The National Office of Clinical Audit (NOCA) was established in 2012 to create sustainable clinical audit programmes at national level. NOCA is funded by the Health Service Executive Office of the Chief Clinical Officer and operationally supported by the Royal College of Surgeons in Ireland. The National Clinical Effectiveness Committee (NCEC) defines national clinical audit as “a cyclical process that aims to improve patient care and outcomes by systematic, structured review and evaluation of clinical care against explicit clinical standards on a national basis” (NCEC, 2015, p. 2). NOCA supports hospitals to learn from their audit cycles.

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Dear Professor Deasy

I wish to acknowledge receipt of the *Major Trauma Audit National Report 2021*.

On behalf of the NOCA Governance Board, I wish to congratulate the Audit Management team (Pamela Hickey and Breda Horan), the governance committee and you on an excellent report which provides information on trauma activity, care and outcomes in 2021, including insights on blood product use and the continuing impact of COVID-19 on the Health Service.

Please accept this as formal endorsement from the NOCA Governance Board of the *Major Trauma Audit National Report 2021*.

Yours sincerely,

[Signature]

Dr Brian Creedon  
Clinical Director  
National Office of Clinical Audit
FOREWORD

This is the eighth year of the Major Trauma Audit (MTA). The national report for 2021 highlights the excellent work of the National Office of Clinical Audit and the Major Trauma Audit Committee. In this report, there is extensive information on the patient’s journey when requiring blood product administration after sustaining a major trauma. It also reviews the demographics such as age and sex, mechanism injury and outcomes. The Irish Blood Transfusion Society is very grateful for having been invited to write its foreword.

As stated in the report, human donations of blood play a critical role in health care. Recent years have seen several situations lead to blood shortage in Ireland. During the COVID-19 pandemic, restrictions made it difficult to arrange blood clinics and to recruit new blood donors. Therefore, we now need 15,000 new blood donors to ensure the transfusion needs of Irish patients are met. All eligible people, including health care workers, are encouraged to enrol at www.giveblood.ie. The revised blood donor eligibility criteria and a web portal have made blood donation more accessible.

Dr Tor Hervig  
Medical Director  
Irish Blood Transfusion Service
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EXECUTIVE SUMMARY

This is the seventh national report from the Major Trauma Audit (MTA). Since 2016, 26 eligible hospitals have been participating in the MTA and data have been collected on almost 33,500 major trauma patients. This report focuses on processes that impact outcomes for patients who sustained major trauma during 2021. Chapter 6, The Patient Journey, includes a focus on major trauma patients who required blood products between 2017 and 2021. The process of reconfiguring Ireland’s trauma system began while this report was being written, following the publication of *A Trauma System for Ireland: Report of the Trauma Steering Group* (Department of Health, 2018). The commitment to developing an integrated trauma system is welcomed by the MTA. The ongoing work to ensure that facilities and services are coordinated for the delivery of care of major trauma patients in Ireland within standardised pathways is acknowledged.

This report includes data from only 22 of the 26 participating hospitals. The effects of redeployment when contending with a fourth and fifth wave of a global pandemic alongside further disruption associated with the cyberattack on the Health Service Executive (HSE) and vacant posts left unfilled have resulted in data coverage which is below the optimum standard of 80%. The data coverage for all 26 hospitals was 68%, which represents a further reduction from 73% in 2020 and 83% in 2019 (NOCA, 2022). As four hospitals had no data entered for 2021, the data coverage for the 22 hospitals is 76%. The goal for future reports is to provide hospital-level reporting in MTA to drive quality through enabling hospitals to benchmark against peer hospitals.

The MTA has consistently shown that injuries in the home, especially low falls, comprise the most common cause of major injuries. More needs to be done to keep our population safe; therefore, we continue to advocate the use of public health messages on this issue, which can be obtained via the website of the National Office of Clinical Audit (NOCA). The hyperlinked documents are highlighted in blue throughout the text. The *Major Trauma Audit National Report 2018*, (NOCA, 2020) featured a home safety infographic, the *Major Trauma Audit Paediatric Report 2014–2019* (NOCA, 2021) featured an injury prevention infographic for children and the *Major Trauma Audit National Report 2019 and 2020* (NOCA, 2021) featured a home safety checklist.

Each hospital is encouraged to use MTA reports for continuous quality improvement. Without the constant leadership provided by the hospital clinical leads for the MTA and the dedication and hard work of the audit coordinators, this audit would not be possible. The NOCA Executive Team and the MTA Governance Committee wish to thank the clinical leads, audit coordinators and staff in the participating hospitals for their continued commitment to, and engagement with, this audit.
KEY FINDINGS

- MTA data coverage was 76% in 2021, reporting on 22 out of the 26 participating hospitals.
- The average age of major trauma patients was 62 years of age.
- The percentage of major trauma patients injured in low falls (from less than two metres) remains high, at 62%.
- The majority (55%) of all major trauma injuries occurred at home.
- The percentage of road trauma is at 16%, which is an increase from 15% in 2020.
- The pre-alert rate to receiving emergency departments, as documented by the National Ambulance Service (NAS), was low, at 13%.
- The overall percentage of major trauma patients received by a trauma team remains low, at 8%.
- As patients get older, they are less likely to be:
  - pre-alerted, at 7% of 75–84 year olds versus 32% of 15–24 year olds;
  - met by a trauma team, at 3% of 75–84 year old versus 21% of 15–24 year olds;
  - received by a senior clinician, at 17% of 75–84 year old versus 31% of 15–24 year olds.
- There was an increase in the proportion of major trauma patients who died from falls.
  - Of those who died from falls, the proportion who died from a fall of less than two metres continues to increase.
  - The percentage of those who died from falls of more than two metres decreased from 16% in 2020 to 9% in 2021.
- Of the 161 patients sustaining major trauma who required a computed tomography (CT) head scan (having head injuries and an initial Glasgow Coma Scale (GCS) of <13) in 2021, 50% (n=81) received it within one hour or less; this was an increase from 43% in 2020 (NOCA, 2022).
- In 2021, 21% of major trauma patients were transferred at least once to another hospital for further care, an increase from 18% in 2020 (NOCA, 2022).
- The proportion of patients who received rehabilitation in an inpatient rehabilitation facility has declined from 10% in 2020 (NOCA, 2022) to 7% in 2021.
- This report also includes a number of high-level key findings relating to blood transfusions.
**KEY FINDINGS 2021**

**DATA COVERAGE**

- 76% Coverage

**LOCATION OF INJURY**

- **HOME** 55%
- **PUBLIC AREA OR ROAD** 29%
- **INSTITUTION** 6%
- **FARM** 3%
- **INDUSTRY** 3%

**PATIENTS RECORDED**

- 4055 Patients

**MEAN AGE**

- 62 Years

**CONTENT**

- **DATA COVERAGE** 76%
MECHANISM OF INJURY

- Falls less than 2m: 62%
- Road trauma: 16%
- From a blow: 6%
- Falls more than 2m: 11%

INJURY SEVERITY SCORE >15: 36%

RECEIVED BY A TRAUMA TEAM: 8%

Percentage of patients with a Glasgow Coma Scale score <13 to receive a CT scan within 1 hour: 50%

- Pre-alert rate: 13%
- Median length of stay: 9 days
- Discharged home: 60%
- Discharged to rehab: 7%
# KEY RECOMMENDATIONS

## RECOMMENDATIONS TO THE NATIONAL OFFICE FOR TRAUMA SERVICES

The National Office for Trauma Services, HSE, should:
- collaborate with MTA /NOCA to develop/align standard key performance indicators (KPI)
- review the data within with the blood product chapter to inform the provision of haematology services and stockholding within the major trauma centres (MTCs)
- define rehabilitation needs assessment (RNA) and rehabilitation prescription (RP) using the approved National Office for Trauma Services (NOTS) documentation and roll out same nationally in order to collect meaningful rehabilitation data within the MTA.

## RECOMMENDATIONS TO THE NATIONAL OFFICE OF CLINICAL AUDIT

MTA in the National Office of Clinical Audit (NOCA) should:
- progress the completeness of key data fields such as heart rate, subsequent blood product administration and second dose of TXA administration in order to capture meaningful data
- work with relevant organisations and stakeholders to support the establishment of local governance committees in order to review the data inputted with the MTA and implement quality improvement initiatives that will improve quality of care.
- use the information within the MTA for the development of home safety and injury prevention strategies that can reduce older persons’ risk of major trauma in the home, and disseminate same via public messaging campaigns.
The National Office of Clinical Audit (NOCA) works directly with public and patient interest (PPI) representatives, and each audit committee includes at least one PPI representative. This report aims to further promote injury prevention messages and public health/safety messaging, including the use of previous home safety messaging by NOCA, as highlighted in the executive summary.

In 2021, the MTA collaborated with the Irish Blood Transfusion Service (IBTS). Blood transfusion plays a vital role in saving the lives of patients who have sustained major trauma. Approximately one in four people will require a blood transfusion at some point in their lives and our health services administer blood to over 1,000 patients per week (IBTS, 2021). Blood is essential for a variety of the services provided within the healthcare system. For instance, a car accident victim may require up to 30 units of blood. Blood group O Rhesus negative is particularly needed for emergency transfusion, as demonstrated in Figure 1.0 below. Ireland currently needs over 3,000 blood donors each week to meet this demand. It is important to note that only 3% of the eligible Irish population donates blood, and this is in the context of a national population of over five million (CSO, 2022). There is therefore scope to improve blood supply in this country. The administration of blood products is dependent on their availability and the general public’s altruism in terms of making blood donations. The graph below provides a snapshot of the current blood supply in Ireland; they are also updated daily on www.giveblood.ie. The IBTS’s annual report 2021 also highlighted the incredible work done in Ireland in that year, despite the difficult circumstances caused by COVID-19, in order to ensure there was an adequate blood supply.

![Figure 1.0: Days of Blood Type Remaining](image-url)
This report analyses the available data within the MTA, focusing on case mix, mechanism of injury and patient outcomes when they receive their first blood product within the first 24 hours following a major trauma. This analysis covers the five-year period of 2017 to 2021. The audit coordinators across the country routinely collect data on the first blood products administered to a patient in the emergency department or critical care unit within 24 hours of sustaining a major trauma. The patients concerned may receive multiple blood product interventions throughout their hospital journey. However, for the purpose of this report, additional data were requested from the Trauma Audit and Research Network (TARN) to review the data on the first blood product administered, as a high level of data was gathered on this variable by the MTA, thus ensuring a good standard of data quality. It is recognised that additional variables, such as number of units transfused and all additional blood products transfused within the 24 hours, including pre-hospital, will be built upon for subsequent reports. Ongoing work is underway with hospitals to improve data capture and quality.

The MTA welcomes the opportunity to highlight the ‘GIVE BLOOD’ information campaign, and encourages national blood donation to sustain the necessary level of blood supply for safe operation of healthcare services. Further information on the registration process and information on donation centres can be found at https://www.giveblood.ie/can-i-give-blood.
INTRODUCTION

Major trauma is defined as an incident resulting in life-threatening or life-changing injury that has the potential to cause prolonged disability or death, such injuries can be caused by blunt or penetrating mechanisms such as falls, motor vehicle collisions, stab wounds and gunshot wounds (World Health Organization, 2022). Worldwide, more than five million people die each year as a result of injuries. Injury accounts for 8% of the world’s deaths (World Health Organization, 2022).

The Major Trauma Audit (MTA) is a clinically led audit established by the National Office of Clinical Audit (NOCA) in 2013. This audit focuses on the care of the more severely injured trauma patients in Ireland’s healthcare system. The methodological approach for the MTA is provided by the Trauma Audit and Research Network (TARN), based in the University of Manchester, United Kingdom (UK). In 2016, the MTA became the first national clinical audit endorsed by the National Clinical Effectiveness Committee (NCEC) and mandated by the Minister for Health.

This is the seventh Major Trauma Audit National Report published by NOCA and for the first time includes a sub-chapter on blood products. Previous reports can be found on the NOCA website. The MTA was developed using TARN methodology. TARN has been in operation in the UK since the 1980s and has been at the forefront of quality and research initiatives in trauma care. It is the largest trauma registry in Europe and is clinically led, academic and independent. TARN has been integral to the reconfiguration of trauma care delivery in the UK, and it monitors the effects of changes implemented. TARN receives and analyses anonymised MTA submissions from participating Irish hospitals and reports back to these hospitals through clinical reports. This feedback from TARN and NOCA supports hospitals and clinicians to monitor care and use the data to improve care delivery.

In addition to standardised clinical reports and dashboard reports, TARN has now developed an interactive data analytics portal where hospitals can access their own data and create live reports for specific categories. TARN officially launched the analytics portal on 25 May 2023. Notable benefits of the new portal are:

- advanced data visualisation tools
- presentation of complex information in an intuitive and visually appealing manner
- advanced analytics, providing users with deeper insights into their data.

The new report aims to increase efficiency and provide data-driven decision making by providing users with the necessary tools and insights to interpret raw data. This information technology innovation gives hospitals the ability to use the data more prospectively. It also facilitates quality improvement and service development in a supportive manner. As the MTA has matured, it has become a rich repository of data that can be used for research as well as clinical audit.

The MTA Governance Committee has welcomed the Major Trauma Audit National Report 2021 and continues to support the reconfiguration of the trauma system in Ireland. The MTA focus now is to ensure that the reconfiguration of services has the desired effect on processes and outcomes, as captured in the MTA, and that it supports quality improvement in care delivery. There are also important opportunities for injury prevention and health promotion. This report is intended for use by a wide range of individuals and organisations, including patients and carers, patient organisations, healthcare professionals, hospital managers, Hospital Groups, policymakers, the Irish Blood Transfusion Service (IBTS) and the general public.
NOCA continues to work with NOTS and the HSE, providing data to inform service planning and progress the recommendations of the National Trauma Strategy. The Strategy recommends the phased implementation of an inclusive trauma system for Ireland, where care is provided across two regional networks (the Central Trauma Network serving a population of 3.3 million and the South Trauma Network serving a population of 1.5 million). Each network will operate a hub and spoke model, each with a MTC as the hub with a number of supporting trauma units. The MTCs will provide the highest level of specialist trauma care to the most severely injured patients on a single hospital site and will act as the highest point of escalation for trauma services within their respective network. Trauma units will provide definitive care for the majority of patients who do not need the specialist expertise of an MTC. The designation of University Hospital Galway as a trauma unit with specialist services (TUSS), with additional expertise above and over trauma units, recognises the enhanced role the hospital currently plays in trauma care in the west and north–west of the country. Levels of service to be provided by a trauma unit and by the TUSS have been defined. NOTS will work with each hospital to support them in achieving those standards as implementation of the trauma system progresses.

The Mater Misericordiae University Hospital and Cork University Hospital have been designated as the MTCs for the Central Trauma Network and South Trauma Network respectively. An important milestone in the implementation of the strategy was reached on 20 April 2023, with the official launch of major trauma services in these hospitals. The launch of major trauma services and the implementation of protocols to supplement the provision of these services means that the fundamental components of the trauma system for Ireland are now in place. This was prioritised to ensure the most severely injured patients will benefit from early access to quality trauma care. The first phase of the implementation of the strategy has also seen developments across all stages of the trauma care pathway, including; the development of a trauma triage tool (TTT) for pre-hospital care providers to identify patients who should receive their trauma care at an MTC; and a transfer of care and egress policy, which will ensure the efficient and safe flow of trauma patients from hospitals currently providing acute care to trauma patients to the most appropriate care setting closer to home. Gemma’s Story explains the benefit of such progress for the benefit of patient care. Each patient’s rehabilitation needs will be assessed within 48 hours of admission and a standardised rehabilitation needs assessment (RNA) and an individualised rehabilitation prescription (RP) will accompany the patient as they move along their care pathway.

