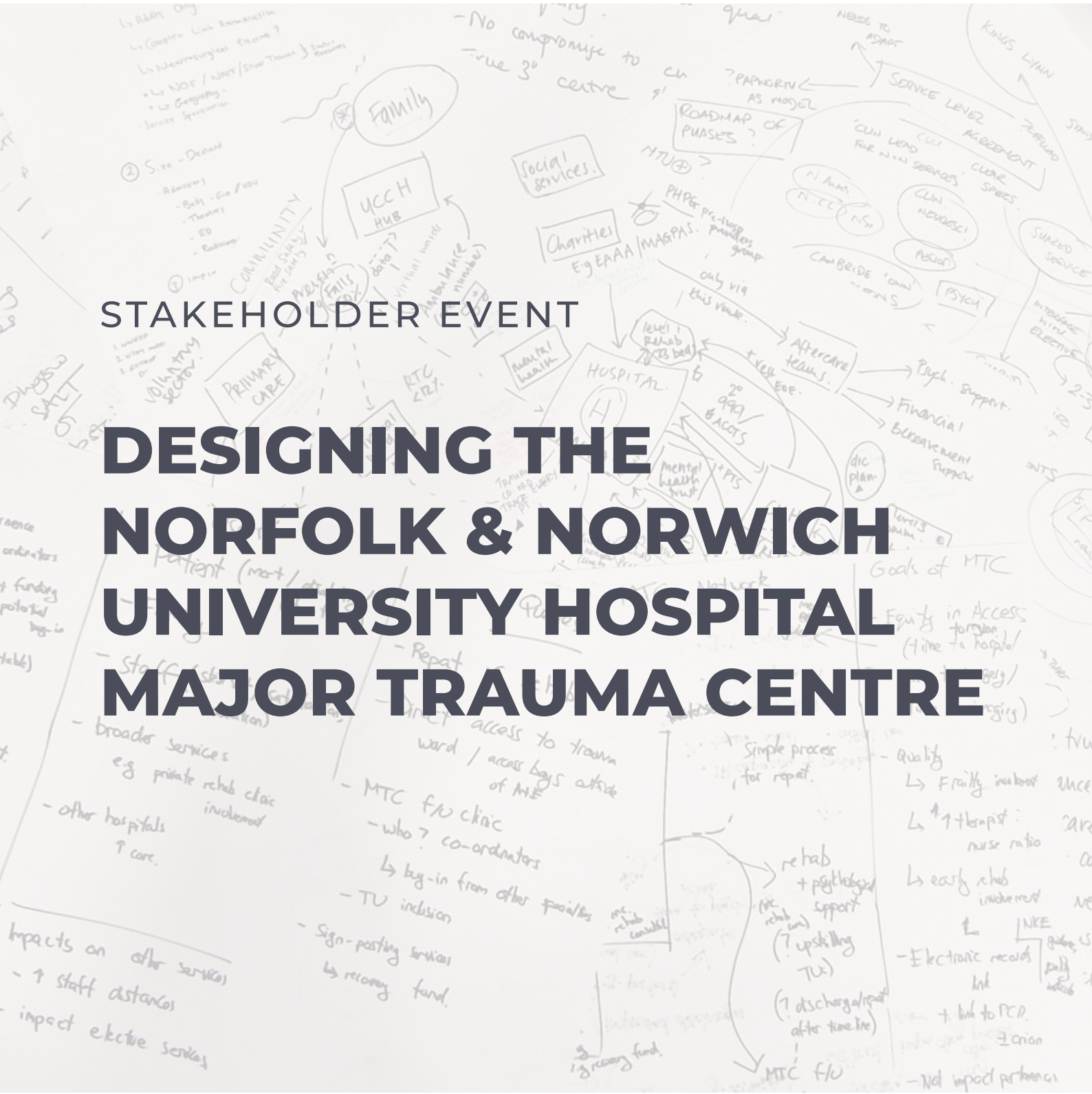
UNIVERSITY OF CAMBRIDGE
Engineering Design Centre

