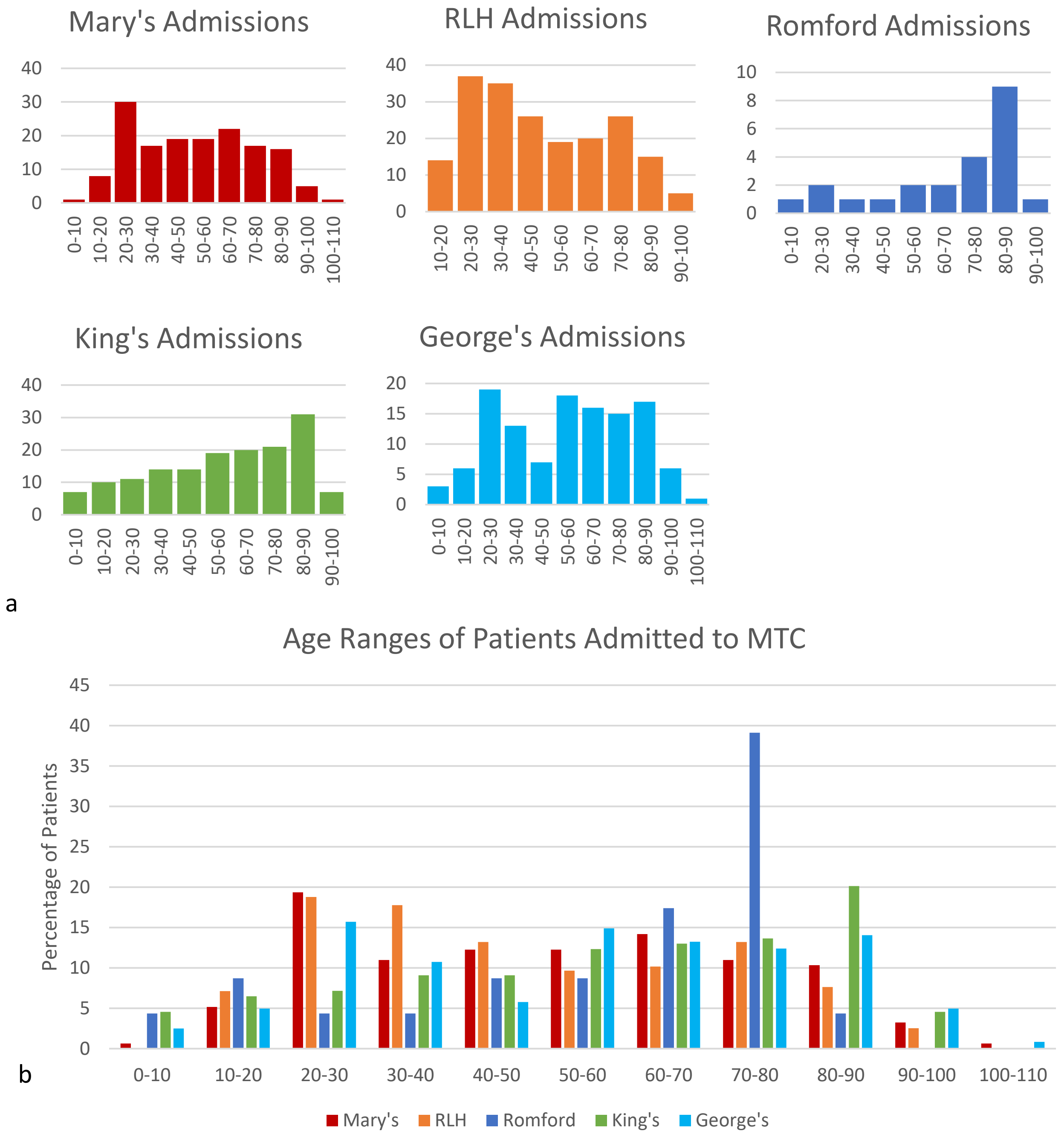


Figure 4) Age distributions of patients admitted to the MTC in each network (a) and combined (b). X axis are age ranges, Y axis are actual numbers of patients in a, percentages in b.