The next phase will focus on the continued development of major trauma services in Dublin and Cork and the development of trauma services at the TUSS in Galway and at trauma units nationwide. This next phase will also see three key enabling services being prioritised as part of the further development of the trauma system: the development of planned trauma care (where patients with suitable injuries who do not need immediate acute admission are managed in a scheduled manner); the priority bypass of certain hospitals for trauma patients; and collaboration with other initiatives across the HSE to address deficits in rehabilitation for trauma patients. Delivery of these services will facilitate the efficient operation of the system, ensure efficient patient flow and build additional capacity for scheduled care services nationally.
MTA METHODOLOGY

An overview of the aim and objectives of the Major Trauma Audit (MTA) can be found in Appendix 1. The MTA collects data on all major trauma patients who meet the inclusion criteria specified in Appendix 2. The MTA uses the Trauma Audit and Research Network (TARN) methodology, as described in Appendix 2.

DATA COLLECTION

The data are collected in local hospitals by audit coordinators who enter the data retrospectively from patient medical records or information technology systems. Each hospital has an MTA coordinator and a clinical lead, and each hospital should also have an MTA governance committee. A list of cases eligible for inclusion is identified by creating an MTA report through the Hospital In-Patient Enquiry (HIPE) system. All cases identified in these reports are reviewed and, where eligible, entered onto the TARN portal. Where deemed ineligible, they are recorded as such within the HIPE system, along with a reason for not being included. The ineligible cases are removed from each hospital’s denominator at the end of each reporting year to ensure that the data coverage is accurate.

The audit coordinator and clinical lead can generate local reports. TARN issues clinical reports three times a year and dashboard reports twice a year. In addition, National Office of Clinical Audit (NOCA) sends quarterly reports to the Hospital Groups. Most data are entered retrospectively and in accordance with the data collection targets (Table 2.1). The TARN coders and analytical team analyse the data to create key variables, in advance of sharing the data with NOCA. Examples of these key measures are the Injury Severity Score (ISS) and the Abbreviated Injury Scale (AIS) in Appendix 3.

TARN analytics dashboards are now available in each hospital, which allows them to view their data contemporaneously using Microsoft Power BI (a data visualisation tool). Microsoft Power BI contains several report templates (for example, TARN have created reports for data quality, body regions injured, case mix, and pathways and outcomes), and the data can be further analysed by selecting options on the screen. The reports can be exported into portable document format (PDF) or PowerPoint, which makes them easy to share with relevant stakeholders and to use them for service development and quality improvement.

The COVID-19 pandemic saw the redeployment of major trauma data coordinators in some hospitals, which impacted data coverage. Even more concerning, four hospitals were unable to enter data due to inadequate resourcing. This negatively impacted data capture in the audit, and is being proactively addressed for future national reports. Despite this reduction to 22 hospital submissions, the overall case number submission in 2021 (N=4,461) remained similar to 2020 (N=4,146). This shows the commitment from hospital management, clinical leads and audit coordinators who value the power of the MTA data in service planning and care delivery. Since September 2023 NOCA has been informed that Sligo University Hospital, Letterkenny University Hospital and Children’s Health Ireland have audit coordinators in post and training has commenced.
**DATA ENTRY**

Please see Appendix 4 for the data collection calendar for 2021.

**DATA ANALYSIS**

NOCA received the data extract from TARN on 8 December 2022. Additional data extract variables were requested and received on 12 June; any further requests have since been restricted following a cyberattack on the University of Manchester on 9 July 2023. Analysis for the national report was completed by the NOCA data analytics team following data checks with TARN. The analysis was conducted using Statistical Package for the Social Sciences (SPSS) V25. This report focuses on a year of complete data from 22 out of 26 participating hospitals. Please see Appendix 6 for the link to hospitals we work with. Figure 2.1 highlights the impact of the different waves of the COVID-19 pandemic during the 2021 reporting period as a reference when interpreting this report.
CHAPTER 2

FIGURE 2.1: TIMELINE OF THE COVID-19 PANDEMIC IN IRELAND DURING 2021

- DEC 2020: Lockdown eased to level 3
- JAN 2021: Peak day in ICU with 330 patients of whom 215 had COVID-19
- FEB 2021: The phased reopening of schools and childcare begins
- MAR 2021: 1st Vaccine for COVID-19 administered in Ireland
- APR 2021: Full lockdown imposed, Third wave confirmed
- MAY 2021: A significant cyber attack on the HSE lead to a shut down of HSE IT services
- JUN 2021: Start of 4th wave
- JUL 2021: The phased reopening of public services continued with an emphasis on outdoor services and increased public health measures alongside the COVID vaccine certificate
- AUG 2021: The easing of restrictions continued and public transport resumes full capacity
- SEP 2021: Start of a national vaccination campaign
- OCT 2021: The Omicron variant of COVID-19 is followed by the reintroduction of some restrictions
- DEC 2021/ JAN 2022: Continued expansion of the vaccination campaign and broadening of the age categories to include children ages 5 years and older
- FEB 2022: NPHT disbanded
- MAR 2022: COVID-19 Advisory Group established
- APR 2022: COVID-19
CHAPTER 3

DATA QUALITY

Relevance

Accuracy and reliability

Timeliness and punctuality

Coherence and comparability

Accessibility and clarity
CHAPTER 3

DATA QUALITY

DATA FOR THIS MTA REPORT

This report includes all patients who arrived for trauma care between 1 January 2021 and 31 December 2021, and who fulfilled the Trauma Audit and Research Network (TARN) eligibility criteria for inclusion, as set out in Appendix 2, Table 3.1. It also includes a subchapter on all patients who received blood products in the period 2017–2021 from all participating hospitals.

<table>
<thead>
<tr>
<th>Table 3.1: Data Analysis for Major Trauma Audit Report 2021</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2021</strong></td>
</tr>
<tr>
<td>Number of participating hospitals</td>
</tr>
<tr>
<td>All TARN submissions</td>
</tr>
<tr>
<td>Individual patients</td>
</tr>
<tr>
<td>Not transferred (into or out of first hospital)</td>
</tr>
<tr>
<td>Direct admissions</td>
</tr>
</tbody>
</table>

*Mercy University Hospital, Letterkenny University Hospital, Sligo University Hospital and Children’s Health Ireland (CHI) at Crumlin did not enter any cases during 2021.

DATA QUALITY STATEMENT

The purpose of the data quality statement (Table 3.2) is to highlight the assessment of the quality of the MTA data using internationally agreed dimensions of data quality as laid out in Guidance on a data quality framework for health and social care (Health Information and Quality Authority, 2018). The data quality statement identifies strengths in the data quality, including information to allow for subgroup analysis and areas for further improvement, such as matching of cases, etc. An overview of the assessment of the MTA against the dimensions of data quality is presented in Table 3.2.
# TABLE 3.2: OVERVIEW OF DATA QUALITY FOR MAJOR TRAUMA AUDIT 2021

<table>
<thead>
<tr>
<th>Dimensions of data quality</th>
<th>Definition (HIQA, 2018)</th>
<th>Assessment of dimension (MTA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevance</td>
<td>Data meets the current and potential future needs of users.</td>
<td>The MTA dataset is reviewed continuously as part of the TARN and MTA governance structures, in order to ensure that all data fields are relevant. Monthly teleconferences with the audit coordinators enable any new data fields or definitions to be discussed and feedback given to TARN. Each year, TARN holds two workshops for audit coordinators and clinical leads to support the use of the database and ensure that the data collected are meaningful and relevant. The MTA receives multiple research requests and data requests, especially relating to service development needs regarding reconfiguration of the trauma system. There have been many research publications using MTA data, which are listed in Chapter 8.</td>
</tr>
<tr>
<td>Accuracy and reliability</td>
<td>Data correctly and consistently describes what it was designed to measure.</td>
<td>The MTA collects data on trauma patients through a secure portal on the TARN website. The reference population for the national report for 2021 was: All patients admitted in 2021 with major trauma who fulfilled the TARN criteria for inclusion (see Appendix 2), and all patients who fulfilled the TARN criteria for inclusion and received blood products between 2017 and 2021. The expected standard for reporting at hospital level is a minimum of 80% data coverage. This refers to the number of major trauma cases entered against the overall expected number of cases (this is also referred to as case ascertainment). In 2021, 50% of the participating hospitals achieved this minimum standard of coverage. Therefore, the majority of the data in this report is reported at an aggregated – not hospital – level for 2021. Data coverage for the under 16 years age group are caveated as being less reliable, as data coverage for CHI at Crumlin is incomplete.</td>
</tr>
</tbody>
</table>
For the first time, this MTA report analysed the journey of major trauma patients who require blood products. Data quality issues were identified within data capture for some variables; for example:

(i) incident date and time and/or blood administration date and time, was not available.

(ii) Heart rate and second dose administration of tranexamic acid coverage for each variable would need to improve in order to report nationally.

These are discussed later in this report, on page 59 and page 68 in-document links respectively. We hope to see expansions on data quality for future reports.

In 2021, two workshops were held for audit coordinators. These workshops were provided online due to travel restrictions in place, secondary to COVID-19. These training sessions are available via the National Office of Clinical Audit (NOCA) audit manager.

NOCA issues a data collection and reporting calendar each year, with quarterly targets. These targets are adjusted when appropriate. During the data collection period for this report, the data collection process was monitored to ensure timely reporting. The calendar was adjusted at various intervals to account for events such as the winter surge, the Health Service Executive (HSE) cyberattack and the impact of COVID-19; see Figure 2.1. Data entry for this reporting period was closed on 31 November 2022.

In order to improve the timeliness of reporting, an executive management meeting was held in April 2023 and new agreed reporting timelines for NOCA to receive data downloads from TARN have been agreed. This will allow more timely quarterly reports to be circulated to participating hospitals. The TARN recommendation is for cases to be entered within 40 days of discharge, but analysis of data submitted can be completed at any time point retrospectively.
### TABLE 3.2: OVERVIEW OF DATA QUALITY FOR MAJOR TRAUMA AUDIT 2021 (CONTINUED)

<table>
<thead>
<tr>
<th>Dimensions of data quality</th>
<th>Definition (HIQA, 2018)</th>
<th>Assessment of dimension (MTA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coherence and comparability</td>
<td>Data are consistent over time and across providers and can be easily combined with other sources.</td>
<td>The MTA uses validated and comparable metrics to allow benchmarking; e.g., the International Classification of Diseases, Tenth Revision (ICD-10) codes used in the HIPE system. TARN and NOCA provide data entry guides, and procedure manuals are available from their respective websites. In 2018, a more detailed MTA data dictionary was completed, in line with HIQA’s <em>Guidance on a Data Quality Framework for Health and Social Care</em> (HIQA, 2018). This is updated regularly. NOCA and TARN also collaborated on compiling an updated version of this data dictionary in 2023, which, once completed, will be made available via the NOCA website. MTA data can be compared directly with data in the UK through the TARN audit. Some definitions vary slightly but, overall, the TARN audit acts as an appropriate international comparator. Any changes to the dataset, definitions and methodology are documented on the TARN website (<a href="http://www.tarn.ac.uk">www.tarn.ac.uk</a>), and any relevant changes are noted in the MTA national report.</td>
</tr>
<tr>
<td>Accessibility and clarity</td>
<td>Data are easily obtainable and clearly presented in a way that can be understood.</td>
<td>A list of publications related to the MTA are available on the NOCA website, in the ‘Reports and Research’ section (<a href="http://www.noca.ie">www.noca.ie</a>). Hospitals and Hospital Groups (if requested) can access their TARN data via a secure portal on the TARN website. This includes three clinical working reports, two dashboard reports and reports through the TARN analytics portal. Access to TARN data for Ireland is managed and governed by NOCA. Data access requests can be made directly through the NOCA website (<a href="http://www.noca.ie">www.noca.ie</a>) for a number of purposes, including research (in collaboration with the TARN research committee), service improvement, freedom of information and media queries. Ad hoc requests for data or audit reports must receive approval from the MTA Governance Committee.</td>
</tr>
</tbody>
</table>
DATA COVERAGE

The expected number of cases is estimated based on the HIPE codes related to trauma for the reporting year. The TARN eligibility criteria for inclusion are applied to the national HIPE codes in order to estimate how many patients in each hospital potentially meet the inclusion criteria for the audit. The limitations to this process were identified in the Major Trauma Audit National Report 2016, and during 2017 and 2018 NOCA worked with the Healthcare Pricing Office (HPO) and TARN to enable the audit coordinators from the hospitals to identify cases that did not meet the inclusion criteria for the audit, and then exclude these from the hospital denominators.

The national coverage for this report is described for the year 2021.

1) MTA total coverage was 76% for 2021 (Figure 3.1). This includes patients of all ages who met the inclusion criteria and had data entered on TARN from the 22 hospitals who entered data.

The coverage is the direct result of the hard work and commitment of the hospital audit coordinators and clinical leads. However, additional service planning and resourcing is needed to enable data capturing that sees all MTA eligible cases submitted and analysed. Eleven out of the 22 participating hospitals (50%) achieved the TARN coverage (case ascertainment) target of 80%. This disruption to data collection was further compounded on 14 May 2021, when the HSE cyberattack prevented any data entry to the MTA for a prolonged period. The majority of hospitals lost their access to the internet during this period; therefore, access to the TARN website was not possible. In an effort to make the data for 2021 as complete as possible, the deadline for data entry was extended by two months, to 31 November 2021.
DATA ACCREDITATION

The completion of key data fields for each submission recorded is used as the second measure of data quality (Figure 3.2). This is called data accreditation. TARN applies a standard of 95% for this measure. The national data accreditation level for the 2021 MTA was 95%. Figure 3.3 shows data accreditation by key data fields.

Despite the reduction in data capture for 2021, the quality, measured as data accreditation, remains at 95%, which gives reassurance that the information collected is of a very high standard (Figure 3.2). Figure 3.3 shows the data accreditation (completeness) for the key data points, which is one method of assessing data quality. As highlighted in previous national reports, difficulty persists regarding the capture of pre-hospital information in relation to 999 call details and incident details. Ongoing work with the National Ambulance Service (NAS) and Dublin Fire Brigade is under way to improve this, and currently the electronic patient care record (ePCR) used by the NAS is supporting hospitals to improve the capture of this information.

*CHI at Crumlin, Letterkenny University Hospital, Mercy University Hospital and Sligo University Hospital did not enter data during 2021.
KEY CONSIDERATION FROM CHAPTER THREE

A key consideration from this report would be for each hospital participating in the Major Trauma Audit (MTA) to be resourced to enter data on >80% of major trauma eligible patients within the MTA audit portal and put in place a contingency plan during redeployment/sick leave to allow for matching of cases. As highlighted in the *Major Trauma Audit National Report 2021*, there are still deficits in many of the participating hospitals in terms of data collection. More concerning, four hospitals did not enter data in 2021 due to resourcing. As the major trauma centres (MTCs) develop, there will be an increased demand to match transferred patients in order to ensure a comprehensive record of the patient’s entire journey. Without the presence of audit coordinator links within the hospitals, this crucial process will be effected, which will result in gaps in the data.

