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# Quality Improvement Project in the introduction of Major Trauma and Major Haemorrhage Protocol

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**Introduction:** We recognised there was a need for a set criterion for the activation of MHP and MTTA at our Trust. The main aim is to streamline the trauma care that our patients would receive around the clock. Ours is a large Major Trauma Unit regularly receiving a large volume of trauma patients of varying severity of injury **Objective:** The use of a checklist for the initial management of MTTA and MHP to ensure the process is streamlined and led by the trauma team leader. This would help reduce the cognitive load that is often presented to the team leader. This would also help direct junior team members with limited experience in the initial management of major trauma. **Method/Intervention:** An initial survey about MTTA and MHP from senior clinicians was carried out. Several teaching sessions were undertaken. In addition to this, an algorithm for the initial management in terms of transfer protocol was also introduced. **Results:** From the clinicians' perspective, 89% of the respondents felt that the use of MHP and MTTA protocol would reduce the cognitive load whilst managing major trauma. There was an improvement in the level of confidence of clinicians in the initial management of major trauma from 52.9 % to 89%. **Conclusion:** Through this project, we hope that there is a better understanding of the need to have pre-defined criteria for activation for MTTA and MTP for several reasons as highlighted in the article. The eventual aim of the project is to streamline the initial management of the majorly injured patient and undertake the necessary practical steps.

**Keywords:** Major Trauma, Haemorrhage, Resuscitation

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# Introduction

We recognised there was a need for a set criterion for the activation of MHP and MTTA at our Trust. The main aim is to streamline the trauma care that our patients would receive around the clock. Ours is a large Major Trauma Unit regularly receiving a large volume of trauma patients of varying severity of the injury. There was also a recognised need for trauma training and understanding amongst the treating clinician whilst applying the concepts learnt from courses like the ETC/ATLS. Having checklists would enable the entire team to gain awareness of the necessary steps to optimise the care of the injured patient. The Trauma Cell-based at North West Ambulance Service (NWAS) triages patient and direct the pre-hospital teams to the appropriate hospitals in the North West of England. All major trauma is directed to RPH unless the severely injured patient (SIP) is deemed haemodynamically compromised to make the necessary journey.

**Two strategies are undertaken for the major trauma patient**

1. Primary survey is done and if there are no concerns of haemodynamic compromise, the patient is subsequently transferred to MTC if concerns of multiple injuries

2. Primary survey is done with major trauma team activation, appropriate imaging (usually CT Polytrauma), assessed for injuries and then based on findings, transferred to our MTC

MTTA is carried out at the request of the team leader (Consultant) most of the time. Alternatively, this would be requested by the Middle-grade doctor (SCF, SAS, Registrar in Training)

**The rationale for the project:** Both major trauma activation and MHP are decisions that are made by senior clinicians (Registrar level and above). There are clinical scenarios that inherently involve the activation of both protocols. This includes Code Red (Actively haemorrhaging patient in peri/traumatic cardiac arrest), and multiply injured patients (in 2 or more anatomical regions). The focus is not based on identifying these scenarios but it is on establishing a set of criteria where the clinical scenario may not be self-explanatory. It is a necessary requirement that clinicians working at the Registrar level and above are up to date with all life support courses.

The use of a checklist for the initial management of MTTA and MHP to ensure the process is streamlined led by the trauma team leader. This would help to reduce the cognitive load that is often presented to the team leader. This would also help direct junior team members that may not have significant experience in the initial management of major trauma.

In addition to the above, a checklist for the initial management of the major trauma patient is being created to ensure that clinicians are aware of both primary and secondary transfers. The contact details for the MTC (Adults and Paediatrics) were also included in this document. The main purpose of this document was for clinicians who may not be aware of the locally agreed protocol and to gain an overall understanding of how major trauma was managed.