INTERNATIONAL HEALTH SYSTEMS

Systems engineering approach to major trauma centre design



STAKEHOLDER EVENT

DESIGNING THE NORFOLK & NORWICH UNIVERSITY HOSPITAL MAJOR TRAUMA CENTRE

DECEMBER 2024

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STAKEHOLDERS

NORFOLK AND NORWICH UNIVERSITY HOSPITALS NHS FOUNDATION TRUST

EAST OF ENGLAND MAJOR TRAUMA NETWORK

NHS ENGLAND

NORFOLK AND WAVERNEY ICB

CAMBRIDGE UNIVERSITY HOSPITALS NHS FOUNDATION TRUST

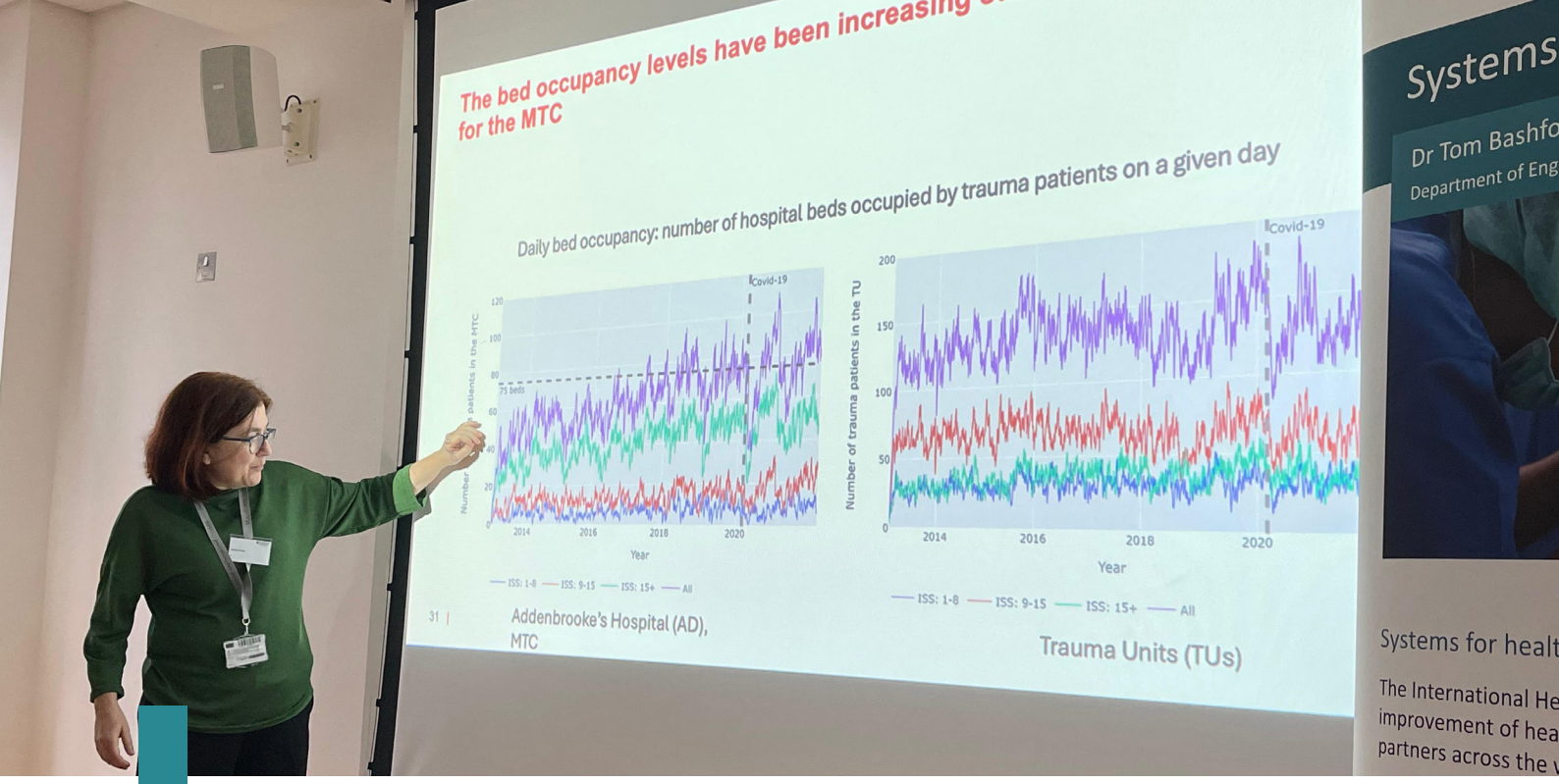
EAST OF ENGLAND NEUROSURGERY NETWORK

EAST OF ENGLAND AMBULANCE SERVICE NHS TRUST

JUDGE BUSINESS SCHOOL, UNIVERSITY OF CAMBRIDGE

SUMMARY

The International Health Systems Group at the University of Cambridge hosted a stakeholder event to help frame and reboot the design process for the East of England's second Major Trauma Centre at the Norfolk and Norwich University Hospital. The day platformed key stakeholders in the project, addressed important aspects of Major Trauma care and helped facilitate communication and collaboration between important players in this substantial transformational project for healthcare in the region.



THE NEEDS ASSESSMENT

JUDGE BUSINESS SCHOOL

Based on 10 years of Trauma Audit Research Network (TARN) data (2012 – 2021) for Adult Major Trauma patients in the East of England (EoE), the Judge Business School at the University of Cambridge, in collaboration with the NHS England and The EoE Trauma Network demonstrated that over the 10-year period analysed:

- The number of adult trauma patients with Injury Severity Score (ISS) >15 who would qualify for management in an MTC is consistently increasing in the region.
- Trauma patients in the region are, on average, increasing in age.
- The number of beds occupied by trauma patients is also consistently increasing.
- The Addenbrooke's MTC reached its trauma bed capacity in 2018.
- Bed occupancy of Major Trauma patients in Trauma Units has been increasing in the region since 2018.