The MTA dataset is extensive and requires dedicated expert training to ensure data quality in data collection. Since 2016, the National Clinical Effectiveness Committee (NCEC), thus mandating that relevant hospitals participate fully in the audit, has accredited the MTA. This mandate includes data collection, validation, governance and use of the data for quality improvement.

The expected standard for transparent hospital-level reporting is 80%. The MTA has been unable to report at this level since 2018.

Chapter three shows that in 2021, four hospitals were unable to enter data due to resourcing. Eleven out of the 22 participating hospitals (50%) achieved the Trauma Audit and Research Network (TARN) coverage (case ascertainment) target of 80%. This is directly linked to a lack of whole-time equivalent staff and redeployment of staff. This is a worrying trend, which undermines the validity and usefulness of MTA data.

NOCA will continue to engage and facilitate training and education regarding data collection.
CHAPTER 4
WHO WAS INJURED AND HOW WERE THEY INJURED
WHO WAS INJURED AND HOW WERE THEY INJURED?

This chapter describes the case mix characteristics of major trauma patients. Further information and breakdown of tables can be found in Appendix 7, which complements the figures within this report.

The reporting period represents a time when our healthcare system was under significant strain from COVID-19; see Figure 2.1. The highest seven-day rolling average number of COVID-19 cases reached its peak at 6,516 on 9 January 2021 (Department of Health, 2021).

SEX AND AGE GROUP

The mean age of patients in this report is 62 years, and the median age is 65 years. The age profile continues to rise, from mean age of 60 in 2020 to 62 in 2021. Figure 4.1 shows the distribution of age groups by gender and clearly shows that major trauma predominantly affects younger men and older women. Overall, 57% (n=2,304) of patients were male, though among patients 75 years and older, female was the predominant gender (n=865, 61%).

**FIGURE 4.1:** PERCENTAGE OF MTA PATIENTS, BY SEX AND AGE GROUP (N=4,055)

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>MALE (n=2304)</th>
<th>FEMALE (n=1751)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-14</td>
<td>33</td>
<td>17</td>
</tr>
<tr>
<td>15-24</td>
<td>215</td>
<td>71</td>
</tr>
<tr>
<td>25-34</td>
<td>192</td>
<td>58</td>
</tr>
<tr>
<td>35-44</td>
<td>248</td>
<td>74</td>
</tr>
<tr>
<td>45-54</td>
<td>313</td>
<td>135</td>
</tr>
<tr>
<td>55-64</td>
<td>392</td>
<td>255</td>
</tr>
<tr>
<td>65-74</td>
<td>347</td>
<td>276</td>
</tr>
<tr>
<td>75-84</td>
<td>354</td>
<td>456</td>
</tr>
<tr>
<td>85+</td>
<td>210</td>
<td>409</td>
</tr>
</tbody>
</table>

**FIGURE 4.1:** PERCENTAGE OF MTA PATIENTS, BY SEX AND AGE GROUP (N=4,055)
MECHANISM OF INJURY

Figure 4.2 shows a breakdown of the mechanism of injury by age group. Falls of less than two metres, termed ‘low falls’, continue to be the most frequent cause of injury (n=2,532, 62%), with a large proportion (n=1,265, 89%) of patients aged 75 years and over having been injured in low-fall events. The second most frequent cause of major trauma was road trauma (n=631, 16%), with 42% (n=226) of patients aged 15 to 34 thus injured.

One in five major trauma injuries in the age group 15–34 years were due to blows (n=104, 19%). One half (n=54, 52%) of those injuries were due to alleged assault, and 33% (n=34) due to sport injury.

2 Percentages may not add up to 100% due to rounding.

FIGURE 4.2: MECHANISM OF INJURY, BY AGE GROUP (N=4,055)²
INJURY SEVERITY SCORE

A breakdown of the Injury Severity Score (ISS) across all injured patients by age group is presented in Figure 4.3. In 2021, 43% (n=1,762) of major trauma patients suffered moderate–severe injuries and 36% (n=1,455) suffered severe injuries. The age group 0–44 years saw a larger proportion of patients with a severe injury (n=409, 45%) than patients aged 45 years and older (n=1,046, 33%).

The term ISS is explained in Appendix 3 (Baker et al., 1974).

FIGURE 4.3: PERCENTAGE OF PATIENTS BY ISS, BY AGE GROUP (N=4,055)

Percentages may not add up to 100% due to rounding.
PLACE OF INJURY

Home was recorded as the place where over half (n=2,218, 55%) of major trauma injuries occurred. Some 29% (n=1,159) of injuries occurred in a public place or on a road. Home was the predominant place of injury in the 0–14-year-old age group and in patients aged 55 years and over.

FIGURE 4.4: PLACE OF INJURY, BY AGE GROUP (N=4,055)

4 Percentages may not add up to 100% due to rounding.
BODY REGIONS INJURED

Overall, the limbs and head remain the most commonly injured body regions (n=2,133, 53%). Figure 4.5 lists most severely injuries by type and proportion.

![Body Regions Injured Diagram]

**FIGURE 4.5: TYPE OF BODY REGION INJURED (N=4,055)**

**KEY FINDINGS FROM CHAPTER 4**

- Age and gender distribution remained consistent between 2020 and 2021.
- Falls of less than two metres, termed 'low falls', continue to comprise the most frequent cause of injury (n=2,532, 62%). A large proportion of patients aged 75 years and over were injured in low-fall events (n=1,265, 89%). The second most frequent cause of major trauma was road trauma (n=631, 16%), with 42% (n=226) of patients aged 15 to 34 thus injured.
- Home continues to be the main location of major trauma injuries, with over 50% being thus recorded. This is followed by public area or road trauma (29%).
- Limbs and head remain the most commonly injured body parts, making up more than 50% of the injury profile.
CHAPTER 5

CARE OF MAJOR TRAUMA PATIENTS IN THE ACUTE HOSPITAL SERVICE
CHAPTER 5

CARE OF MAJOR TRAUMA PATIENTS IN THE ACUTE HOSPITAL SERVICE

PROPORTION OF PATIENTS WHO WERE PRE-ALERTED

Pre-alert is a system whereby the ambulance service communicates to the receiving hospital that it is bringing a patient to its emergency department, as well as the nature of the patient’s injuries, the patient’s physiology, their expected requirements on arrival and the expected time of arrival.

Figure 5.1 includes analysis of pre-alert data; specifically to the hospital the patient is initially brought to, after having sustained traumatic injury. Younger patients continue to be more likely to be pre-alerted than older patients. There continues to be a very low percentage of patients documented as having been pre-alerted (n=494, 13%). The Major Trauma Audit (MTA) welcomes the National Office for Trauma Services’ (NOTS) development of a trauma triage tool for pre-hospital care providers to identify patients who should receive their trauma care at a major trauma centre (MTC), and will continue to monitor the impact of this introduction. A link to the module aimed at all pre-hospital care providers and those involved in triaging patients in an emergency department can be found on HSEland.ie.

FIGURE 5.1: PRE-ALERTED, BY AGE GROUP (n=3,672)

Figure 5.1 refers to direct admissions only.

![Pre-alerted, Not pre-alerted, Not recorded](chart.png)
**DOCUMENTED RECEPTION BY A TRAUMA TEAM, BY AGE GROUP**

Time to critical interventions and outcomes are both improved when a trained trauma team is present on the arrival of a severely injured patient (Driscoll and Vincent, 1992). The overall percentage of major trauma patients received by a trauma team remains extremely low (n=292, 8%). Patients in the younger age groups were more likely to be received by a trauma team (mean age 46), with a steady decline in the likelihood of reception by a trauma team as patient age increased (Figure 5.2). *A Trauma System for Ireland* (Department of Health, 2018) references that each MTC will have “a consultant-led trauma team available at all times”. This along with the development of national trauma guidelines for older persons by NOTS (HSE, 2022a) represent positive steps in the management of major trauma patients in Ireland. The MTA will be able to capture and report on the impact of the implementation of these measures in future reports.

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>Received by a trauma team</th>
<th>Not received by a trauma team</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-14</td>
<td>19%</td>
<td>81%</td>
</tr>
<tr>
<td>15-24</td>
<td>21%</td>
<td>79%</td>
</tr>
<tr>
<td>25-34</td>
<td>16%</td>
<td>84%</td>
</tr>
<tr>
<td>35-44</td>
<td>18%</td>
<td>82%</td>
</tr>
<tr>
<td>45-54</td>
<td>12%</td>
<td>88%</td>
</tr>
<tr>
<td>55-64</td>
<td>7%</td>
<td>93%</td>
</tr>
<tr>
<td>65-74</td>
<td>5%</td>
<td>95%</td>
</tr>
<tr>
<td>75-84</td>
<td>3%</td>
<td>97%</td>
</tr>
<tr>
<td>85+</td>
<td>1%</td>
<td>99%</td>
</tr>
<tr>
<td>Total</td>
<td>8%</td>
<td>92%</td>
</tr>
</tbody>
</table>

**FIGURE 5.2: DOCUMENTED RECEPTION BY A TRAUMA TEAM, BY AGE GROUP (n=3,672)**

---

6 Figure 5.2 refers to direct admissions only.
7 Percentages may not add up to 100% due to rounding.
CHAPTER 5

DOCUMENTED GRADE OF MOST SENIOR DOCTOR ON ARRIVAL

In 2021, 20% (n=752) of patients with a major trauma were seen by a consultant on arrival. The Trauma Audit and Research Network (TARN) average is 44% for this same time period. Figure 5.3 shows that younger major trauma patients were more likely to be seen by a consultant on arrival.

FIGURE 5.3: DOCUMENTED GRADE OF MOST SENIOR DOCTOR TREATING PATIENT ON ARRIVAL, BY AGE GROUP (n=3,672)

Figure 5.3 refers to direct admissions only. The category ‘Other’ includes information that was not recorded, as well as associate specialist and intern.

* Percentages may not add up to 100% due to rounding.
TIME TO SEE PATIENTS ON ARRIVAL TO HOSPITAL

Patients should be triaged and reviewed in a timely manner by the relevant grade doctor according to their injuries. In 2021, when received by a trauma team, a consultant saw 44% (n=128) of patients with major trauma within 30 minutes of arrival to the emergency department (Figure 5.4), compared to 76% when benchmarked against the TARN average.

FIGURE 5.4: DOCUMENTED MOST SENIOR DOCTOR SEEING PATIENT ON ARRIVAL IN THE EMERGENCY DEPARTMENT AND THOSE WITH AN INJURY SEVERITY SCORE >15

Per centages may not add up to 100% due to rounding. ED = Emergency department.

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10 Percentages may not add up to 100% due to rounding. ED = Emergency department.
SURGICAL INTERVENTION, BY BODY REGION AND AGE GROUP

Patients who sustain a major trauma commonly have multiple injuries and these can require multiple surgeries. In some cases, multiple surgeries from multiple specialties are required for a single injury. In the current report, all surgeries are reported. In 2021, some patients had multiple surgeries, and some had surgery at more than one hospital, thereby generating more than one submission. Out of 1,751 patients who had a surgical procedure, the majority had one surgery (n=1,102, 63%), 22% (n=380) had two surgeries, 11% (n=184) had three surgeries, and 5% (n=85) had four or more surgeries performed.

Out of 2,784 surgeries performed on 1,751 patients, the most common type of surgical intervention performed was limb surgery (n=1,503, 54%). Figure 5.5 shows a breakdown of surgical intervention by the body region on which surgery was performed and age group. The overwhelming majority of surgical intervention was limb surgery mainly done by orthopaedic surgeons. There was variation in surgical interventions by age group, with a larger proportion of major trauma patients who had a head and brain surgical interventions in age groups 0–14 years and 65–84 years, when compared to other age groups. The age group 35–44 years had the largest proportion of skin and soft tissue surgical interventions, when compared to other age groups.

FIGURE 5.5: SURGICAL INTERVENTION, BY BODY REGION AND AGE GROUP (n=2,784)11,12

1 A total of 1,751 patients had 2,784 had major surgeries performed. Figure 5.5 refers to all surgeries performed in the hospital to which the patient was admitted; subsequent surgeries in the same hospital were also included. A patient may have had two or more surgeries performed in two or more hospitals and will therefore be counted more than once in Figure 5.5.

12 Percentages may not add up to 100% due to rounding.
HOSPITAL SYSTEMS PERFORMANCE

The TARN audit is underpinned by clinical standards and systems indicators, which are intended to provide opportunities for learning and quality improvement. Each hospital receives clinical reports issued by TARN and quarterly National Office of Clinical Audit (NOCA) reports, which compare individual hospitals with the TARN average on a number of hospital key hospital performance indicators to which they can benchmark across with the UK. The development of the TARN analytics dashboards will further assist in accessing timely data to compare performances.

1. AIRWAY MANAGEMENT OF MAJOR TRAUMA AUDIT PATIENTS WITH A GLASGOW COMA SCALE <9

International guidelines use a Glasgow Coma Scale (GCS) of <9 as a criterion for the requirement of definitive airway management; i.e., endotracheal or tracheal intubation, on arrival to an emergency department (Royal College of Surgeons of England, 1999).

The number of patients with a GCS of <9 has been gradually decreasing, from 183 patients in 2019, to 164 patients in 2020 (MTA, 2022), to 120 patients in 2021. Of these 120 patients, 72% (n=86) were documented as being intubated in the emergency department. Twenty percent (n=24) had ‘not known’ recorded for their airway support status (Figure 5.6).

![Figure 5.6: Airway Management of Patients with a GCS (n=120)](image-url)

**Figure 5.6: Airway Management of Patients with a GCS (n=120)**

- Intubated - ED: 72%
- Intubated - pre-hospital: 0%
- Intubated both ED and pre-hospital: 6%
- No intubation: 3%
- Not known: 20%

---

13 This refers to direct admissions only.
14 Percentages may not add up to 100% due to rounding.
2. MANAGEMENT OF SHOCKED PATIENTS

The definition of a shocked patient is one who has suffered blunt trauma and was admitted with a systolic blood pressure of less than 110 mmHg. These patients have a significantly increased risk of mortality (Hasler et al., 2011). The crude survival rate does not attempt to adjust for differences in age, gender, comorbidities or other factors that contribute to survival. In 2021, 7% (n=29) of shocked patients died, and this was consistent with 8% in 2020 (MTA, 2022).

3. TIME TO CT SCAN FOR HEAD INJURY PATIENTS AT INITIAL TREATING HOSPITAL

Head injury patients with an initial GCS of <13 should have a computerised tomography (CT) head scan within one hour of arrival to hospital (NICE, 2014). Of 161 patients sustaining major trauma who required a CT head scan (having head injuries and an initial GCS of <13) in 2021, 50% (n=81) received it within one hour or less (Figure 5.7). This was an increase from 43% in 2020 (NOCA, 2022) but still below the TARN average of 76%. The median time to CT scan was one hour (with an interquartile range (IQR) of 42 minutes to 1 hour and 36 minutes).