**Intended outcomes**

1. The earlier recognition of the haemorrhaging patient with appropriate activation of the MHP

2. Limiting the over-reliance on Haemoglobin levels alone

3. Recognition of the importance of base excess and lactate levels for both diagnosis of tissue shock and assessment of adequate resuscitation

4. Ensuring that the principles of balanced transfusion are followed

5. Early use of TXA (unless contraindicated)

6. Awareness of the elderly trauma patient (not initially presenting as initial trauma)

7. a greater understanding of the need for dedicated trauma imaging to ensure that occult injuries are not missed.

8. Recognition that physiological deterioration as a consequence of active bleeding is less tolerated at the extremes of age, including in the pregnant trauma patient

**Evidence:** Before the start of the study, a pilot study was carried out to assess the pre-existing knowledge and awareness of the indications for MHP and MTTA. These responses were gathered from a cohort of clinicians of varying levels of seniority. The use of descriptive factors was used to evaluate the basic understanding of what would be the triggers for activation of MHP and MTTA. It was interesting

To note that the more junior colleagues still believed that there was a role for fluid resuscitation in the initial management of the haemorrhaging patient. This could potentially reflect the limited experience in managing trauma whilst being unaware of the changes in clinical practice in the realms of damage-controlled resuscitation. It was reassuring to note that the vast majority of clinicians would trigger MHP irrespective of the current physiological parameters.

Prior to this study being carried out, a dedicated middle-grade teaching session was carried out highlighting the concepts of acute traumatic coagulopathy, trauma-induced coagulopathy, damage control resuscitation and the caveats in the management of the severely injured patient based on the revised ATLS principles.

Whilst, this project was ongoing, a need for trauma simulation sessions arose out with the standard trauma courses- ATLS/ETC. The concept and importance of damage-controlled resuscitation were re-iterated and highlighted.

It can be acknowledged that not all clinicians would have the necessary experience or expertise in dealing with major trauma. With the development of major trauma systems in the United Kingdom, the exposure to major trauma is variable, especially outside the MTC setting.

To assess the clot strength, our Trust provides ROTEM measurement to direct further blood and blood products transfusion. This is a useful adjunct in trauma resuscitation.

# Method/Intervention

We have a set triage criterion that when met would trigger the need for a primary survey. This is both in terms of the mechanism of injury as well as triggers for silver trauma. It may seem that patients may be over-triaged using this method, however, if not early consideration is made there are always risks those injuries are missed in the silver trauma patient. There is wider recognition that the silver trauma patient has specific needs including altered physiology that may lead to the detrimental outcome if not considered early in the patient's journey. Problems with triaging can represent a significant problem in the context of trauma. This is particularly a problem in the context of non-MTC. It is well known that under triage

Of trauma is particularly concerning with the walking trauma patient. There is also the need to establish Geriatric Trauma Protocols (GTP). This is a recognition that trauma to an altered physiology results in significant morbidity and mortality.

With regards to the self-presenting/NWAS presentation not considered initially as major trauma, the nursing staff would perform the initial triage. The nursing staff are trained to assess if the patients trigger the criteria for 'silver trauma' hence requiring a primary survey. Based on NICE guidelines, if there has been a significant mechanism of injury then the need for a primary survey would also be highlighted. Once triaged, the nursing staff highlights the aforementioned senior doctor in charge of the department. The clinician performing the primary survey has to be at a Registrar level and above with appropriate ATLS/ETC/APLS training. Based on the findings from the primary survey, the patient continues to be managed in the major area or gets transferred to the Resus area of the ED.

At the time of undertaking this project, the trust trauma guidelines were being updated. This enabled our project in highlighting the importance of trauma resuscitation. There was also a middle-grade teaching session on trauma-induced coagulopathy in addition to acute traumatic coagulopathy. This was well received amongst colleagues supported by the written formal feedback post-session.

We also introduced a new algorithm for the initial management of the Major trauma patient presenting to our ED. This was designed to ensure that the responsible clinician irrespective of the grade was aware of the accepted pathway. The contact details for the trauma coordinators for both the regional paediatric and adult MTCs were included in the document.