- Major Trauma patients, who live further from the MTC (>35mins drive) are less likely to be transferred directly, or secondarily from a TU, to the Addenbrooke's MTC, particularly if >75 years of age.
- Only 7% of major trauma patients in Norfolk and Waveney present to Addenbrooke's while 52% present directly to the NNUH despite its TU status. No patients in N&W are within 45 minutes transport time to the only current MTC in the region.
- If the NNUH were to become an MTC, **limbs** would be the most severely injured body region of all presenting trauma patients at 30.06%. The **head** would be the most severely injured region in patients presenting with an ISS >15 making up 26.65% of all trauma presentations.

THE EAST OF ENGLAND TRAUMA NETWORK

- The East of England (EoE) Trauma Network includes Bedfordshire, Cambridgeshire, Essex, Hertfordshire, Suffolk and Norfolk.
- 35% of all trauma patients in EoE have major trauma (ISS >15).
- The number of major trauma patients has almost doubled since 2012/13.
- Half of all major trauma is now in the elderly with a median age of 72 years.

CHANGES TO THE EAST OF ENGLAND POPULATION

- Ten-year growth of **487,500 persons at 8% growth** since 2011 (Census 2021).
- **20% increase in persons aged over 75** and growth forecast to continue.
- Time series model on TARN data predicts a **one-third increase in trauma patients by 2026.**

TRAUMA MECHANISM OF INJURY

- Increase in falls <2 metres: making up >half of all major trauma presentations.
- Vehicles incidents are the main cause of major trauma < 54 years age.

GEOGRAPHY

- 22% of EoE Major Trauma patients reside in Norfolk and Waveney ICB.
- Patients from Norfolk and Waveney ICB are the least likely to be directly admitted to the current EoE MTC.

EQUITY

- Only 3% of deprived patients in the EoE are within 45 minutes of the only MTC.
- **Elderly, low fall mechanism** and patients from **more deprived backgrounds** are more likely to remain in a TU than be transferred to an MTC.