**FIGURE 5.7: PERCENTAGE OF PATIENTS TO RECEIVE A CT SCAN WITHIN 1 HOUR (n=161)**

- 50% Within an hour
- 50% After one hour

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15 Patients who did not have time to have their CT scan recorded were not included in Figure 5.7.
### 4. INTENSIVE CARE UNIT ADMISSION

Patients sustaining major trauma are admitted to a critical care service for many reasons, including ongoing resuscitation, organ support and/or closer monitoring. Critical care encompasses both intensive care and high-dependency care. In practice, Level 2 is the high-dependency care and Level 3 is the intensive care level of critical care (National Standards for Adult Critical Care Services, 2011). The length of stay in an intensive care unit (ICU) can be influenced by the availability of ICU beds, the needs of the patient and/or the availability of step-down beds.

Table 5.1 shows that 15% (n=623) of MTA submissions were admitted to an ICU, with a median length of stay in the unit of four days. Some patients (n=115, 18%) generate multiple MTA submissions during their patient journey, as they are transferred between hospitals.

<table>
<thead>
<tr>
<th>TABLE 5.1: INTENSIVE CARE UNIT LENGTH OF STAY FOR MAJOR TRAUMA AUDIT PATIENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of patients</strong></td>
</tr>
<tr>
<td>All MTA patients</td>
</tr>
<tr>
<td>MTA patients with an ISS &gt;15</td>
</tr>
<tr>
<td>MTA patients with a severe TBI*</td>
</tr>
<tr>
<td><strong>Median (IQR) ICU LOS, in days</strong></td>
</tr>
<tr>
<td>All MTA patients</td>
</tr>
<tr>
<td>MTA patients with an ISS &gt;15</td>
</tr>
<tr>
<td>MTA patients with a severe TBI*</td>
</tr>
<tr>
<td><strong>Total number of ICU bed days</strong></td>
</tr>
<tr>
<td>All MTA patients</td>
</tr>
<tr>
<td>MTA patients with an ISS &gt;15</td>
</tr>
<tr>
<td>MTA patients with a severe TBI*</td>
</tr>
</tbody>
</table>

*TBI=Traumatic brain Injury

### 5. HOSPITAL LENGTH OF STAY

Hospital length of stay for trauma patients is dependent on the nature and severity of the injuries sustained, the baseline health of the patient, the efficiency of the hospital in delivering care and the ability of the hospital to discharge the patient to an appropriate setting when they have recovered. Access to rehabilitation, step-down facilities, and home and community support influence length of stay at the acute hospital for severely injured patients.

The median length of stay for all major trauma patients in 2021 was nine days (Table 5.2), and this remained unchanged from 2020 (NOCA, 2022). The median length of stay for major trauma patients with ISS >15 was 11 days.

<table>
<thead>
<tr>
<th>TABLE 5.2: HOSPITAL LENGTH OF STAY FOR MAJOR TRAUMA AUDIT PATIENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of patients</strong></td>
</tr>
<tr>
<td>All MTA patients</td>
</tr>
<tr>
<td>MTA patients with an ISS &gt;15</td>
</tr>
<tr>
<td><strong>Median (IQR) LOS, in days</strong></td>
</tr>
<tr>
<td>All MTA patients</td>
</tr>
<tr>
<td>MTA patients with an ISS &gt;15</td>
</tr>
<tr>
<td><strong>Total number of LOS bed days</strong></td>
</tr>
<tr>
<td>All MTA patients</td>
</tr>
<tr>
<td>MTA patients with an ISS &gt;15</td>
</tr>
</tbody>
</table>
KEY FINDINGS FROM CHAPTER 5

- Younger patients continue to be more likely to be pre-alerted than older patients. However, there continues to be a very low percentage of patients documented as having been pre-alerted (n=494, 13%) (Figure 5.1).

- The overall percentage of major trauma patients received by a trauma team remains extremely low (n=292, 8%) (Figure 5.2).

- Out of 1,751 patients who had a surgical procedure, the majority had one surgery (n=1,102, 63%), 22% (n=380) had two surgeries, 11% (n=184) had three surgeries and 5% (n=85) had four or more surgeries performed. The most common type of surgical intervention performed was limb surgery (n=1,503, 54%) (Figure 5.5).

- Of 161 patients sustaining major trauma who required a CT head scan (having head injuries and an initial GCS of <13) in 2021, 50% (n=81) received it within one hour or less (Figure 5.7); this was an increase from 43% in 2020 (NOCA, 2022).
CHAPTER 6
THE PATIENT JOURNEY
THE PATIENT JOURNEY

This chapter describes the journey of major trauma patients through the hospital system in 2021, pre-trauma networks and major trauma centre (MTC) commencement. It will also follow the patient journey when requiring blood products.

PRESENTATION BY MONTH

Figure 6.1 shows the number of Major Trauma Audit (MTA) admissions per month. In 2021, the average number of admissions for COVID-19 Waves 3 and 4 was 338 admissions per month. In May 2021, the Health Service Executive (HSE) experienced a cyberattack on HSE health services and computer systems (HSE, 2021). During that month, the number of admissions decreased from 348 to 316 admissions, and increased to 371 admissions in June, at the beginning of COVID-19 Wave 4. The highest number of admissions was during the month of July (n=408).

![Figure 6.1: Presentation, by Month (N=4,055)](image-url)
MODE OF ARRIVAL

Road ambulance remains the most common mode of transportation to hospital for major trauma patients (n=2,817, 79%) (Figure 6.2), and has gradually increased from 2019 (74%) and 2020 (77%) (NOCA, 2022).

![Diagram of hospital with different modes of transportation: helicopter, ambulance, by car, walking.]

**FIGURE 6.2: MODE OF ARRIVAL AT HOSPITAL (n=3,558)**

*Patients who were transferred to another hospital (n=383) have been excluded. Patients who were transferred out (n=453) were included in Figure 6.2. Data on patients whose mode of transport to hospital was ‘Other’ or ‘Not applicable’ (n=114) have not been presented in Figure 6.2.*
MOST SENIOR PRE-HOSPITAL HEALTHCARE PROFESSIONAL

Of the patients brought to hospital by ambulance and/or helicopter (n=2,895, Figure 6.2), 45% (n=1,314) were attended to by a paramedic (Figure 6.3). This was a decrease from 50% in 2020 (NOCA, 2022). Forty-one percent (n=1,190) were attended by an advanced paramedic, which was an increase from 37% in 2020 (NOCA, 2022).

FIGURE 6.3: MOST SENIOR PRE-HOSPITAL HEALTHCARE PROFESSIONAL (n=2,895)17

17 Percentages may not add up to 100% due to rounding.
**TRANSFERS**

Optimal care of patients with injuries requires a coordinated, integrated and standardised system of trauma care. Inclusive trauma systems have been shown to significantly reduce the number of deaths and disabilities caused by major trauma. As part of the trauma system for Ireland, attention is currently being placed on moving to a system where patients receive the right treatment in the right place at the right time. It is hoped that the MTA will be in position to monitor the impact of this evolution of the trauma system, namely in a reduction in the number of patients transferred. This will ultimately lead to an improved patient experience, with less disruption caused by multiple transfers between hospitals.

In 2021, 21% (n=836) of major trauma patients were transferred at least once to another hospital for further care (Figure 6.4). This remained consistent with 2019 (21%); however, it does mark an increase from 2020 (18%) (NOCA, 2022).

![Figure 6.4: Percentage of patients transferred to another hospital (N=4,055)](image)

**FIGURE 6.4: PERCENTAGE OF PATIENTS TRANSFERRED TO ANOTHER HOSPITAL (N=4,055)**
PATIENT JOURNEY WHEN REQUIRING BLOOD PRODUCT ADMINISTRATION

As highlighted by the media, there is a national shortage in blood products, with demand outstripping supply. In light of this, the MTA governance committee recognised the need to explore the demand for blood products within the MTA and to contribute to the existing repository of information within the Irish Blood Transfusion Service (IBTS). The MTA captures a wide range of additional data within Trauma Audit and Research Network (TARN). This year, the data focused on information that is routinely collected within the MTA on the administration of the first blood product within the pre-hospital setting, emergency department and critical care admission, within 24 hours of incident. This cohort of patients requires lifesaving intervention, including transfusion, to stabilise and reduce the risk of mortality and morbidity.

The first blood product administration, for all patients recorded within the MTA for 2017–2021, is described here. The World Health Organization defines a blood product as any therapeutic substance derived from human blood, including whole blood and other blood components for transfusion, and plasma-derived medicinal products (WHO, 2023). The collection of data on subsequent blood products administered are less routinely collected. It is anticipated that future reports will expand on this chapter to include subsequent blood products, including the quantity of components administered throughout the patient journey.

Administration of Prothrombin Complex Concentrate (Octaplex®/Beriplex®) to patient by age and gender is also described. Prothrombin complex concentrate is used to treat and prevent bleeding and in the rapid reversal of warfarin or other vitamin K antagonists in cases of life-, limb- or sight-threatening haemorrhage or prior to emergent surgery. Future reports will also analyse anticoagulation reversal, as 15% of patients found to be anticoagulated in a UK national comparative audit of massive haemorrhage in 2018 (NHS, 2018).

Blood products derived from human donations of blood and plasma play a critical role in health care. Safe, effective and quality-assured blood products contribute to dramatically improving the life expectancy and quality of life of patients suffering from life-threatening traumatic haemorrhage (World Health Organization, 2022). An insufficient or unsafe blood supply for transfusion has a negative impact on the effectiveness of key health services and programmes to provide appropriate patient care in numerous acute and chronic conditions. Ensuring that all patients in need of transfusion have access to safe, effective and quality-assured blood products is a critical component of an effective health system and vital for patient safety. A Trauma System for Ireland (HSE, 2018) also highlights the importance of equipping MTCs with on-site laboratory services that are available 24/7 and are supported by a transfusion specialist/haematologist. The blood bank must maintain sufficient in-house supplies stockholding of red cell concentrate, fresh frozen plasma, platelets and appropriate coagulation factors to deal with activation of an agreed-upon massive transfusion protocol. There needs to be a ready supply of Group O blood suitable for emergency release to the emergency department, typically O RhD negative.

There was an increase in red cells (+5.1%) and platelets (+6.3%) issued to hospitals in 2021, compared to 2020 (IBTS, 2021). Demand varied throughout the year, due to the impact of COVID-19 on hospital activity and the HSE cyberattack. However, over the course of the year, demand increased for both red cells and platelets compared to 2020. Red cell units were imported from the National Health Service Blood and Transplant to supplement bloodstocks on two occasions to ensure blood support for patient care. A total of 525 units were imported, mainly RhD negative blood groups (IBTS, 2021). The availability of blood and platelets is solely based on supply from general public donations.

Additional information, compiled by the IBTS, illustrating the blood products supplied to the hospitals during 2017–2021 can be found in Appendix 9.
Damage Control Resuscitation – Haemostatic Resuscitation

Early administration of blood and blood products is generally recommended to replace all the constituents of whole blood from the outset of resuscitating the traumatised patient who is bleeding. Evidence suggests that timely transfusion can reduce blood product use overall (Geeraedts et al., 2009; Lasanianos et al., 2011). The concept is based on the assumption that coagulopathy is present very early after severe injury and rapidly corrective interventions can improve outcomes (McDaniel et al., 2014). This requires us to rethink our concept of massive transfusion and massive transfusion protocols. Massive transfusion has traditionally been defined as those patients requiring more than 10 units of red cells in 24 hours. Management of coagulopathy was almost exclusively reactive and only instituted once the patient had received large volumes of blood. Clearly, a damage control resuscitation (DCR) approach requires the recognition of patients with the potential to require large volume transfusion, as discussed above (Ball, 2014; Lamb et al., 2014). Local protocols will vary, but haemostatic resuscitation/DCR aims to deliver a mixture of red blood cells, fresh frozen plasma and platelets in approximately a 1:1:1 ratio (Kornblith et al., 2014). This is known as balanced transfusion; with the administration of packed red blood cells being balanced with coagulation factor delivery. Without this, dilution of coagulation factors will exacerbate consumptive loss. This has the potential to rapidly result in a spiral of coagulopathy and worsening blood loss (Ball, 2014). While such protocols have been found to reduce morbidity and mortality, the requirement for such large amounts of clotting products and the exact composition of this transfusion regime does remain controversial. Most MTCs have developed their own protocols based upon availability of blood products and local experience (Ball, 2014). When surveyed, among 20 out of the 26 participating hospitals:

1. 95% have a massive transfusion protocol in place
2. 85% have an audit process in place for massive transfusion protocols.

Between 2017 and 2021, 4% (n=943) of major trauma patients received blood products within the first 24 hours, which accounted for 982 blood products. The most common type of first blood product administered was red cell concentrate (RCC) (n=782, 80%) (Figure 6.5).

Mean and median age of patients who received blood was 51 years. Women were predominantly older, with a mean age of 56 years (median 60), when compared to male major trauma patients, who had a mean and median age of 48 years.

On its website giveblood.ie, the IBTS reports that only 8% of blood donors are Group O RhD negative but that these donations are heavily in demand for emergency blood transfusions, pending the confirmation of the patient’s own blood group. Group O RhD negative blood is necessary for RhD negative/group unknown female patients of child-bearing age (15–55 years) (EPA, 2010) and children to prevent RhD sensitization and haemolytic disease of the fetus/newborn in future pregnancies. It is reasonable, especially in times of blood shortage, to use Group O RhD positive blood for the emergency transfusion of adult males and post-menopausal females and prioritise the RhD negative supply for females of child-bearing age and males aged under 18 years. The age and sex profile of major trauma patients who were transfused suggests that this approach is indeed feasible. This information is also relevant to those providing pre-hospital emergency blood products.

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18 Blood product: Red cell concentrate (blood/plasma reduced cells, leucocyte-depleted red cells and plasma); frozen plasma (fresh frozen plasma, freeze-dried plasma, solvent detergent plasma); platelets; and fibrinogen concentrate.
19 One patient may have had more than one blood product, in one or more hospitals.
CHAPTER 6

FIGURE 6.5: TYPE OF BLOOD PRODUCT, BY AGE AND SEX (2017–2021) (N=982)

20 One patient may have had more than one blood product, in one or more hospitals.
21 Percentages may not add up to 100% due to rounding.
**CHAPTER 6**

**PROTHROMBIN COMPLEX CONCENTRATE (Octaplex®/Beriplex®)**

Between 2017 and 2021, a total of 9% (n=94) of blood products administered were prothrombin complex concentrates. There was a reduction of Octaplex or Beriplex administration, from 15% (n=37) in 2017 to 2% (n ≤5) in 2021 (Figure 6.6). It is worth noting that the numbers reported are small as this report has focused on only the first product being recorded; therefore, Octaplex may still have been given but not recorded, if the first product transfused to a patient was RCC. Patients with head trauma/intracerebral haemorrhage who are on oral anticoagulants, or who require emergent reversal for major surgery (but not those haemorrhaging requiring RCC transfusion) are more likely to receive Octaplex as the first product.

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**FIGURE 6.6: PERCENTAGE OF PATIENTS WHO RECEIVED BERIPLEX/OCTAPLEX, BY YEAR (2017–2021) (N=1,076)**

One patient may have had more than one blood product administered, and therefore counted more than once in Figure 6.6.
Between 2017 and 2021, 94 major trauma patients received prothrombin complex concentrates. Of those, the majority were male (n=54, 57%) (Figure 6.7). Women were predominantly older, with a mean age of 80 years (median 82), compared to male patients who had a mean age of 72 years (median 81). The majority of patients who received prothrombin complex concentrates had a ‘low fall’ (of less than two metres) as the mechanism of injury (n=80, 85%). This was expected, as older patients are more likely to suffer from atrial fibrillation and to be on treatment with anticoagulants/requiring reversal, as well as to be in the ‘low fall’ group.