Mechanism of Injury:

Figures 4 and 5 demonstrate the mechanisms of injury leading to presentation at the Trauma Units and to the MTCs respectively.

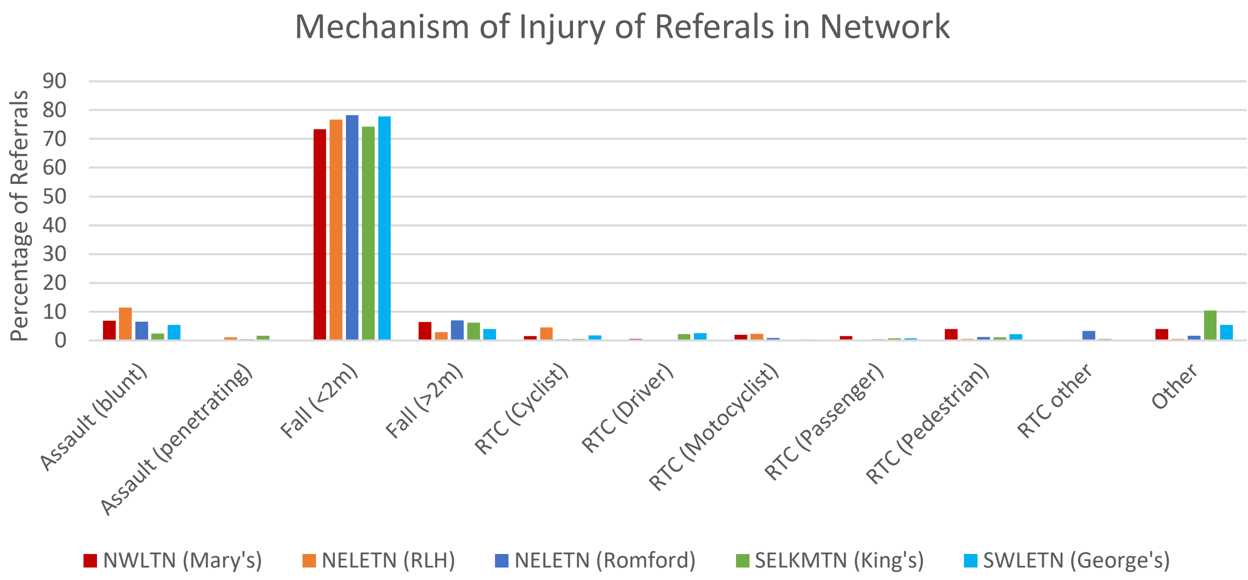


Figure 4) Mechanism of Injury in those presenting to the Trauma Units in each network (expressed as a percentage).