Estimated proportion of all trauma admissions to Norwich MTC for 2023-2027 using most established scenario	
ISS >15	42%
AGE 75+	57%
FALL LESS THAN 2M	69%

NHS ENGLAND COMISSIONING PERSPECTIVE

THE COMMISSIONING PROCESS

- *Delegation arrangement:* an organisation delegates its statutory functions to another organisation which carries that function out.
- *Joint working arrangement:* organisations come together to jointly exercise the functions of one or more of the organisations.
- East of England Joint Commissioning Consortium (JCC) 6 X ICBs have delegated commissioning responsibility and budget for 70 specialised services.
- JCC determines its work programme and priorities and spending.
- NHSE retains oversight and broad strategic responsibility i.e., New Hospital Programme.

NNUH MTC PROJECT TO DATE

- Project Group Established January 2022 – wide engagement.
- Forward view of expected major trauma activity in the East of England.
- Gap analysis for Norfolk and Norwich University Hospital against the current D15 Service Specification and QST Quality Measures for an adult major trauma centre.
- Development of the clinical case for change to improve outcomes and develop second major trauma centre and clinical model.

CHALLENGES OBSERVED

- Multiple organisational changes: 3 x trust Chief Executives, delegation of Specialised Services, ICBs downsizing.
- Unresolved questions around Neurosurgery and the clinical model.
- Overall Project drift since the Needs Assessment.
- Demise of TARN.

OWNERSHIP, ACCOUNTABILITY AND COMMUNICATION

- Norfolk and Norwich Hospital are responsible for developing and ultimately delivering a Business Case.
- Shared responsibility. All stakeholders have a role in shaping the business case – Trauma Network, N&W ICB, Spec Com Team, EAAS, CUHFT as current MTC, national Clinical Lead/CRG, NHSE, patients, local authority etc.
- JCC/ICB/NHSE are accountable for ensuring their populations have equitable access to high quality care in a timely fashion with good outcomes.
- JCC will need to approve the final business case to commission/establish a 2nd MTC in EoE.

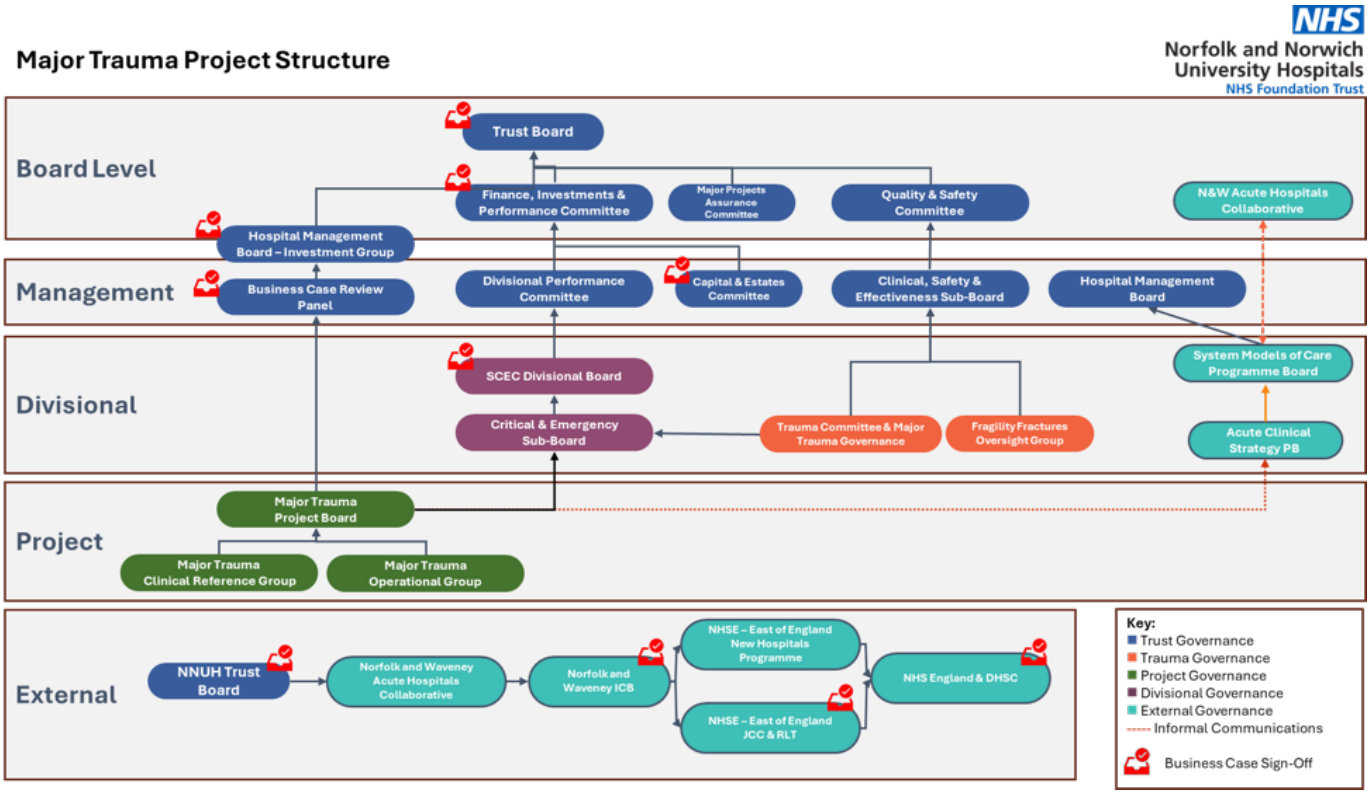
TIPS ON HOW TO MAKE THE PROCESS SUCCESSFUL