**FIGURE 6.7: PERCENTAGE OF PATIENTS WHO RECEIVED BERIPLEX/OCTAPLEX, BY SEX AND AGE GROUP (2017–2021) (N=94)**
BLOOD PRODUCT ADMINISTRATION BY RECEIVING HOSPITAL

The majority of patients who received a blood product received the transfusion in the first admitting hospital (n=776, 82%)\(^\text{23}\). A further 14% (n=130) received blood products in their consecutive hospital(s), and a small proportion of patients (n=37, 4%) received blood products in both their first and consecutive hospital(s) (Figure 6.8).

Out of all the patients who received an RCC transfusion, 44% (n=283) of them received it within six hours of incident. For 28% (n=180) of major trauma cases who received RCC, information was not available on either incident date and time and/or blood administration date and time, see further information in Appendix 8, Table 8.1.

\(^{23}\) Blood product: Red cells concentrate (blood/plasma reduced cells, leucocyte depleted red cells and plasma); fresh frozen plasma (fresh frozen plasma, Freeze dried plasma, solvent detergent plasma); platelets; fibrinogen concentrate.
PLACE OF INJURY OF PATIENTS WHO RECEIVED BLOOD PRODUCTS TRANSFUSION

Among major trauma patients who received a blood product transfusion, half (n=494, 50%) of these injuries were recorded as having occurred in a public area or on a road. Thirty-six percent (n=354) of injuries occurred at home (Figure 6.9).

**FIGURE 6.9:** PLACE OF INJURY OF PATIENTS WHO RECEIVED BLOOD PRODUCTS (2017–2021) (N=982)

24 A single patient may have had more than one product, in one or more hospitals; such cases will therefore appear more than once in Figure 6.9.

25 Percentages may not add up to 100% due to rounding.
MECHANISM OF INJURY FOR PATIENTS WHO RECEIVED BLOOD PRODUCTS

Figure 6.10 shows the mechanism of injury for patients who received a blood product transfusion. Road trauma (n=355, 36%) and falls of less than two metres (n=303, 31%) were the most frequent causes of injury. There was variation in mechanisms of injury by blood product. Out of the major trauma patients who received platelets, 67% (n=50) suffered trauma from a fall of less than two metres.

A single patient may have had more than one product, in one or more hospitals; such cases will therefore appear more than once in Figure 6.10.

Percentages may not add up to 100% due to rounding.

FIGURE 6.10: MECHANISM OF INJURY FOR PATIENTS WHO RECEIVED A BLOOD PRODUCT (2017–2021) (N=982)\textsuperscript{26,27}
INJURY SEVERITY SCORE OF PATIENTS WHO RECEIVED BLOOD PRODUCTS

The majority (n=701, 71%) of patients who received blood products had a severe injury (Figure 6.11).

**FIGURE 6.11: PERCENTAGE OF PATIENTS WHO RECEIVED BLOOD PRODUCTS, BY ISS (2017–2021) (N=982)\(^2\)**

- Red cells concentrate (n=782):
  - Low severity injury: 6%
  - Moderate severity injury: 25%
  - Severe injury: 70%

- Frozen plasma (n=110):
  - Low severity injury: 1%
  - Moderate severity injury: 27%
  - Severe injury: 72%

- Platelets (n=75):
  - Low severity injury: 1%
  - Moderate severity injury: 13%
  - Severe injury: 85%

- Fibrinogen concentrate (n=15):
  - Low severity injury: 7%
  - Moderate severity injury: 13%
  - Severe injury: 80%

- Total:
  - Low severity injury: 5%
  - Moderate severity injury: 24%
  - Severe injury: 71%

\(^2\) A single patient may have had more than one product, in one or more hospitals; such cases will therefore appear more than once in Figure 6.11.

\(^3\) Percentages may not add up to 100% due to rounding.
PRESENTATION BY TIME OF DAY OF PATIENTS WHO RECEIVED BLOOD PRODUCTS

Figure 6.12 shows patients’ time of presentation to their initial treating hospital. Eighty percent (n=649) of patients who received a blood product arrived at hospital between 8:00am and 23:59pm.

Figure 6.12: Patient time of presentation to initial treating hospital (2017–2021) (n=812)

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Refers to direct admissions only. Patients with missing information on time point of admission were excluded.
BODY REGION INJURED AMONG PATIENTS WHO RECEIVED BLOOD PRODUCTS

The head was the most common injured body area among patients who received a blood product (n=270, 27%). This was followed by limbs (n=182, 19%), chest injury (n=181, 18%) and multiple injuries (n=171, 17%). For the majority of major trauma patients who received platelets, the head was recorded as their most severely injured body area (n=61, 81%) (Figure 6.13). This possibly indicates patients on anti-platelet agents as it is the first product transfused.


A single patient may have had more than one product, in one or more hospitals; such cases will therefore appear more than once in Figure 6.13.

Percentages may not add up to 100% due to rounding.
FIGURE 6.13B: BODY REGION INJURED BY TYPE OF BLOOD PRODUCT RECEIVED.
PRE-ALERT RATE FOR PATIENTS WHO RECEIVED BLOOD PRODUCTS

The receipt of a pre-alert by the hospital blood bank mobilises scientific staff to perform blood group testing and prepare the blood products required. It also enables short-shelf-life blood products to be ordered, such as platelets from the IBTS, which have an expiry of seven days, and for frozen plasma to be thawed, which takes between 20 and 40 minutes. The pre-alert prompts the blood bank to check and, if necessary, replenish their stock of blood. Once thawed, frozen plasma cannot be refrozen, and should be used immediately; if not required, it can be stored within 30 minutes of thawing in a controlled blood fridge for up to five days (Selleng and Greinacher, 2021).

Figure 6.14 show the proportion of patients who received a blood product, by pre-alert status and age group. The pre-alert rate for patients who received a blood product was 45% (n=369) in comparison to the overall pre-alert rate of 13% (Figure 5.1). Of those who received red cell concentrate, 48% (n=314) were pre-alerted. Pre-alert was received for 21% (n=13) of those major trauma patients who received platelets.

**Figure 6.14: Proportion of Patients Who Received Blood Products Who Were Pre-Alerted, (2017–2021) (n=813)**

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33 Figure 6.14 refers to direct admissions only.
34 Percentages may not add up to 100% due to rounding.
RECEPTION BY A TRAUMA TEAM AMONG PATIENTS WHO RECEIVED BLOOD PRODUCTS

Thirty-five per cent (n=286) of patients who received a blood product were documented as having been received by a trauma team (Figure 6.15).

**Figure 6.15:** Proportion of patients who received blood products and were received by a trauma team, 2017–2021 (n=813)

<table>
<thead>
<tr>
<th>Blood Product</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red cells concentrate (n=649)</td>
<td>38%</td>
</tr>
<tr>
<td>Frozen plasma (n=91)</td>
<td>24%</td>
</tr>
<tr>
<td>Platelets (n=61)</td>
<td>18%</td>
</tr>
<tr>
<td>Fibrinogen concentrate (n=12)</td>
<td>42%</td>
</tr>
<tr>
<td>Total</td>
<td>35%</td>
</tr>
</tbody>
</table>

35 Figure 6.15 refers to direct admissions only.
TRANEXAMIC ACID

The use of tranexamic acid (TXA) in the major trauma setting has been found to reduce the mortality associated with blood loss when administered during resuscitation (Bickell et al., 1994; Roberts et al., 2013). TXA functions by blocking the lysine-binding sites on plasminogen and hence inhibiting fibrinolysis, resulting in inhibition of clot degradation. The CRASH-2 trial (Roberts, 2013) showed that the use of TXA could reduce mortality rates associated with exsanguinating haemorrhage by 15%, with few complications. To have such an effect, it must be given within three hours of injury as an immediate intravenous dose of one gram, followed by a further one gram infusion over eight hours. It therefore should form part of early resuscitative protocols. A Trauma System for Ireland (2018) also recommends the administration of TXA to patients with significant haemorrhage within three hours of injury and a second dose according to the CRASH-2 trial protocol.

TXA WITHIN THREE HOURS OF INCIDENT

Among patients who received blood products within six hours, 85% (n=280) received TXA. Among patients who received TXA, 87% (n=244) received it within three hours of the incident (Figure 6.16), which is in line with the TARN average of 88%. The median time from incident to TXA was 66 minutes (IQR: 37–115 minutes). Between 2017 and 2021, among all major trauma patients who did not receive blood (n=22,893), 8% (n=1717) received TXA. Our findings provide reassurance that the recommendation in A Trauma System for Ireland (2018) regarding administration of TXA following a significant haemorrhage is functioning well.

Figure 6.16 refers to direct admissions only, and patients who received blood products within six hours.

FIGURE 6.16: PERCENTAGE OF PATIENTS WHO RECEIVED TXA WITHIN THREE HOURS (2017–2021) (N=280)
SHOCKED PATIENTS WHO RECEIVED TXA

The CRASH-2 trial (Roberts et al., 2013) recommended the administration of TXA within three hours for patients with suspected haemorrhage with a systolic blood pressure (SBP) of <90mmHg and a heart rate >110. Within the Major Trauma Audit, data are routinely collected on SBP but not on heart rate. The most accurate calculation to identify at-risk patients by TARN is the shocked patients i.e., those with an SBP of <110 and who have suffered blunt trauma. Data collection in line with CRASH-2 trial protocol i.e., heart rate and second-dose administration of TXA coverage for variable would need to improve in order to report nationally. Work is underway with data coordinators nationwide to increase the quality of data collected under these variables.

Between 2017 and 2021, 2,497 major trauma patients suffered a blunt trauma and had an SBP of less than 110 mmHg. Out of those, 20% (n=498) received TXA (Figure 6.17).

![Figure 6.17: Proportion of shocked patients who received TXA (n=2,497)](image-url)

27 Figure 6.17 refers to direct admissions only, and patients who received a blood product within six hours.
INJURY SEVERITY SCORE OF PATIENTS WHO RECEIVED TXA

The majority of patients who received TXA had a severe injury (n=214, 76%) (Figure 6.18).

Figure 6.18 refers to direct admissions only, and patients who received a blood product within six hours.

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Figure 6.18: Percentage of patients who received TXA, by ISS (2017-2021) (n=280)<sup>38</sup>
MORTALITY OF PATIENTS WHO RECEIVED BLOOD PRODUCTS

Figure 6.19 shows the percentage of patients within each age group who died from their injuries as a proportion of the total number of patients who died (N=182). The highest proportion of deaths occurred among patients aged 55 years and over (n=100, 23%). Of those who received blood products, 19% (n=182) died. For patients who did not receive blood products, the mortality rate was 5% (n=1,064). Patients who received blood products were more likely to have had a severe injury (Figure 6.11), which may explain the higher rate of mortality in that group.

FIGURE 6.19: MORTALITY, BY AGE GROUP AMONG PATIENTS WHO RECEIVED BLOOD PRODUCTS (2017 –2021) (N=943)
KEY FINDINGS FROM CHAPTER 6

- The number of major trauma admissions remains consistent with previous years, at an average of 338 per month.

- Ambulance continues to be the most common mode of transport to the initial treating hospital (n=2,817, 79%).

- Among patients brought to hospital by an ambulance and/or helicopter (Figure 6.2), 45% were attended to by a paramedic (Figure 6.3). This marked a decrease from 50% in 2020 (NOCA, 2022). Forty-one percent were attended to by an advanced paramedic, which was an increase from 37% in 2020 (NOCA, 2022).

- The proportion of patients transferred to another hospital was 21% in 2021, an increase from 18% in 2020 but at the same level found in 2019 (21%). Between 2017 and 2021, 4% (n=943) of major trauma patients received blood products.

- Among all patients who received a red blood cell concentrate transfusion, 44% (n=283) received it within six hours of incident.

- Among patients who received blood products, one half (n=494, 50%) of major trauma injuries were recorded as having occurred in a public area or road.

- Road trauma (n=355, 36%) and ‘low falls’ of less than two metres (n=303, 31%) were the most frequent causes of injury.

- Eighty per cent (n=649) of patients who received blood products arrived at the initial treating hospital between 8.00am and 23.59pm.

- The pre-alert rate for patients who received blood products was 45% (n=369), compared to an overall pre-alert rate of 13% (Figure 5.1).

- Among patients who received TXA, 87% (n=244) received it within three hours of the incident.
CHAPTER 7
OUTCOMES
OUTCOMES

This chapter describes the outcomes of major trauma patients in terms of mortality, discharge destination and case-mix-standardised rate of survival. Mortality is reported at 30 days post discharge.

MORTALITY AT 30 DAYS POST DISCHARGE

Mortality is a crude measure of quality of care in major trauma patients; quality of survival and return to independent living combined are far more patient-centred measures. The National Office of Clinical Audit (NOCA) Major Trauma Audit (MTA) is working towards developing these outcome measures. In 2021, 5% (n=199) of patients were recorded as having died during their hospital admission.

MORTALITY AND AGE

Figure 7.1 shows the percentage of patients within each age group who died (n=199). The highest proportion of deaths occurred among patients aged 75 years and over.

![Figure 7.1: Mortality, by age group (n=199)](image-url)
MORTALITY BY MECHANISM OF INJURY

The highest proportion of deaths continues to be attributable to ‘low falls’ – those less than two metres (n=145, 73%). The second leading recorded cause of mortality in major trauma patients is ‘Other’, which includes blow(s), asphyxiation, drowning, and amputation. The third leading recorded cause is falls from more than 2 metres (Figure 7.2).

**FIGURE 7.2: MORTALITY, BY MECHANISM OF INJURY (n=199)**

- Fall less than 2m: 73%
- Other: 11%
- Fall more than 2m: 9%
- Road trauma: 8%
MORTALITY BY ISS

Among patients who died in 2021, 65% (n=130) had an Injury Severity Score (ISS) of >15, indicating severe injury (Figure 7.3).

FIGURE 7.3: MORTALITY, BY ISS CATEGORY (n=199)
DISCHARGE DESTINATION

Figure 7.4 shows that 60% (n=2,420) of major trauma patients were discharged directly home from hospital. The proportion of patients who received rehabilitation within an inpatient rehabilitation facility has declined, from 10% in 2020 (NOCA, 2022) to 7% in 2021. In both major trauma centres (MTCs), the NOTS rehabilitation needs assessment (RNA) and rehabilitation prescription (RP) have been introduced, which will enable the MTA to capture data on the services required for patients following major trauma.

FIGURE 7.4: DISCHARGE DESTINATION (n=4,055)

The category ‘Other’ includes information that was not recorded.
RISK-ADJUSTED BENCHMARKING

The survival probability was compared with the 30-day outcome for patients (alive or dead) and used to compute excess survival scores (W) and risk-adjusted excess survival scores (Ws) for the cohort using the Trauma Audit and Research Network (TARN) statistical methodology (TARN, 2019). Risk adjustment is a technique used to derive a probability of survival for a patient using confounding factors (i.e., age, gender, severity of injury, pre-existing comorbidities and Glasgow Coma Scale (GCS)) that influence the outcome. From approved TARN submissions, a risk-adjusted excess survival rate was calculated for Ireland for 2021. This was based on all approved submissions from participating hospitals and is referred to as the Ws value. Ireland’s Ws value of 1.25 (95% confidence interval (CI), 0.51–1.99) (Table 7.1) means that for every 100 major trauma patients treated in Ireland, there are 1.25 more survivors than the TARN statistical model predicts. This is statistically significant. The observed survival in the probability bands of 25–65 (i.e., very sick patients with a low probability of survival) was lower than expected (Bouamra et al., 2015).