This pathway underwent clearance from the clinical governance before being incorporated into clinical practice and was included in the Major Trauma documentation for our Trust.

In addition to the wide dissemination of both these checklists and pathways, they were included in the monthly newsletter. This would reach a wider audience with the eventual aim of reducing the cognitive load and streamlining major trauma management. The importance of damage-controlled resuscitation was further

Reinforced through discussion at our regional Journal Club meeting. This was another opportunity to emphasize to my colleagues to use the checklists that we had introduced.

## Data collection

Data was collected via an initial survey studying the responses from various groups of clinicians working within the ED. The group of clinicians the junior clinicians with limited experience in major trauma care to the more experienced trauma team leader. It was accepted that with the varying levels of experience, the responses to the questions would be variable as well. Being a Major Trauma Unit (MTU), the level of expertise would be different than in the setting of the Major Trauma Centre (MTC). The main domains were studied as follows:

- Understanding the experiences of clinicians activating and triggering MHP and MTTA.
- The criteria in consideration for the trigger of the above two domains.
- The background understanding of the concept of damage control resuscitation.
- The physiological markers that the clinicians would conder as key to the trigger of the MHP and the MTTA.

**The results from the pilot study are described in detail below:** A significant proportion of clinicians would consider the use of crystalloid fluid resuscitation in the initial management of the trauma patient. The previously targeted therapy to maintain normotension is no longer the preferred means of resuscitation. The main aim of resuscitation is to restore organ perfusion through the careful use of damage-controlled resuscitation measures. The concept of damage-controlled resuscitation is an evolving concept that has gained further recognition in recent years. In our survey clinicians indicated that they understood the concept of DCR, however, this can only be evaluated in clinical practice through qualitative means. DCR starts in the pre-hospital through the time definitive control of haemorrhage is carried out and the resuscitation process continues in the ICU. It is a continuum with every part of the journey having a direct impact on the chances of patient survival in the context of trauma. The concept of haemostatic resuscitation is further evolved to ensure that the clot strength is maintained with ongoing Resuscitation measures. We have all gained an understanding of the deleterious nature of crystalloid resuscitation and as noted in the newer versions of ATLS, this is being phased out in clinical use. In some mature trauma systems, the use of crystalloid is completely phased out as the risk of complications as resultant of volume resuscitation outweigh any benefits.

The response with regards to factors that would trigger the MHP was also studied. This was to understand the recognition from clinicians of the importance of haemodilution in acute blood loss. The reliance on heart rate and blood pressure in the activation of the MHP has been proven to be outdated. This is particularly important at the extremes of age where the physiological reserves are depleted. There is increasing recognition that base excess and lactate are more sensitive in the context of acute blood loss with a resultant shock state (1). The value of the venous blood gas which forms the immediate investigation in most ED Resus settings is comparable to the results obtained from arterial blood gas. Part of the problem with the activation of MHP is the presumed waste that is associated with it, this has been discussed in more detail in the discussion section. It can be understood that if packed red cells or blood products are wasted this would cause considerable to the clinician.

The importance of initial management of a major trauma patient is of utmost importance. There are several potential considerations here. As described in other sections within this article, working as a middle grade require competency in managing major trauma patients. The level of confidence of the individual clinicians was assessed with follow-up plans to include regular trauma simulation scenarios as part of a teaching programme. These clinicians must be aware and updated on any changes to the management. A potential source of new information was identified as having links/updates on the monthly ED Newsletter. The basic management of trauma care has remained unchanged however with time and newer ATLS-based guidance fine-tuning is required.

As previously mentioned, our hospital is a Major Trauma Unit and not a Major Trauma Centre, it is important to note that approximately 50% of clinicians would consider undertaking the initial major trauma care before assessing

The need to transfer. This can have several implications, both in terms of logistics as well as the necessary funding that MTCs would receive could considerably be lower than what an MTU would receive. Understandably, the setup of an MTC would be different when compared to an MTU with dedicated teams and resources in the management. However, irrespective of the clinical setting standard trauma management must be across all settings.