- Reboot the Project Group – set clear milestones
- Recognise the politics
- Keep talking/engagement stakeholders
- Don't let perfect be the enemy of good
- National/CRG Support

EXPECTED OBSTACLES AND HOW TO OVERCOME THEM

- *Obstacle:* Numerous stakeholders to convince.
- *Obstacle:* Affordability (revenue + capital)
- *Obstacle:* Capacity.
- *Norwich based solution to a regional system challenge – system benefits.*
- *Vision - How MTC compliments broader strategic vision for N&W service provision.*
- *Focus on equity, outcomes, workforce.*
- *Frequent communication and updates.*

NNUH PROGRESS TO DATE



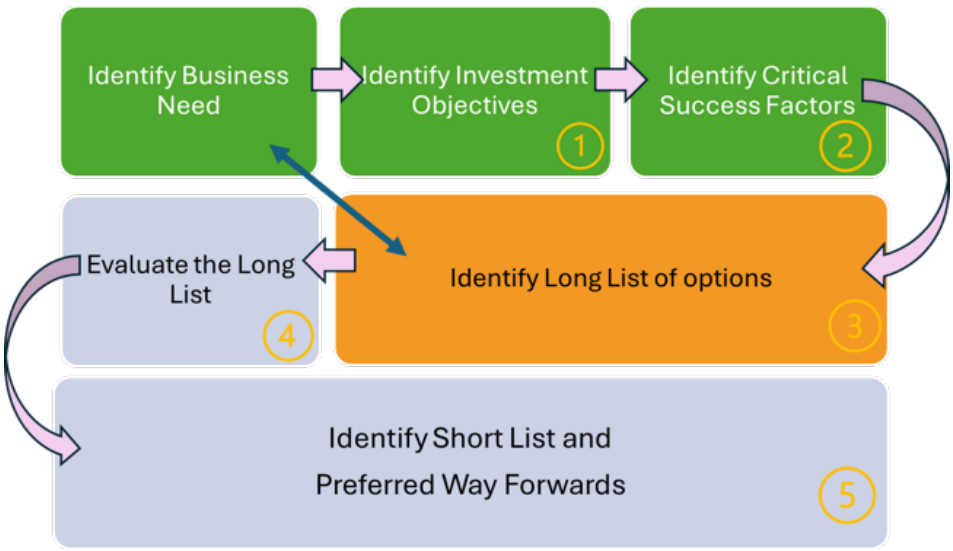
BUSINESS CASE DEVELOPMENT

MOVING FROM SOC > OBC > FBC

SOC: Make the case for change and establish a preferred way forward **(CURRENT STAGE)**.