<table>
<thead>
<tr>
<th>Probability of survival (%)</th>
<th>n</th>
<th>Survivors</th>
<th>Expected Survivors</th>
<th>W Excess</th>
<th>TARN fraction</th>
<th>Contribution to Ws</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>95–100</td>
<td>2,591</td>
<td>2,567</td>
<td>2,549.16</td>
<td>0.69</td>
<td>0.65</td>
<td>0.44</td>
<td></td>
</tr>
<tr>
<td>90–95</td>
<td>626</td>
<td>592</td>
<td>582.01</td>
<td>1.60</td>
<td>0.17</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>80–90</td>
<td>366</td>
<td>332</td>
<td>314.84</td>
<td>4.69</td>
<td>0.10</td>
<td>0.47</td>
<td></td>
</tr>
<tr>
<td>65–80</td>
<td>137</td>
<td>110</td>
<td>101.61</td>
<td>6.12</td>
<td>0.04</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td>45–65</td>
<td>59</td>
<td>27</td>
<td>32.20</td>
<td>-8.82</td>
<td>0.02</td>
<td>-0.17</td>
<td></td>
</tr>
<tr>
<td>25–45</td>
<td>32</td>
<td>9</td>
<td>11.70</td>
<td>-8.43</td>
<td>0.01</td>
<td>-0.12</td>
<td></td>
</tr>
<tr>
<td>0–25</td>
<td>31</td>
<td>7</td>
<td>3.97</td>
<td>9.78</td>
<td>0.01</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,842</strong></td>
<td><strong>3,644</strong></td>
<td><strong>3,595.49</strong></td>
<td><strong>1.25</strong></td>
<td><strong>0.51–1.99</strong></td>
<td></td>
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</tr>
</tbody>
</table>

Note: Patients who died at or were discharged from a hospital are eligible for Ws calculations. Patients who were transferred out of a hospital and not readmitted are included in the receiving (final) hospital’s Ws.

Risk-adjusted survival does not take into account the potential high personal and societal costs when patients are delayed or prevented from returning to their pre-trauma functional status or quality of life.

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40 Excess survivors per 100 patients within each probability of survival band.
41 Contribution to Ws was obtained by multiplying ‘Column W’ by ‘TARN fraction’ (direct standardisation).
KEY FINDINGS FROM CHAPTER 7

- In 2021, 5% (n=199) of patients were recorded as having died during their hospital admission.

- The highest proportion of deaths continues to be attributable to falls less than two metres (n=145, 73%) (Figure 7.2).

- The proportion of patients who received rehabilitation in an inpatient rehabilitation facility has declined, from 10% in 2020 (NOCA, 2022) to 7% in 2021 (Figure 7.4).

- More than four out of every five deaths are attributable to falls, at 82%.
AUDIT UPDATE

This chapter presents a summary of progress made since publication of the *Major Trauma Audit Report 2019 and 2020*, as well as a list of key events that took place and key outputs generated during 2021 and 2022.

**UPDATES ON AUDIT RECOMMENDATIONS FROM THE MAJOR TRAUMA AUDIT REPORT 2019 and 2020**

<table>
<thead>
<tr>
<th>Recommendations to the National Office for Trauma Services, HSE</th>
<th>Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>The National Office for Trauma Services (NOTS), Health Service Executive (HSE), will continue to work closely with, and support, the MTA by:</td>
<td>Since the publication of <em>A Trauma System for Ireland: Report of the Trauma Steering Group</em>, (Department of Health, 2018), the National Office for Trauma Services (NOTS) has been working closely with the MTA, using the data to help design and plan trauma care delivery.</td>
</tr>
<tr>
<td>• using data from the Major Trauma Audit (MTA) to identify injury prevention opportunities for the new trauma system</td>
<td>In 2022, the trauma system implementation programme has developed a clinical guidance document for the management of major trauma in older patients. This document aims to provide guidance and considerations to all healthcare providers about how older adults should be managed within the trauma system.</td>
</tr>
<tr>
<td>• using data from the MTA to support trauma care re-organisation and monitor the effect of changes.</td>
<td>NOTS provides MTA key definitions in order to enable the audit to continue to collect robust and relevant data to support the ongoing reconfiguration of the trauma system. Definitions such as trauma triage tool (TTT) and tertiary survey are currently being captured in the MTC, as of April 2023, and an online training module on TTT was made available on HSEland in July 2023.</td>
</tr>
<tr>
<td></td>
<td>Data access requests for MTA data have been provided to NOTS.</td>
</tr>
</tbody>
</table>
### Recommendations to hospital managers, clinicians and audit coordinators

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each hospital should establish a local MTA governance committee to ensure their local audit findings are acted on; this is in line with guidance issued by the MTA.</td>
<td>Hospital group management receives a quarterly report from the MTA data. New National Office of Clinical Audit (NOCA) dashboard reports are being piloted in 2023. A hospital survey was completed in 2023 to capture hospital governance in place. Work is ongoing to encourage hospitals to establish their MTA governance committees. Due to the impact of the COVID-19 pandemic, data entry dates were adjusted, and hospitals were accommodated in order to allow them to enter data after the originally agreed deadlines.</td>
</tr>
</tbody>
</table>

### Recommendations for the National Office of Clinical Audit

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Update</th>
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</thead>
<tbody>
<tr>
<td>NOCA will work with the HSE to develop a strategy for sustainable support for clinical audit in participating hospitals. NOCA should continue to support each hospital to establish a local MTA governance committee.</td>
<td>In 2022, an organisational survey of audit coordinators took place to identify current gaps in data collection. Communication with hospitals management has allowed identification of gaps in data collection. In September 2023 24 out of 26 hospitals now, have co-ordinators in place. A governance pack and slide deck was created and piloted in two sites. This resource pack is now available to all sites. Site visits have recommenced in 2022 to support the setting up of local governance. Monthly training sessions take place online with a focus on governance and report interpretation skills.</td>
</tr>
<tr>
<td>NOCA should support each hospital to achieve high standards of data quality and data completeness.</td>
<td>During 2021, two online training session with the Trauma Audit and Research Network (TARN) were held to support the accuracy of data collection. This is reflected in the data quality within the report. Monthly demonstrations of the TARN analytics portal are provided to the audit coordinators to encourage the use of TARN analytics, and to identify and resolve data quality issues early, before data are used at a national level.</td>
</tr>
<tr>
<td>Recommendations</td>
<td>Update</td>
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<tr>
<td>NOCA will support hospitals in quality improvement and facilitate training in</td>
<td>Significant progress has been achieved on the quarterly MTA reports, which were developed by the NOCA data analytics team using Microsoft Power BI. These reports indicate each hospital’s overall performance against defined standards. Each standard is then displayed on a statistical process control chart to facilitate local quality improvement.</td>
</tr>
<tr>
<td>the use of the TARN analytics portal.</td>
<td>These reports have been circulated on a pilot basis in 2023 and feedback has been sought. An in-person training day was held in April 2023 to support the introduction of TARN analytics; this was held in the premises of the Royal College of Surgeons in Ireland (RCSI). In addition, it has been confirmed that one in-person and one online training event will take place with TARN trainees per year.</td>
</tr>
<tr>
<td>NOCA should work with relevant organisations to carry out research on how to</td>
<td>In 2021–2022, a number of articles on this process were published in academic journals. In 2022, nine data access requests were received, which are currently being processed in collaboration with TARN. Due to the disruption associated with the University of Manchester cyberattack, four of these are on hold. Access to audit data can be requested through the NOCA website. NOCA is currently providing assistance to the TRAUMA Health Research Board (HRB) study.</td>
</tr>
<tr>
<td>better identify patients with major trauma injuries at the earliest possible</td>
<td></td>
</tr>
<tr>
<td>time.</td>
<td></td>
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<tr>
<td>NOCA should work with public and patient interest (PPI) representatives and</td>
<td>The MTA PPI representatives have contributed to the development of the MTA national reports and summary reports. They continue to inform the MTA about what is meaningful for patients and their carers. In addition, MTA information has been disseminated through patient groups and organisations, and PPI representatives from the MTA committee have also given presentations on the findings.</td>
</tr>
<tr>
<td>organisations to utilise and disseminate public health messages from the MTA.</td>
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</tbody>
</table>
AUDIT DEVELOPMENTS

TARN WORKSHOP

The first face-to-face TARN workshop in three years was held on 26 April 2023, on the premises of the RCSI. Two trainers from TARN travelled from Manchester for the workshop: Laura White, Operations Director, and Emma Evans, Audit and Coding Lead. There were 28 attendees from across various disciplines and levels, including audit coordinators from the different hospitals, data analysts from NOCA and National Office of Trauma Services (NOTS), and researchers. Also in attendance was Prof Conor Deasy, National Clinical Lead for MTA. Pamela Hickey, Audit Manager for MTA, gave a brief introduction on MTA and how the data are used in the reform of the trauma system, followed by a presentation on the importance of governance at local level.

A foundation session in the morning was followed by a reporting session in the afternoon. The foundation session consisted of a TARN overview, including a refresher on criteria for inclusion, identifying cases and data entry review. Prior to the workshop, audit coordinators had submitted questions, which were answered throughout the day. The afternoon session focused on reporting and involved a practical component covering case submission. This interactive session proved very helpful for all attendees, as the trainers provided test cases, which facilitated a better understanding and greater clarity regarding the process of case submission. Additionally, the trainers shared helpful hints and tips to streamline a case submission procedure. This was followed by a presentation on reporting. The presentation covered how to utilise the dashboards and access clinical reports, as well as other elements such as data quality and measuring trauma outcomes. This presentation was beneficial, as it demonstrated how the data can be accessed and then effectively presented for local governance purposes.
The Major Trauma Audit Report 2019–2020 was published in 2022 and launched via a webinar. The event, which was well attended, featured an engaging and impactful talk from the patient public representative, Richard Murray, who spoke about his patient journey having sustained life-changing traumatic injuries. The event also featured expert speakers, including: Professor Conor Deasy, MTA Clinical Lead; Mr Keith Synnott, Clinical Lead, National Office for Trauma Services; Mark Harrington, National Programme Manager Healthy Age Friendly Homes; George Peck, Consultant Physician and Geriatrician; and Dr Emer Aherne, National Clinical Advisor and Group Lead for Older Persons. Louise Brent, Irish Hip Fracture Database and MTA Manager, presented the benefits of establishing an MTA governance committee, with contributions from Marion Lynders, Mater Misericordiae University Hospital, and Deborah McDaniel, Our Lady of Lourdes Hospital, Drogheda. Antoinette Edwards, TARN Executive Director, and Naomi Brook, Training Coordinator, provided a demonstration of the TARN analytics software.

Two TARN virtual workshops also took place during 2021. Throughout 2021, monthly teleconferences were held, which, due to the pandemic, became video conferences while networking in person was no longer possible. Due to the pandemic restrictions on holding face-to-face meetings, NOCA has had to find new ways of working and supporting hospitals. The virtual nature of the most recent workshops meant that the sessions could be recorded and shared with anyone who could not attend on the day. These recordings will now form part of a repository of materials to support hospital audit coordinators.

In 2021, several key developments took place, including:
- completion of the MTA data dictionary
- updating of the quarterly hospital and Hospital Group reports
- implementation of the new data analytical portal by TARN.
HEALTH RESEARCH BOARD GRANT TRAUMA STUDY

Dr Nora Ann Donnelly, Senior Post-doctoral Researcher

In July 2022, the Health Research Board funded study, Targeted Review and Amalgamation of Unmapped Major trauma and Ambulance Data in Ireland (TRAUMA study), began. This study is a collaboration between the Royal College of Surgeons in Ireland (RCSI), NOCA and the National Ambulance Service (NAS). It aims to investigate joining together the National Ambulance Service’s (NAS) electronic patient care record (ePCR) and the MTA. This would, for the first time in Ireland, create a seamless database of the patient journey from incident to hospital discharge. The study involves three interconnected work packages. In the first work package, the NAS, ePCR and the MTA datasets will be linked on a once-off basis. The combined data will be anonymised and then analysed to identify characteristics determining the need to bypass smaller hospitals and bring patients to an MTC or trauma unit. This includes developing a clinical prediction rule for major trauma in Ireland. The second work package involves a stakeholder consultation to see if the datasets could be combined on an ongoing basis. In the final work package, the geo-spatial implications of major trauma services will be analysed.

Progress has been ahead of schedule for most elements to date. All of the relevant permissions and agreements for the first work package of the study have been finalised. This includes the Research Ethics Committee approval, Health Research Consent Declaration Committee approval, National Ambulance Service Research Committee approval and the data sharing agreement. In order for the clinical prediction rule for major trauma to be based on evidence from the international literature, we are undertaking a hybrid systematic review of pre-hospital characteristics that identify major trauma patients in international trauma triage tools. The protocol has been published on HRB Open (https://hrbopenresearch.org/articles/6-31). We are in the process of combining the NAS, ePCR and MTA data for the years 2020–2022. These data will be brought together for analysis. This will be really helpful in informing important decisions in terms of which hospitals are to take trauma patients. If you were a trauma patient during 2020–2022 and would like more information on the study, or wish to withdraw from the study, please don’t hesitate to contact us by email (TRAUMAstudy@rcsi.ie).

As part of the second work package of the study, we have obtained Research Ethics Committee approval and have met with several stakeholders with expertise in the national data linkage landscape in Ireland. We plan to hold collective intelligence workshops with these and other experts in the final quarter of 2023.

In November 2022, the study website was launched. The website provides more information on the study, including further details on each of the work packages. It can be found at https://www.traumastudy.eu/. You can also follow the study on Twitter: @TRAUMA_study. Should you have any questions on the study please email us on TRAUMAstudy@rcsi.ie.

The TRAUMA Study is funded by the Health Research Board (SDAP-2021-006).
PUBLICATIONS

Recent publications from the MTA are detailed below.


MAJOR TRAUMA GOVERNANCE QI PROJECT

As part of a master’s degree in quality improvement and patient safety, the assistant audit manager Breda Horan initiated a quality improvement project to increase the establishment of major trauma governance committees in major trauma hospitals by providing the audit coordinators with the appropriate guidance, resources and training. A summary of the background and the project is outlined below.

Background

Effective governance is essential for ensuring that key principles, such as quality improvement, standards of care, responsibility and accountability, are upheld (NHS Greater Glasgow and Clyde, 2012). To implement governance at any level, the first step is to bring together important committee members. However, the lack of hospital governance committees has negatively impacted the collection of MTA data, highlighting the need for support and training in reporting data through governance meetings. By implementing a structured guide, hospital staff can maximise the use of the data to improve services, promote collaboration and enhance patient-centred care. It is crucial that clinical practice and clinical governance align, rather than being treated as separate entities, if this process is to be successful. This is particularly relevant to an organisation where a substantial change will take time, but smaller incremental changes demonstrate progress (Randell et al., 2020).