**Main steps undertaken**

1. Survey about MTTA and MHP from senior clinicians

2. Dedicated teaching session about damage-controlled resuscitation and haemorrhage control and initial management of Major Trauma to advanced nurse practitioner

3. Introduction of an algorithm for activation of MTTA and MHP having cleared governance

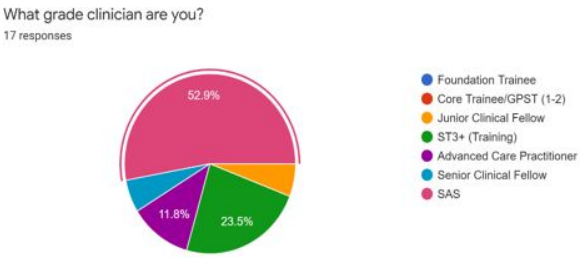
4. Further introduction of an algorithm for the initial management of Major Trauma

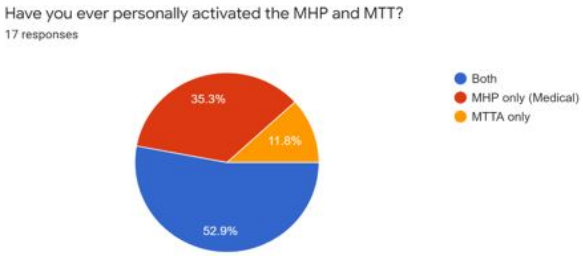
5. Further survey post introduction of the above measures

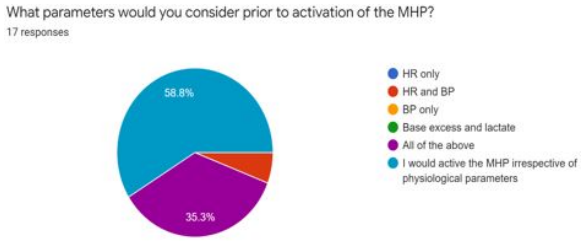
6. Analysing the change that the above measures have been undertaken

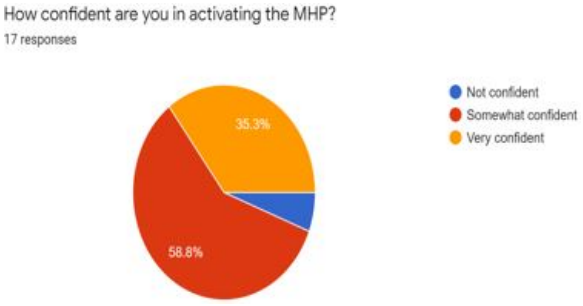
**Responses from the initial MTTA/MHP Survey**

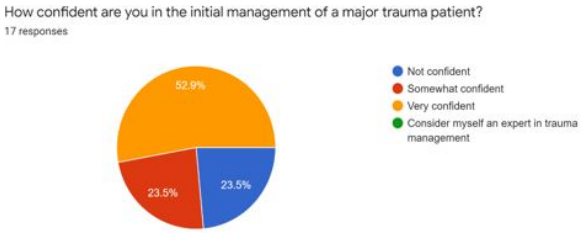
| Question/Statement | Yes | No |
|---|---|---|
| Any surgical experience (outside of foundation training) | 23.5 % | 76.5 % |
| Have you undertaken any additional trauma training (not including ATLS/ETC)? | 29.4 % | 70.6 % |
| Have you ever worked in an MTC/Level 1 Trauma Centre? | 41.2 % | 58.8 % |
| Current ATLS/ETC provider | 70.6 % | 29.4 % |
| Have you ever led an Adult traumatic cardiac arrest? | 47.1 % | 52.9 % |
| Have you been involved in the transfer of the patient to a regional MTC? | 23.5 % | 76.5 % |
| Role of crystalloids in the initial management of haemorrhaging trauma patient | 47.1 % | 52.9 % |