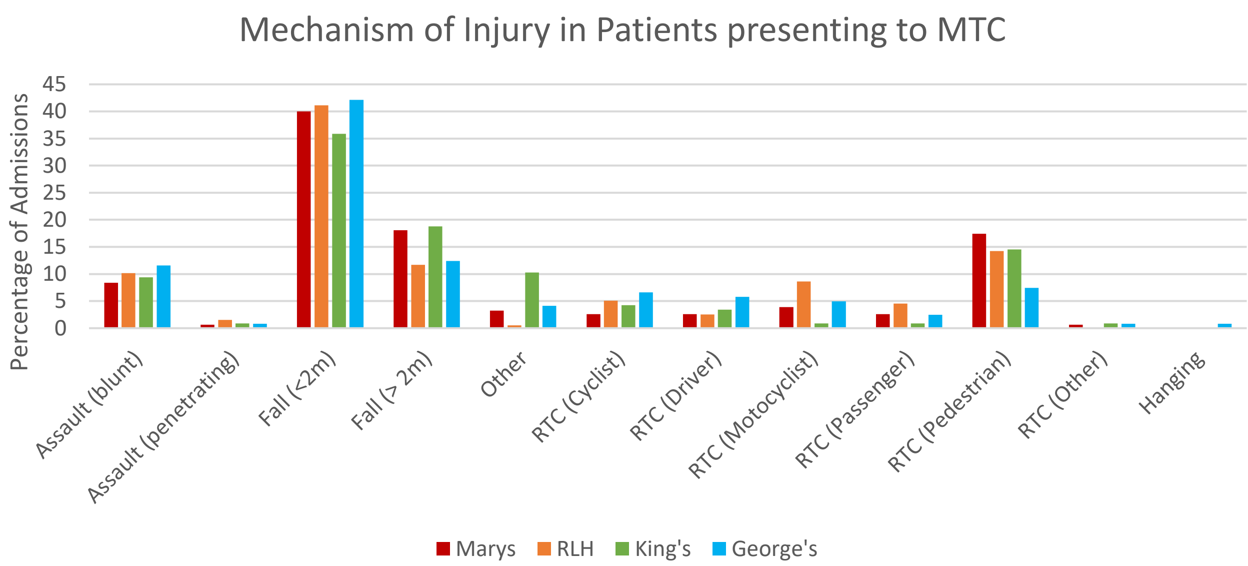


Figure 5) Mechanism of Injury in those presenting to the Major Trauma Centres (no data on Mechanism of injury supplied for Romford inpatients).

Polytrauma vs Isolated Head Injury:

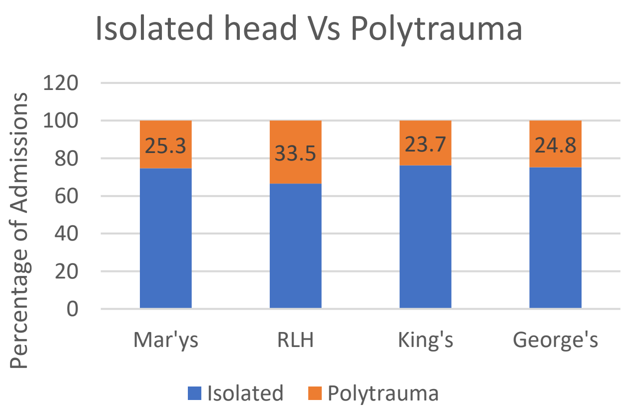


Figure 6 demonstrates the comparisons of isolated and polytrauma patients admitted to the MTCs.

Figure 6) the volume of isolated vs polytrauma at MTCs (expressed as percentage)

Mode of Arrival:

The mode of arrival was most commonly ambulance service, especially in TUs. In MTCS HEMS services also made up a significant proportion of transport services. This however is highly subjected to reporting bias

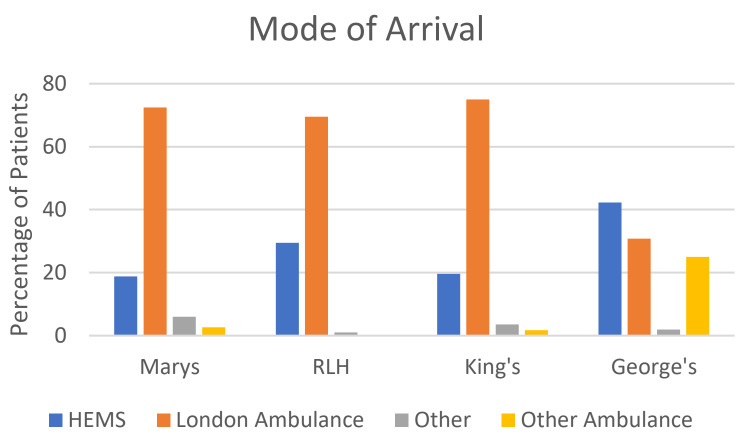


Figure 7) Mode of arrival at respective MTCs. Note, Romford did not record mode of arrival for admitted patients. Additionally there is probably reporting bias as numbers reported vary (n= Mary's 149, RLH 197, King's 112, George's 52).