Berwick (1996) states that change initiatives, which are the responsibility of the healthcare professional, are less likely to succeed without the proper leadership figure to guide them. Changes recommended by external source or agencies may not be implemented successfully without internal leadership (Di Blasio, 2022), therefore collaborative efforts are required for achieving the overall goal of improving quality. The organisation can then prepare an informed plan that integrates a disparate system, with clear guidelines and approaches to governance.

Objectives

• Increase attendance at monthly audit coordinator meetings
• Hold an in-person workshop to improve data collection and reporting.
• The pilot site will demonstrate their ability to hold the first MTA GC meeting utilising the governance resources and site visit training.
Methods

Using the Senior and Swailes’ Organisational Change model (2010) as a template ensured that stakeholders could fully engage in the implementation and development process.

- Diagnose current situation using
- Develop a vision for change
- Gain commitment to the vision
- Develop an action plan
- Implement the change
- Assess and reinforce the change.

Following audit coordinator calls in 2022, a quality improvement initiative was commenced by the MTA audit managers. Specifically, a governance committee resources pack was created as an additional resource for audit coordinators in their efforts to develop governance committees in the major trauma hospitals. The pack includes templates for: terms of reference, agenda, minute taking and structured PowerPoint slides. NOCA will endeavour to support this process further by running an additional training session with audit coordinators with specific training on reporting and presenting dashboard information and the clinical report information for governance. This will ensure that audit coordinators have the confidence and ability to present and contribute key information at governance meetings.

Results

Following a survey carried out in 2020 on governance committee establishment, hospitals were asked to complete a follow-up questionnaire in 2023 to assess any change. There was an increase in the response rate, from 7 in 2020 to 12 in 2023, but disappointingly there has been very little increase in governance committee establishment, with only 30% (n=8) of hospitals having such governance in place. NOCA has published a guidance document to support clinical leads and hospitals in developing their local MTA hospital governance committee (Figure 8.2). This guidance outlines how to structure a meeting, how often to meet, the resources required to run a meeting successfully, who should attend the meetings, and what topics should be discussed.

In addition to resources, site visits and virtual calls were offered to audit coordinators. This allowed for the opportunity to create an environment of shared learning and feedback loops to enhance the experience for those involved.

- In January 2023, the MTA manager and assistant manager visited the audit coordinator in the Mater Misericordiae University Hospital to provide advice and assistance in the presentation of TARN dashboard information for governance committee meetings.
- In April 2023, the MTA manager and assistant manager conducted a site visit to the Midlands Regional Hospital, Tullamore. The visit was requested by the audit coordinator to assist with governance set-up and implementation. The resource pack was formatted and presented on the day and the NOCA team met with that hospital’s audit coordinator, emergency department consultant and director of nursing and clinical audit manager.

The positive impact of these site visits is reflected in both projects’ submissions, as provided in the quality improvement section of this report.
MAJOR TRAUMA GOVERNANCE COMMITTEE (MTGC) GUIDANCE

WHAT IS GOVERNANCE?

The system through which healthcare teams are accountable for the quality, safety and experience of patients in the care they have delivered (HSE, 2014). What this means to healthcare staff: Specifying the clinical standards you are going to deliver and showing everyone the measurements you have made to demonstrate that you have done what you set out to do (HSE, 2014). The MTA National Report 2019/2020 recommends that: every hospital participating in the MTA should have a committee to ensure that the data from the major trauma audit is being used to drive continuous quality improvement in major trauma care (NOCA, 2022).

MEETING ETIQUETTE

- Terms of reference developed for group
- Frequency of meetings: Quarterly minimum
- Agenda to be circulated one week in advance
- Minutes to be circulated one week later
- Key actions identified and allocated to specific members at each meeting.

TOPICS FOR DISCUSSION

- Major trauma audit reports (clinical and dashboard reports)
- TARN analytics reports
- Data quality
- Quality improvement
- Patient safety
- Critical incidents
- Complaints
- Pre-alert
- Trauma team activation
- Length of stay
- Transfers
- Mortality
- Delayed discharges
- Resources/business cases

SUGGESTED MEMBERSHIP OF MTGC

CHAIR (CLINICIAN)

VICE-CHAIR (FROM OTHER PROFESSIONAL GROUP)

MTA CLINICAL LEAD AND AUDIT COORDINATOR

MEMBERS REPRESENTING:
- Emergency medicine, Paediatrics, General surgery, Trauma coordinator, Orthopaedics, Geriatric medicine, Anaesthetics, Radiology, HSCP, Nursing, Quality & Safety, Risk management, Senior Hospital Management, Rehabilitation, Administration, Ambulance service, HIPE personnel, Public/Patient Representative, Bed Manager, Theatre Manager

RESOURCES

https://www.noca.ie/publications
Template for agenda, minutes & PowerPoint.

FIGURE 8.1: MTA GOVERNANCE COMMITTEE GUIDANCE
QUALITY IMPROVEMENT

As part of the monthly webinar with audit coordinators, one presentation focused on quality improvement (QI). The education session was dedicated to brainstorming ideas, and exploring QI tools and frameworks to help guide and structure a QI project. Guidance was also provided on how to present the projects using templates that would be engaging, informative and possible to replicate in other hospitals within the MTA. The data comprise a key driver for local QI in local hospitals, with examples such as those on the following pages being submitted to the NOCA QI awards in 2022.
CASE STUDY NUMBER 1

Mater Misericordiae University Hospital

BACKGROUND

- In 2016, 151 major trauma cases submitted to TARN.
- This data was not captured in any electronic format within the hospital.
- Started recording basic patient details in an excel spreadsheet.
  - Excel is a flat file and is not a relational database.
  - As the number of TARN submissions increased, a more powerful application was needed to organize and monitor the data.
  - General data protection regulation (GDPR) compliant.

OPPORTUNITY

- MS Access used to create customized tables and queries to meet AC data needs for storage and analytics.
  - Once data from existing excel spreadsheet was imported into Access database, AC is able to merge simple tables into multiple tables of related data.
  - Allows user to create queries, structure the data and define data types to help ensure data integrity.
  - One critical query created is titled the ‘TARN 90 day submission’.
  - Once the patient’s date of discharge is entered into the ‘90 day submission’ table, the number of remaining days to deadline submission is automatically generated in the ‘days to deadline’ column.

AREA FOR IMPROVEMENT

- From July 2016 to December 2016, the key indicator measuring the proportion of all TARN eligible patients submitted within 90 days of discharge or death was reported to be 15.5% for the Mater Hospital.
  - The national mean for the same time period was 25.8%.

RESULTS

In July 2022, TARN issued its biannual dashboard for the period July 2021 - December 2021.

- The key indicator measuring the proportion of all TARN eligible patients submitted within 90 days of discharge or death was reported as 98.1% for the Mater Hospital.
- The national average remains at 27.1%.

QUALITY IMPROVEMENT

- Linking both tables has enabled audit coordinator to see the number of cases in chronological order that need to be submitted to meet the 90 day deadline.
CASE STUDY NUMBER 2

Midlands Regional Hospital Tullamore (MRHT)

Improvement in documentation and communication of pre-alert calls received to the Emergency Department (ED) from the National Ambulance Service (NAS)

BACKGROUND

- A ‘Pre-alert’ is a system whereby the ambulance service communicates to the receiving hospital that it is bringing a patient to the emergency department (ED), the nature of the patient’s injuries, the patient’s physiology, their expected requirements on arrival, and the expected time of arrival.

- Accurate pre-alert information on the patient’s injuries and condition is important to ensure the appropriate resources are in the ED awaiting the patients’ arrival.

NEED TO IMPROVE

- MTA highlighted that in both 2019 and 2020 there was a 12% pre-alert rate nationally.
- In MRHT, these rates were 8.3% and 5.3% respectively.
- Pre-alert communication can be difficult to locate in the pre-hospital or admission documentation in MRHT.

The implementation of the Pre-Alert documentation has improved documentation and communication between the National Ambulance Service (NAS) and the Emergency Department in MRHT.

The duplicate copy of these Pre-Alerts will enable future audits with the department, and in collaboration with the NAS.

Nationally, there needs to be a specific Trauma Triage Tool developed which prompts a Pre-Alert to each Emergency Department.

SMART AIM

- Increase documentation of pre-alert rate in the patient medical/nursing notes from a baseline of 5% to a future state of 15% by 31 July 2023 in patients who present at the emergency department with major trauma.
- Improve communication between the ED Staff and the NAS.
- Develop a process map showing how the system works currently.
- Discuss this process map with key stakeholders and carry out a cause and effect to establish key areas which need improvement.
- Generate ideas for change from stakeholder survey completion
- Develop a management plan for change
- Develop and test a data collection tool to capture pre alert documentation

RESULTS

An increase to 37% of all Major Trauma Defined Calls with documented Pre-Alert Communication

<table>
<thead>
<tr>
<th></th>
<th>MAY</th>
<th>JUNE</th>
<th>JULY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>3</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>23</td>
<td>30</td>
</tr>
</tbody>
</table>

- Major Trauma
- Pre-Alerts

QUALITY IMPROVEMENT

- The implementation of the Pre-Alert documentation has improved documentation and communication between the National Ambulance Service (NAS) and the Emergency Department in MRHT.
- The duplicate copy of these Pre-Alerts will enable future audits with the department, and in collaboration with the NAS.
- Nationally, there needs to be a specific Trauma Triage Tool developed which prompts a Pre-Alert to each Emergency Department.
FUTURE DEVELOPMENTS

The robust nature and maturity of the MTA means that it can be used to provide data for high-quality research publications, quality improvement projects, service planning and policy development. MTA data can also be used to: conduct detailed subgroup analysis; assist the development and reconfiguration of the trauma system; support hospitals to undertake quality improvement projects with the data; and present findings at national and international conferences.

Between 2021 and 2022, the MTA received more than 10 data access requests. In 2021, five requests were received and successfully fulfilled. In 2022, five requests were received, and four of them were completed. Currently, the MTA has received three requests, which are on hold due to the cyberattack on the University of Manchester.
CHAPTER 9
RECOMMENDATIONS
## RECOMMENDATION 1

The National Office for Trauma Services, HSE, should collaborate with NOCA on the Major Trauma Audit (MTA) to develop and/or align standard key performance indicators (KPIs).

### Rationale

- Since the publication of *A Trauma System for Ireland: Report of the Trauma Steering Group*, (Department of Health, 2018), NOTS has been working closely with the MTA, using the data to help determine how to reconfigure the trauma system, including the identification of which hospitals should become MTCs and which should become trauma units.

- NOTS’ remit is such that the MTA seeks direction for key definitions in order to enable the audit to continue to collect robust and relevant data to support the ongoing reconfiguration of the trauma system.

- This collaboration will allow MTA to align our reporting of KPIs to monitor the evolution of the trauma system for Ireland.

### Evidence base for recommendation

- Central to the assessment of the trauma network performance will be the use of a continuous audit, based around a set of key performance indicators (KPIs). These would include markers of both clinical and non-clinical performance. Such parameters should be system specific, evidence based and subject to regular review. In Ireland, large elements of this framework are already in place, in the form of the TARN database clinical report. Although this is beneficial when it comes to benchmarking performance against that of the UK, having a core set of standards specific to Ireland will allow for hospital-level benchmarking and monitoring the impacts of the evolving trauma system in Ireland.

### What action should be taken?

- NOTS should provide clear KPIs so that each hospital can measure this in a standardised way for the MTA, allowing NOCA to continue to develop meaningful dashboard reports.

### Who will benefit from this action/recommendation?

- Hospitals will benefit from having more real-time quarterly information that can show signs of clear improvement or lack thereof.

### Who is responsible for implementing this action/recommendation?

- NOTS is responsible for developing and providing these definitions to hospitals.

### When will this be implemented?

During 2023/2024.
RECOMMENDATIONS TO THE NATIONAL OFFICE FOR TRAUMA SERVICES, HSE

RECOMMENDATION 2

The National Office for Trauma Services, HSE, should review the data within with the blood product chapter to inform the provision of haematology services and stockholding within the MTCs.

<table>
<thead>
<tr>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Within the 2021 MTA report, it was found that 4% of major trauma patients required a blood product transfusion within 24 hours of admission.</td>
</tr>
<tr>
<td>• Only 45% were pre-alerted.</td>
</tr>
<tr>
<td>• 41% of these patients arrived after 16:00 pm.</td>
</tr>
<tr>
<td>• <em>A Trauma System for Ireland</em> (HSE, 2018) also highlights the need within MTCs to be equipped with laboratory services that are available on site 24/7 and supported by a transfusion specialist/haematologist.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evidence base for recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The receipt of a pre-alert by the hospital blood bank mobilises scientific staff to perform the blood group testing and prepare the blood products required. It also allows for short-shelf-life blood products to be ordered, such as platelets from the Irish Blood Transfusion Service (IBTS), and thawing of frozen plasma which takes up to 20–40 minutes. The pre-alert prompts the blood bank to check and, if necessary, replenish their stock of blood/platelets.</td>
</tr>
<tr>
<td>• Delay in the provision of blood transfusion support was associated with a &gt;30% mortality in life-threatening haemorrhage (SHOT, 2021), compared to a mortality rate of 10% in the UK’s National Comparative Audit of Blood Transfusion (NHS, 2018) and one of 11.4% in a 2022 report by the Department of Health (2022).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What action should be taken?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• In line with the relevant findings reported here, NOTS should consider supporting the development of haematology services with trauma services in Ireland.</td>
</tr>
<tr>
<td>• NOTS should support training and education regarding the pre-alert system. In doing so, they should collaborate with the National Ambulance Service.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who will benefit from this action/recommendation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Patients will benefit from earlier recognition of their injuries by medical, nursing and paramedical staff. In addition, patients will receive timelier and more appropriate care, and have better outcomes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who is responsible for implementing this action/recommendation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• NOTS is responsible for developing and resourcing the MTC.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>When will this be implemented?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ongoing development</td>
</tr>
</tbody>
</table>
RECOMMENDATIONS TO THE NATIONAL OFFICE FOR TRAUMA SERVICES, HSE

RECOMMENDATION 3

The National Office for Trauma Services, HSE, should define rehabilitation needs assessment and rehabilitation prescription (RNA/RP) using the approved National Office for Trauma Services (NOTS) documentation and roll out same nationally in order to collect meaningful rehabilitation data within the MTA.

Rationale

- The publication of *A Trauma System for Ireland: Report of the Trauma Steering Group* (Department of Health, 2018) sets out clear guidance for the development of an evolved and efficient trauma system.

- According to MTA data, only 7% of patients were transferred directly to inpatient rehabilitation services. The MTA is unable to report accurately at national level on the number of patients receiving an RNA or RP, as this documentation approach was not implemented within MTCs until 2022 and, at time of writing this documentation was only available within the MTCs.

- The RNA and RP enable the multidisciplinary team to outline a patient’s ongoing rehabilitation needs, and to identify which clinical care pathway is appropriate to meet their needs and in which setting. Depending on a patient’s individual needs, stage of recovery and social supports available, they may receive rehabilitation in an inpatient or community setting. If a patient requires admission to an inpatient rehabilitation facility but is unable to access a bed in the facility at that time, they will be transferred to a hospital that can cater for their clinical needs and that is as close as reasonably possible to the patient’s home or to where support is available from those important to them. The RP supports a patient’s pathway of care by providing a clear ongoing management plan to the service the patient transfers to.