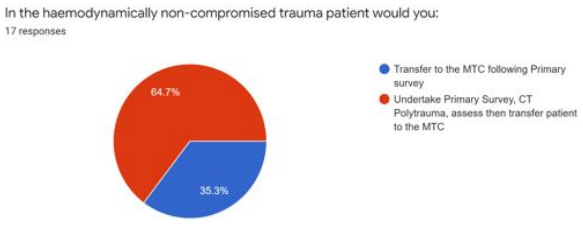


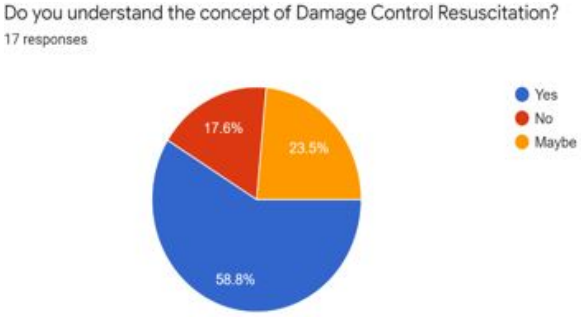



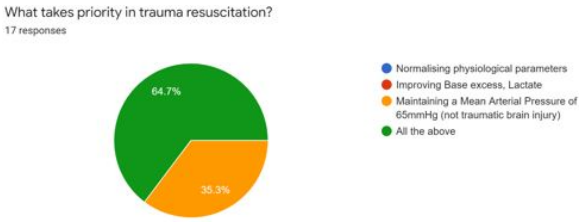






Having had the above responses from the survey, the decision was undertaken to form a checklist for both MTTA and MHP. As previously stated, one of the main aims was to ensure that all team members were cognizant of the initial management strategies for the major trauma patient.

**Post-intervention:** Following the introduction of the algorithm for MHP and MTTA, a post-intervention survey was carried out. It was ensured that wider participation that the initial phase. In addition to the EM middle grades, Consultant EM opinions were also ascertained. We also included the views and the thought processes of nursing staff who are part of the major trauma team. We strongly believe that for the Major Trauma team to function, all the individual members' opinions are very important as we are all part of the process of improvement. There is a requirement for each of the team members to feel valued hence the team-based approach.

**The results from the individual survey are as follows:** From our nursing colleagues, there was an overwhelmingly positive response (11/11) from respondents that agreed that an MTTA and MHP Activation protocol checklist would help. They were also agreeance (11/11) that trauma simulations would enable all the team members to be kept up to date with the necessary skills. Concurrently at the time, our trauma lead was involved in the trauma training of nursing staff to increase the awareness and for early recognition of occult injuries based on the mechanism of trauma. There was a 90% (9/10) agreement that how major trauma was managed was dependent on the experience of the lead clinician. With the appropriate Major Trauma Training, this would be addressed in the future. 70% of the respondents (7/10) felt that there was a delay in the initiation of MHP due to concerns of wastage. This is not surprising as these results are similar to the results from the London Major Trauma System in the initial phase. Concurrently our simulation lead was arranged for Major Trauma and MHP activation Scenarios with the implementation of the tools as a result of this study. From the clinicians' perspective, 89% (8/9) of the respondents felt that with the use of MHP and MTTA protocol has reduced the cognitive load whilst managing major trauma. There was an improvement in the level of confidence of clinicians in the initial management of major trauma from 52.9 % to 89% highlighting that with the appropriate trauma management education the confidence of clinicians can be improved. 89% of the clinicians found that the concept of primary and secondary transfer was clearer based on our transfer protocol. There was also greater awareness of damage-controlled resuscitation from 56% to 89%. There was interest from several levels of clinicians who were very keen to learn about how major trauma is managed. 78% of the respondents felt more confident in the management of the multiply injured patients.

**Trauma Cell:** The NWAS has a dedicated 'Trauma Cell' (2) which a specialist helpdesk co-located in the control room. This is staffed by advanced paramedics that deal with resource allocation, advice and pre-alerting of the major trauma centres. They have their own set of criteria that are used to direct patients to the appropriate level of care deemed necessary at the time.