Transfers:

Transfer rate from TU to MTC varies significantly, but there are many reasons for this. Raw figures reported are: Mary's 23/204, RLH: 13/175, Romford: 33/243, Kings: 33/352, George's: 8/283.

Admitting Teams at Trauma Units:

Recorded admitting team at the time of referral was often "Emergency medicine" or "CDU". Attempts were made to go back to TUs to establish if patient care was then subsequently transferred to an inpatient team. As can be seen, there is a wide variation in specialists even within network who care for TBI patients.

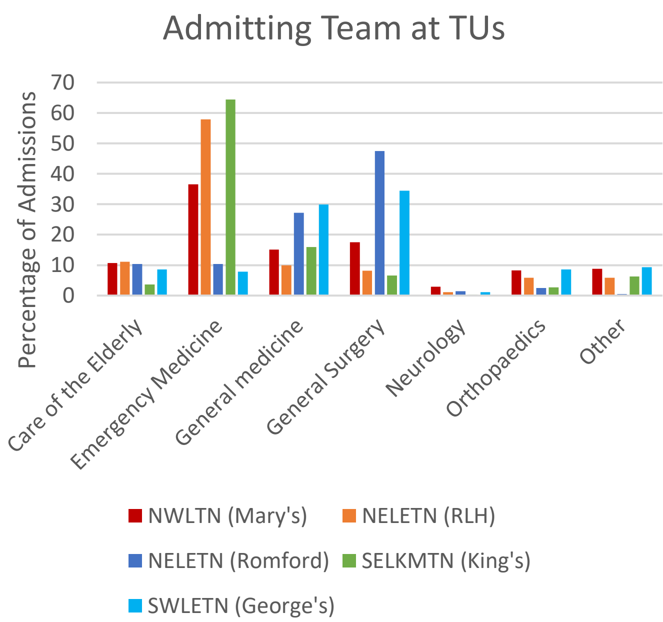


Figure 8) Reported admitted team for each network. Emergency medicine includes CDU admissions for overnight observations.

Anticoagulation:

Figures 9 and 10 demonstrate the numbers of patients on anti-platelet agents or anticoagulated admitted across the network an admitted to the MTCs.

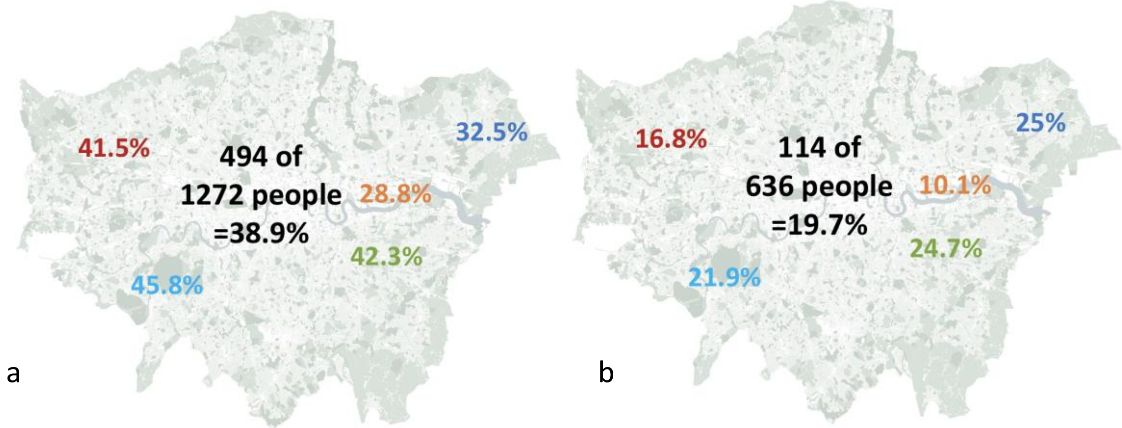


Figure 9) Graphical representation of number of patients a) referred in network on anti-platelet / anticoagulation agents and b) admitted to MTC on anti-platelet / anticoagulation agents.