Evidence base:

- A key recommendation from *A Trauma System for Ireland: Report of the Trauma Steering Group* is that use of an RNA and RP should be used across all stages of the rehabilitation pathway (Department of Health, 2018). Currently, only two MTCs are capturing this data, since April 2023.

- Within the MTC system in the UK, it is mandatory to collect these data. One of its KPI is that all patients with an ISS > 8 have an RNA/RP completed within 48 hours.

What action should be taken?

- The MTA will continue to facilitate training and education to ensure meaningful rehabilitation data are captured in Ireland.

- NOTS will work with the MTA to collect data on RNA/RP at a national level.
Who will benefit?

- Patients will benefit from the implementation of a standardised, individualised assessment tool.
- If implemented and accurately captured, this will provide NOTS data, on not only rehabilitation need, but also on the degree of complexity or ongoing level of rehabilitation service required by the patient. These two further data points will actually show the level of demand for rehabilitation.

Who is responsible for its implementation?

- NOTS in the HSE is responsible for implementing this recommendation.

When will this be implemented?

Ongoing development
RECOMMENDATIONS TO THE NATIONAL OFFICE OF CLINICAL AUDIT

RECOMMENDATION 4

The National Office of Clinical Audit (NOCA) should work with relevant organisations and stakeholders to support the establishment of local governance committees.

Rationale

- The recent audit of MTA hospital governance committees, alongside the decrease in data coverage, shows that there are still challenges at hospital level in relation to governance and data quality.
- NOCA has committed to improving reporting from the MTA and the usability of the data gathered, in order to better support hospitals and MTA hospital governance committees to engage in the audit.

Evidence base for recommendation

- Effective governance is essential for ensuring that key principles such as quality improvement, standards of care, responsibility and accountability are upheld (NHS Greater Glasgow and Clyde, 2012).
- In order to ensure that clinical audits reach their full potential and drive quality improvement, audit users need structures in place to enable them to review the data, ensure that it’s of high quality, and act on data-based findings in order to drive service improvement, safeguard appropriate resourcing for services and improve patient outcomes. Audit users include hospitals, the HSE, the Department of Health and patient organisations.

What action should be taken?

- Through a series of workshops, site visits and the publication of guidance documents, NOCA will support MTA hospital clinical leads and hospitals to develop local MTA governance committees.

Who will benefit from this action/recommendation?

- NOCA will benefit from better engagement with the audit data, improved data quality, and use of data for quality improvement.

Who is responsible for implementing this action/recommendation?

- NOCA is responsible for supporting hospitals in the development of local MTA governance committees in order to improve data quality and enable the use of data for quality improvement.

When will this be implemented?

During 2023/2024.
### RECOMMENDATIONS TO THE NATIONAL OFFICE OF CLINICAL AUDIT

#### RECOMMENDATION 5

The National Office of Clinical Audit (NOCA) should progress the completeness of key data fields in the MTA, such as heart rate, subsequent blood product administration and second dose of TXA administration in order to capture meaningful data.

<table>
<thead>
<tr>
<th>Rationale</th>
<th>The current demand for blood products following a major trauma is highlighted within this report but the data are restricted to the first blood product; this is due to poor data completeness for subsequent administration.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The CRASH-2 trial definition uses heart rate as one of its definitions when identifying suspected haemorrhage. Currently, the data completeness of this variable is poor and therefore it is not possible to report the use of TXA within these criteria. The CRASH-2 trial also recommends that a second dose of TXA be administered as an infusion over eight hours if ongoing bleeding occurs; again, this variable is under-populated.</td>
</tr>
<tr>
<td>Evidence base for recommendation</td>
<td>The 2018 report, <em>A Trauma System for Ireland</em>, recommends that patients with significant haemorrhage should be administered TXA within three hours of injury and receive a second dose according to CRASH-2 trial protocol.</td>
</tr>
<tr>
<td>What action should be taken?</td>
<td>MTA should work with audit coordinators to ensure data fields are completed.</td>
</tr>
<tr>
<td></td>
<td>NOCA should request timelier data download from TARN to monitor the data field completeness.</td>
</tr>
<tr>
<td>Who will benefit from this action/recommendation?</td>
<td>NOCA will be able to provide relevant reporting variables to be used in service planning.</td>
</tr>
<tr>
<td></td>
<td>MTA will have a richer repository of information around blood product and TXA administration, which can then be reported at a national level.</td>
</tr>
<tr>
<td></td>
<td>Clinicians and healthcare workers will better understand the impact of major trauma care and will be able to evaluate care pathways.</td>
</tr>
<tr>
<td>Who is responsible for implementing this action/recommendation?</td>
<td>NOCA and the MTA manager are responsible for implementing this recommendation.</td>
</tr>
<tr>
<td>When will this be implemented?</td>
<td>During 2023/2024.</td>
</tr>
</tbody>
</table>
RECOMMENDATIONS TO THE NATIONAL OFFICE OF CLINICAL AUDIT

RECOMMENDATION 6

Use the information within the MTA for the development of home safety and injury prevention strategies that can reduce older persons' risk of major trauma in the home, and disseminate same via public messaging campaigns.

**Rationale**

- One of the objectives of the Integrated Care Programme for Older People is to support older people to remain at home by optimising independence and clinical outcomes.

- The MTA national reports have consistently shown that falls at home are the leading cause of major trauma. The *Major Trauma Audit National Report 2018*, using data from the MTA, provided advice about how to keep safe at home in order to prevent falls, as well as advice on keeping active in the home, with a view to promoting independence.

- Since the start of the COVID-19 pandemic in 2020, the number of falls at home has increased further.

- Over half (55%) of major trauma injuries happen within the home.

- The mean age of patients in this report is 62 years, and the median age is 65 years.

- The age profile continues to rise from mean age of 60 in 2020 to 62 in 2021.

- Major trauma predominantly affects younger men and older women.

- While overall, 57% (n=2,304) of patients were male, among those aged over 75 years, females were the predominant gender (n=865, 61%).

- There should be a collaborative and whole-system approach to the prevention of, response to and treatment of falls.

- The cost of fall-related injuries in older people is estimated to reach €2,043 million by 2030 (Irish Centre for Social Gerontology, 2007).
### Evidence base for recommendation

- In 2011, Scotland participated in the falls prevention action group within the European Innovation Partnership in Active and Healthy Ageing. This work has been informed by evidence-based clinical guidance produced by a range of organisations and professional bodies. Its strategy focuses on targeting adults at higher risk of harm through fragility fractures. Following this collaboration, Scotland has seen an overall reduction in the rate of hip fractures in Scotland, as well as a reduction in emergency admissions due to falls, across a number of their integration authorities.

- *A Trauma System for Ireland* (2018) recommended involving a broad range of strategies, including:
  - promoting health in older people, including via access to exercise opportunities that promote strength, balance and co-ordination as well as lifelong optimisation of bone health
  - case identification, assessment and appropriate intervention for those at increased level of fall risk
  - integrated care pathways for frail older persons at the high level of fall risk.

### What action should be taken?

- NOCA should collaborate with the Integrated Care Programme for Older People to highlight findings from the report that could be used to inform future public health messaging.

- The Integrated Care Programme for Older People may reference MTA public safety messaging, such as the home safety checklist and exercise programmes and falls prevention in the home. This may also be promoted and disseminated through campaigns such as Make every Contact Count.

### Who will benefit from this action/recommendation?

- Patients will benefit from safer home environments and a reduced risk of injury at home.

- The HSE will benefit from a reduced burden of injury and cost of care.

### Who is responsible for its implementation?

- NOCA and the MTA manager are responsible for implementing this recommendation

### When will this be implemented?

2023/2024
CHAPTER 10
CONCLUSION
CHAPTER 10

CONCLUSION

The Major Trauma Audit National Report 2021 describes the patient’s journey through the acute hospital setting for major trauma patients. The report is especially relevant as our trauma system continues to evolve. The information contained in this report should be used to support the trauma system to prepare robust plans for unforeseen events, such as a pandemic and a cyberattack, in order to ensure that major trauma patients continue to receive the highest level of care.

Both this and many of the previous Major Trauma Audit (MTA) national reports highlight the preventable nature of many of these injury events. In particular, the number of falls at home that lead to major injuries requires all of us to consider what we can do in our own homes to improve safety and prevent harm. Using the home safety infographic published in the Major Trauma Audit National Report 2018, we have built on the home safety message by further recommending a home safety checklist that can be used by all healthcare workers when visiting a patient’s home, or indeed by members of the public to assess their own homes.

This MTA report explores for the first time trends regarding blood product administration. It is hoped that these variables can be further expanded, so that future MTA reports can highlight the demand required within our hospital services for this valuable products. It is also hoped that the information captured will inform compliance monitoring with best practice, such as in relation to administration and time to tranexamic acid (TXA).

As the new trauma system develops and changes, continued support for the MTA will be critical in order to monitor the impact of these changes, ensure that the right resources and care pathways are available for major trauma patients, and also to ensure that patient outcomes are monitored and improved continuously. Such is the maturity of the audit that it is now a rich repository of quality information.

Recommendations set out in this report aim to build on the information available within the MTA, which will allow for more robust data collection linked to key performance indicators that are supported and governed on both a national and local level.

The MTA would not be possible without the support of the Healthcare Pricing Office (HPO), the Trauma Audit and Research Network (TARN) and all the MTA clinical leads, in particular the audit coordinators who not only collect and enter vast amounts of data, but who also have championed quality improvement initiatives and data management since 2016.
REFERENCES


World Health Organization (2023). Blood Products. Available at: https://www.who.int/health-topics/blood-products#tab=tab_2
# Glossary of Terms and Definitions

<table>
<thead>
<tr>
<th>ACRONYM</th>
<th>FULL TERM</th>
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<tbody>
<tr>
<td>AIS</td>
<td>Abbreviated Injury Scale. A value between 1 (minor) and 6 (fatal) is assigned to each injury.</td>
</tr>
<tr>
<td>CHI</td>
<td>Children's Health Ireland</td>
</tr>
<tr>
<td>CT</td>
<td>Computed tomography is a scanning technique that uses X-rays to take highly detailed images of the body.</td>
</tr>
<tr>
<td>DCR</td>
<td>Damage control resuscitation</td>
</tr>
<tr>
<td>Direct</td>
<td>Describes care in the first treating hospital</td>
</tr>
<tr>
<td>ePCR</td>
<td>Electronic patient care record</td>
</tr>
<tr>
<td>GCS</td>
<td>Glasgow Coma Scale. A measure of consciousness ranging from 3, indicating complete unconsciousness, to 15, indicating a state of normal alertness. GCS is composed of eye, verbal and motor scores.</td>
</tr>
<tr>
<td>HIPE</td>
<td>Hospital In-Patient Enquiry</td>
</tr>
<tr>
<td>HIQA</td>
<td>Health Information and Quality Authority</td>
</tr>
<tr>
<td>HPO</td>
<td>Healthcare Pricing Office</td>
</tr>
<tr>
<td>HSCP</td>
<td>Health and social care professionals</td>
</tr>
<tr>
<td>HSE</td>
<td>Health Service Executive</td>
</tr>
<tr>
<td>IAEM</td>
<td>Irish Association for Emergency Medicine</td>
</tr>
<tr>
<td>ICD-10</td>
<td>International Classification of Diseases, Tenth Revision</td>
</tr>
<tr>
<td>ICU</td>
<td>Intensive care unit</td>
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<tr>
<td>IQR</td>
<td>Interquartile range</td>
</tr>
<tr>
<td>ISS</td>
<td>The Injury Severity Score is a score ranging from 1 (indicating minor injuries) to 75 (indicating very severe injuries that are very likely to result in death). An ISS between 9 and 15 is considered moderate. An ISS of &gt;15 is considered severe and signifies major trauma.</td>
</tr>
<tr>
<td>IBTS</td>
<td>Irish Blood Transfusion Service</td>
</tr>
<tr>
<td>KPI</td>
<td>Key performance indicator</td>
</tr>
<tr>
<td>LOS</td>
<td>Length of stay – Refers to the length of time spent in an acute hospital for each patient.</td>
</tr>
<tr>
<td>mmGH</td>
<td>Blood pressure is measured in millimetres of mercury (mmHG)</td>
</tr>
<tr>
<td>Major trauma</td>
<td>Major trauma describes serious and often multiple injuries where there is a strong possibility of death or disability.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACRONYM</th>
<th>FULL TERM</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTA</td>
<td>Major Trauma Audit</td>
</tr>
<tr>
<td>MTC</td>
<td>An MTC is a multispecialty hospital, on a single site, which is optimised for the provision of trauma care and integrated with the rest of the trauma network.</td>
</tr>
<tr>
<td>NAS</td>
<td>National Ambulance Service</td>
</tr>
<tr>
<td>NCEC</td>
<td>National Clinical Effectiveness Committee</td>
</tr>
<tr>
<td>NOCA</td>
<td>National Office of Clinical Audit</td>
</tr>
<tr>
<td>NOTS</td>
<td>National Office for Trauma Services</td>
</tr>
<tr>
<td>PPI</td>
<td>Public and patient interest</td>
</tr>
<tr>
<td>QI</td>
<td>Quality improvement</td>
</tr>
<tr>
<td>QIP</td>
<td>Quality improvement project</td>
</tr>
<tr>
<td>RCSi</td>
<td>Royal College of Surgeons in Ireland</td>
</tr>
<tr>
<td>RNA</td>
<td>Rehabilitation needs assessment</td>
</tr>
<tr>
<td>RP</td>
<td>Rehabilitation prescription</td>
</tr>
<tr>
<td>SBP</td>
<td>Systolic blood pressure</td>
</tr>
<tr>
<td>SHO</td>
<td>Senior house officer</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
</tr>
<tr>
<td>TARN</td>
<td>Trauma Audit and Research Network</td>
</tr>
<tr>
<td>Trauma</td>
<td>Trauma is a term which refers to physical injuries of sudden onset and severity which require immediate medical attention.</td>
</tr>
<tr>
<td>Trauma network</td>
<td>A trauma network is a coordinated, integrated system within a defined geographical region to deliver care to injured patients from injury to recovery, through prevention, pre-hospital care and transportation, emergency and acute hospital care, and rehabilitation.</td>
</tr>
<tr>
<td>TU</td>
<td>A trauma unit is a major hospital within a trauma network that provides care for most injured patients.</td>
</tr>
<tr>
<td>TTT</td>
<td>Trauma triage tool</td>
</tr>
<tr>
<td>TXA</td>
<td>Tranexamic acid</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>W</td>
<td>Crude survival scores</td>
</tr>
<tr>
<td>Ws</td>
<td>Case mix-adjusted summary survival scores</td>
</tr>
</tbody>
</table>
APPENDICES
Accessing Report Appendices

National Office of Clinical Audit (2022)
Major Trauma Audit National Report 2021 - Appendices.
Available at: https://www.noca.ie/publications/publications-listing/P0/category/3

Appendix 1: Audit Objectives
Appendix 2: Inclusion Criteria
Appendix 3: Abbreviated Injury Scale (AIS)
Appendix 4: Data Collection Period
Appendix 5: MTA Governance Committee Meeting Attendance
Appendix 6: Hospitals and People That We Work With
Appendix 7: Frequency Tables
Appendix 8: Supplementary Frequency Tables
Appendix 9: Supplementary Blood Product Supply 2017-2021 Courtesy of the IBTS