# Discussion

Following a discussion with my consultant colleagues, we acknowledged that our hospital does not receive a large volume of Major Trauma hence the evaluation of true user experience cannot be fully assessed. It was agreed that across the board the principles of major trauma management remain relevant. It was also noted that this represents a low-frequency but high-fidelity situation. The clinicians also noted that through the use of this checklist that there were better prepared to deal with major trauma. Several registrars in training felt that whilst this was not necessarily new information, it was relevant to their clinical practice, especially in the setting of a Major Trauma Centre. Following a discussion with our departmental lead in simulation, it was agreed that the use of checklists would be further re-enforced in the simulated clinical scenarios that would require both MTTA and MHP activation. The user experience in these scenarios would further add to the utility of these checklists and truly evaluate their use.

Through their use any changes if needed would be incorporated and modified to suit the needs of the clinician.

# Literature

The definition of under-triage is classed as patients who are severely injured (Injury Severity Score greater than 15) and not received by the trauma team [3,5]. The failure to appreciate the injured patient is directly related to increased morbidity [5]. There is a need for the acute trauma clinician to recognise this and translate the knowledge learnt on ATLS/ETC into clinical practice. The problem of under-triage is not a problem limited to the developing trauma system; it is a problem faced by matured trauma systems [6].

The early use of tranexamic acid (TXA) has been well evaluated in large clinical trials. The most beneficial effect is seen in patients where it is administered within 3 hours from the onset of the injury. Although the absolute risk reduction in mortality with the use of TXA is very small [7], the benefits of TXA outweigh any worsened outcomes from its use. With the evolution of damage control resuscitation and haemostatic resuscitation, there has been more liberal use of packed red cells and blood products early in the management of severely injured haemorrhaging patients. One of the early uses of MHP in the form of Code Red protocol was demonstrated in London's Major Trauma System (LMTS). When the impact of this was analysed, it was noted that mortality rates were improved as well the need for subsequent blood products was reduced. There is a clear distinction between major haemorrhage and massive transfusion. The mortality risk rises with the number of units of PRC transfused. Whilst early transfusion with PRC led to earlier haemorrhagic control, the mortality rates increased with the number of PRC transfused.

One of the main perceived hindrances to activating the MHP would be waste. Clinicians may be ambivalent about the early use of blood and blood products as waste may seem to be unacceptable. The LMTS once again allayed our fears that in the long-term waste is minimised. In our hospital, we can mobilise up to 2 units of PRC immediately with further mobilisation of blood and blood products if MHP is activated. Special irradiated platelets are sourced from a nearby hospital. The use of Visco-elastic haemolytic assays (VHA)

Can help direct the resuscitation effort with transfusion of the appropriate blood and blood products. Our hospital uses ROTEM as part of VHA and is available on request. VHA such as the use of ROTEM and TEG can confer additional benefits when compared to the standard coagulation assays [7].

In MTC, trauma care is streamlined with consultant-led care from the outset all the way through to recovery which has been proven to be beneficial for in-patient morbidity and mortality. However, in the non-MTC setting, this may not necessarily be the case leading to variability in the care thereby hampering the patient's recovery. There is a need for robust processes to ensure that the same level of care is given to patients irrespective of the grade of the clinician and timing of the day among other key factors. It has to be acknowledged that the number of cases of major trauma with ISS>15 would be considerably higher in the MTC setting compared to their counterparts. The composition of the major trauma team is also noted to vary between MTC and non-MTC settings. In developed major trauma systems like the LMTS, there is an immediate consultant presence from the different specialities. At its inception, the trauma team should involve members who are ATLS/APLS/ETC providers as the minimum at a registrar level as above. In time-critical scenarios, informed and appropriate decisions need to be made early on in the patient's journey to optimise the intended outcomes. The presence of senior decision-makers at the time when the patient is received can help to mobilise resources earlier for definitive management. This can be in the realms of IR+DCS or DCS/ICU, being particularly important in out of hours when it can considerably longer period. In high-volume MTCs with the presence of dedicated trauma consultants this is a possibility, however, may not necessarily apply to non-MTC settings due to a variety of logistical reasons.