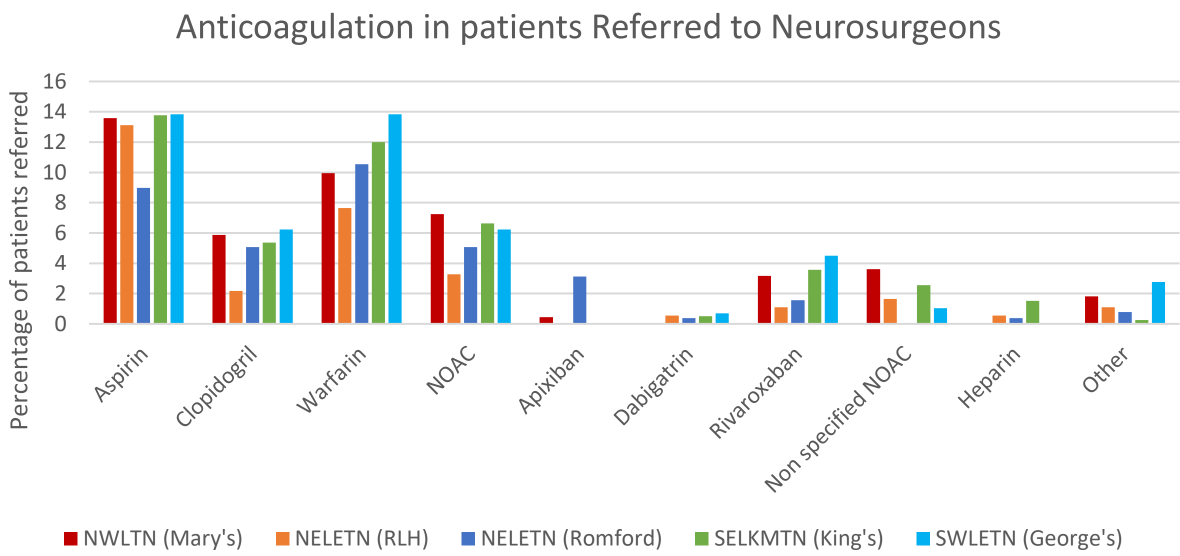


Figure 10) Percentage of patients on anti-platelet and anticoagulation agents broken down by agent type within network.

Length of Stay

Predicted Length of stay:

The quality of data on reported length of stay varied considerably across the networks. Neurosurgical units were asked to predict how long they envisaged a patient referred to them, but not transferred to them, would stay in their TU before returning home. Only Romford provided comprehensive data for most of their referred patients. Figure X is a graph comparing predicted length of stay in the TU (at the time of referral to the Romford) and actual length of stay.

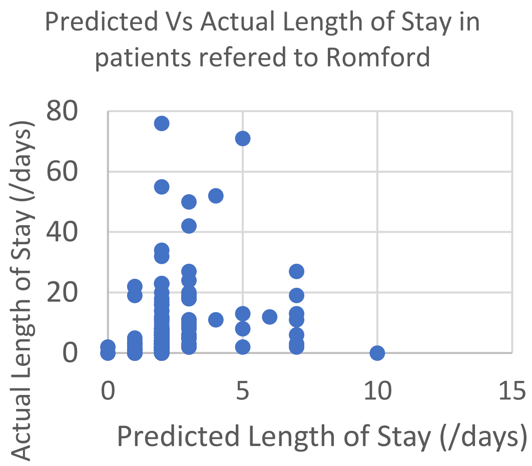


Figure 11 demonstrates predicted vs actual length of stay from referrals made within NELETN (Romford)

Actual Length of Stay:

Figure 12 demonstrates Length of stay for all patients reported (data for n=722)across the trauma networks at TUs that there seems to be two groups of patients, a group that stay a relatively short period (<1 week) in hospital, and a group, usually elder who stay for many weeks.

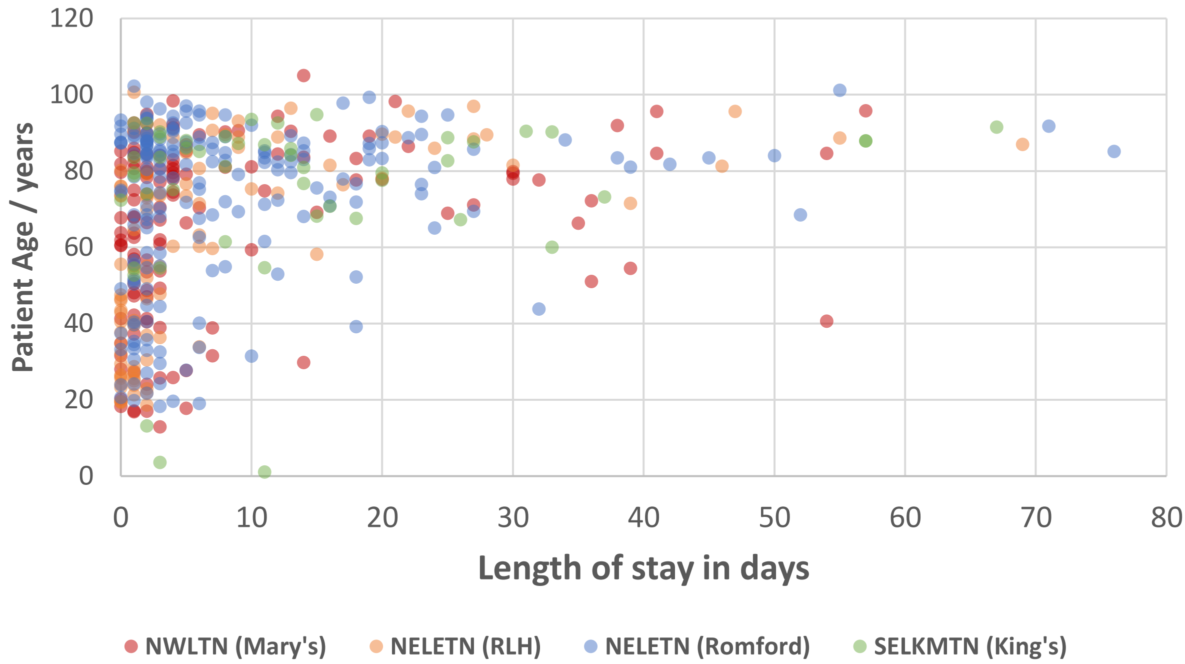


Figure 12) Demonstrates length of stay at TU with age (n = 722). A small number of patients were still inpatients beyond 3 months. They have been omitted from this graph to more clearly see the spread of patients over 3 months.

Reasons for delay in discharge:

There were no set fields for reasons for delay in discharge or transfer onto rehab / further treatment. As a result, this data was poorly captured. However, common reasons cited were awaiting social care, rehab and nursing home placement. Reasons for delay from MTC transfer back to TU most commonly focused around bed availability at the local unit.

Documented Follow up:

Organisation of follow up was poorly captured, however the following recorded outpatient appointments for TU referred patients: Marys: 16/187 = 8.5%, Romford: 10/179 = 5.6%, RLH: not recorded, King's: 2/226 = 0.1%, George's: 6/155 = 3.9%. There are many factors influencing these numbers, most notably if it was recorded. However, some MTCs cover vast distances and it may well be more appropriate for follow up to be with local services than at the MTC.

Surgery:

The actual requirement for neurosurgery is relatively low, but there are many reasons that can affect that reported. These figures do not include ICP monitor insertion. Expressed as a percentage of reported TBI for each network, the number of operations performed are: Mary's:

26/337 = 7.8%; RLH: 38/361 = 10.5%; Romford: 18/244 = 7.3%; King's: 51/496 = 10.2%; George's: 16/397 = 4%.