**Changes as a result of the Project**

- Introduction to the Major Trauma Development board as part of the major improvement project
- Incorporation into the Major Trauma documentation
- Greater discussion and awareness of the role of early DCR and Haemorrhage Control
- Garnered significant interest amongst clinicians at all levels of seniority

- Future areas of improvement in Major Trauma Care as previously highlighted are currently being undertaken.

**Revised criteria for MTTA**

**Special considerations in the following scenario**: -

- Clinical concerns of the team leader or trauma team member
- Pregnant trauma patient
- Paediatric trauma
- Dangerous mechanism of injury irrespective of any injury pattern
- Pre-alert concerns of paramedics
- The elderly trauma patient

**Anatomical considerations:** -

- Non-compressible trauma haemorrhage
- Penetrating trauma
- Multiple regions of trauma
- Burns +/- concerns of inhalational injury
- Concerns about occult injuries

**Physiological considerations:** -

- Compromised haemodynamic status
- Persistently hypotension despite pre-hospital resuscitation
- Concerns about Airway or Breathing issues
- GCS<13
- RR<10 or >29

**Paediatric Trauma Considerations: -**

- Early involvement of senior clinicians from all specialities
- Ensuring that paediatric trained nursing staff are present (play therapy nurses when available)
- Early and rapid primary survey
- Liaising with the regional Paediatric MTC
- Ensuring that plans are in place if there is a delay for transfer to the regional MTC
- Liaising with Paediatrics and NWTS for early advice

**General Considerations for all cases**

- Early application of DCR principles to optimise patient outcomes, avoid crystalloids if possible
- Hands-off aseptic approach unless TCA when handover
- Clear documentation of attending trauma team members in major trauma booklet (both adult and paediatric)
- Early and appropriate analgesia is to be given to all trauma patients, and liaise with anaesthetic teams if any additional concerns including depressed GCS.
- Ensure that CT Polytrauma is carried out at the earliest as an adjunct to the primary survey for identification of injuries, if a pre-alert is received- inform radiology
- If concerns of active intra-abdominal bleeding, consider triple-phase CT B+CAP or Angiogram + Dual porto-venous phase (Liaise early with Radiologist)
- Early mobilisation of blood and blood products through activation of the MHP
- Use of ROTEM as an adjunct to haemostatic resuscitation
- Limit excessive handling of patients (especially in the context of suspected spinal/pelvic fractures)

**Acknowledgement:** We would like to take this opportunity to thank all the staff members working across different clinical settings that enable the safe management of the major trauma patient.

# Conclusions

Through this project, we hope that there is a better understanding of the need to have pre-defined criteria for activation for MTTA and MTP for several reasons as highlighted in the article. The eventual aim of the project is the streamline the initial management of the majorly injured patient and undertake the necessary practical steps. The true impact of this project in improving the trauma services at RBH would be dependent on the cultural changes that would need to be considered.

**Highlights**

- In our clinical setting, Major Trauma presents as a low occurrence with high fidelity requiring meticulous planning for the entire team.
- With appropriate Major Trauma-based education the confidence of middle-grade clinicians can be improved

- This study could be considered as a prerequisite for the need for greater awareness of major trauma
- This study helped to garner interest amongst clinicians at all levels with ongoing discussion with clinical simulations of how such scenarios can be managed
- This formed a part of organisational improvement in the management of Major Trauma at our Trust

**What this article adds to the pre-existing literature**

- There is marked improvement in the confidence level of the clinicians managing major trauma with the necessary interventions.
- The use of checklists acts as a guide for clinicians in streamlining care whilst involving other vital members.
- This article supports the pre-existing understanding of damage-controlled resuscitation rather than mere treating physiology parameters.

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