Brain Injury Classification System and Patterns of Injury:

This will be discussed further in the talk, however the cumulative AIS's reported for patients included in this audit are listed in Appendix 1.

Discussion:

This analysis confirms that traumatic brain injury is a significant burden of disease outside of major trauma centres. Only 33% (n=664) of TBI patients in this study were actually under the care of neurosurgeons in an MTC.

The population falls into two main groups – a younger group who on the whole have a relatively short length of stay, and an older group whose length of stay is considerably longer than anticipated. This is in line with recent suggestions that major trauma can be considered as two diseases [3].

Comparison with TARN collected data is difficult. Patients with brain injuries who die early in ED may not be referred to neurosurgery but appear in TU TARN data. Equally patients perceived as medical who incidentally are found to have sustained a cerebral contusion may be discussed with the local neurosurgeon and appear in this report, but not on TARN. Comparing numbers in North West London suggest general similarity in volume of data captured.

In the elderly population TBI may be an indicator of frailty and multiple co-morbidities resulting in a fall. It may be the signatory injury in this population, in a similar manner to fractured neck of femur in the '90's.

This study confirms that there is considerable diversity in teams looking after TBI patients in trauma units. Despite the advanced age of many patients in TUs with TBI, no more than 10% are admitted under the care of a physician specialising in elderly care. From this study, it is not possible to demonstrate the level of involvement of care of the elderly, for example, by orthogeriatricians when admitted under the orthopaedic services.

Anticoagulation:
This audit has demonstrated that nearly 40% of patients who sustain a TBI and are admitted to a TU are on an anti-platelet or anticoagulant of some description. In this population, the risk of stroke needs to be balanced with their risk of falls.
Clear protocols for rapid reversal of anticoagulation need to be in place:

- Current guidelines for prescribing anticoagulation utilise the CHAD score (CHA2DS2-VASc). This in itself does not factor risk of falls.
- Aspirin – There is controversy over platelet administration in this group. The Patch study implies platelets of little benefit (and maybe harm)in patients who have had haemorrhagic stroke[4], but does this also apply to trauma?
- Warfarin – The rapid reversal of warfarin with Prothrombin Complex Concentrate (PCC) is now common place for advanced pre-hospital care services (such as air ambulance services) but is not routine for most land based services. There can also be delays in administration in hospital.
- DOACs – Reversal agents exist for dabigatran and rivaroxaban, but availability is limited.

Surgery:
Neurosurgery is only required in 5-10% of cases. However, the centre around neurosurgery brings expertise in neurocritical care and therapy specialists that has been demonstrated to be of benefit[5]. It could therefore be argued that more patients should be transferred to such specialist centres. This has to be balanced with the inconvenience of moving patients who do not need surgery further from home and away from local services that can probably be organised more rapidly locally.

Potential Improvements:
The closer working between MTC and specified induvial with a TBI interest in Tus, potentially with joint care could provide more comprehensive care. Expert group opinion can help guide the need and the feasibility of this. The role of local services in reducing the incidence of TBI should also be considered.

Limitations of this study:
Data collection has proven difficult for certain aspects of this study and there has been different data collection completeness across London. As such, some of the objectives of this study cannot be answered with conclusive quantitative values. Where data quality is good, we believe that findings can be extrapolated across London as the underlying demographics of patients is similar.

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Elaine Cole

Principal Neurosurgical Investigators:
Mark Wilson
Ahmed Ibrahim
Christos Tolias
Christopher Uff
Greg James
Matthew Crocker
Martin Tisdall

Speakers:
Michael Fertleman
Colette Griffin

Imperial Team
NET Research Team:
Emily Ashworth
Abby Harper-Payne
Isabella Wilkes
Jo-Anna Conyngham
Alberto Rigoni
Louise Young
Moya Kirmond
Karolina Zimmerman

Imperial Organisation
Ella Johnson
Kerry Looney

Imperial Doctors
Isabel Hostettler Moreno
Oscar MacCormac
Sri Murahari

St Georges Research team:
Christine Ryan
Helen Farah

Kings College London Research team:
Kapil Rajwani
Raquel Irurozqui Mundinano

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Michelle Agar
Jarnail Bal

Royal London Hospital Research team:
Alice Kershberg

TARN Network leads and support teams
Joseph Davies
Leila Razavi
Victoria Osborne-Smith
Rosette De Leon
Ruchi Carter
Oliver Jansen
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Notes from Round Table Discussion:

For discussion:

1) Potential mechanisms TBI, especially in elderly can be prevented
2) When they occur, how best are they managed – local hospital or MTC?
3) Which team(s) should look after these patients.
4) Can we improve collaborative working
5) Anticoagulation – can we improve guidelines both for prophylaxis and treatment post TBI?
6) Role of Realistic medicine
7) Long Term Follow up – best practice

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Additional Resources:

Care of Elderly Report London: http://www.c4ts.qmul.ac.uk/downloads/plmts-management-of-elderly-trauma-09022017.pdf

Appendix:

Appendix 1: Pattern of Brain Injury as reported by AIS across TU referrals (data from

ASDH	1
ASDH tiny; <0.6cm thick ([includes tentorial (subdural) blood one or both sides) 3	94
ASDH: bilateral (at least one side >1cm thick) 5	14
ASDH: large; massive; extensive; >50cc 5	59
ASDH: small bilateral [both sides 0.6-1cm thick] 4	23
ASDH: small; moderate; <50cc 4	132
ASDN Extensive	1
Brainstem compression [includes transtentorial (uncal) or cerebellar tonsillar herniation] 5	1
Brainstem injury involving hemorrhage 5	1
Cerebellar ASDH Large 5	1
Cerebellar ASDH Small / Medium 4	7
Cerebellar ASDH Tiny 2	2
Cerebellar contusion Large 5	1
Cerebellar contusion Small / Medium 4	3
Cerebellar contusion Tiny 2	3
Cerebellar EDH Small / Medium 4	1
Cerebral contusion but NFS: multiple, bilateral 3	3
Cerebral contusion but NFS: multiple, same side 3	5
Cerebral contusion extensive; massive; total volume >50cc: multiple, bilateral 5	1
Cerebral contusion large; deep; 30-50cc: multiple, bilateral 4	3
Cerebral contusion large; deep; 30-50cc: single 4	6
Cerebral contusion NFS: single 3	2
Cerebral contusion small; superficial; <30cc: multiple, bilateral 3	18
Cerebral contusion small; superficial; <30cc: single 3	45
Cerebral contusion tiny (<1cm) 2	26
Cerebral contusion tiny (<1cm): multiple, bilateral 2	6
Cerebral contusion tiny (<1cm): multiple, same side 2	6
Cerebral contusions extensive; massive; total volume >50cc: multiple, same side 5	3
Cerebral contusions large; deep; 30-50cc: multiple, same side 4	3
Cerebral contusions small; superficial; <30cc: multiple, same side 3	24
Crush injury (Must involve massive destruction of skull, brain and intracranial contents.) 6	1
DAI confined to white matter or basal ganglia 4	1
EDH: large; massive; extensive 5	3
EDH: small; moderate; <50cc 4	7
EDH: Tiny <0.6cm thick 2	7
ICH: large; >30cc 5	5
ICH: small; <30cc 4	6
ICH: tiny; single or multiple <1cm diameter 2	5
Skull fracture: BOS without CSF leak 3	15
Skull fracture: closed; simple; undisplaced; diastatic; linear 2	53
Skull fracture: comminuted; compound but dura intact; depressed <2cm; displaced 3	7
Skull fracture: complex; open with torn, exposed or loss of brain tissue 4	2
Small contusion	1
subarachnoid hemorrhage (not associated with coma >6 hours) 2	111
(blank)	
Grand Total	**719**