OBC: Preferred option identified with detailed analysis.

FBC: Detailing economic advantageous offer to deliver the option through competition (contracts/ procurement).



IO CATEGORY	SMART INVESTMENT OBJECTIVES
EFFICIENCY	1. Improve major trauma capacity and emergency resilience for the East of England to meet the expected 25% increase in Major Trauma admissions by X.
EFFECTIVENESS	2. Improve patient outcomes for trauma admissions by ensuring improvement on all Major Trauma Quality Indicators from a 2023/24 baseline position within 2 years of major trauma designation.
	3. Improve equity of access to trauma services (including neurosciences care), ensuring services available are adopted for the epidemiology of patient arrivals, increasing the % residence and Core20 population within 45 minutes of MTC from 20.1% and 3.4% respectively to 36.5% and 23.6% by X
	4. Attract, retain, and upskill the workforce involved in managing trauma to ensure safe delivery of service by ensuring 95% of departments managing trauma patients meet National Major Trauma education competency standards by X
ECONOMY	5. Ensure investment in the Norfolk and Waveney health economy aligns with the macro model of care enabled by the New Hospitals Programme, with a focus on enhancing cost-effectiveness and outcomes for trauma patients
	6. Maximise the opportunity to undertake trauma-related research studies and trials at NNUH, leading to new pathways and pre-hospital prevention programmes – ensuring participation in a minimum of 5 trauma-oriented trials per annum.
COMPLIANCE	7. Full compliance with the NHS England Major Trauma Centre Service Specification by X.

INTEGRATED MAJOR TRAUMA SERVICE

The establishment of an Integrated Major Trauma Service (IMTS) will support with the provision of high-quality care for major trauma patients. The quality indicators included are intricately linked to a robust coordinating function, dedicated key workers, streamlined processes, and well-defined policies. The IMTS will serve as the central point for major trauma, offering a comprehensive and coordinated approach to ensure timely, efficient, and patient-centred care.

Included within this development:

- Expansion to a 7-day Major Trauma Coordinator Service to support the safe and effective flow of trauma inpatients but also ensure a holistic follow up is available.
- Signposting Service.
- Trauma Admitting Service – consultant led service for polytrauma patients to be admitted under and manage care plans.
- Leadership Structure for Major Trauma.

EMERGENCY TREATMENT & DIAGNOSTIC

Identified from the gap analysis, capacity and capability were areas requiring investment to be able to support the forecast levels of Major Trauma meeting quality indicators on a consistent basis. Included within this development:

- ED Trauma Team Leader 24/7 – a new overnight consultant shift ensuring a TTL is available in Resus at all times to receive critical injured patients.
- Senior ED Nurse Training and availability – availability of senior nursing teams involved in the trauma team and initial resus and reception of patients to required competencies.
- Dedicated ED CT scanner including reporting allowing <1 hour arrival to CT – nested within the programme of Radiology infrastructure changes linked to the DAC, dedicate a CT to ED to allow trauma patients to receive a CT within an hour of arrival and provide a responsive and sustainable reporting service.

DEFINITIVE CARE

With the exception of Neurosurgery, specialist services required of an MTC are available at NNUH. The investment in this development primarily looks at expanding the capacity and capability of these services:

- Orthopaedic Trauma including Pelvic
- Spinal Trauma
- Plastic Trauma
- Elderly Trauma
- General, Vascular and Thoracic Trauma
- Urological Trauma
- Neurosurgical Trauma*
- Fracture Liaison Service**
- Trauma Ward and Critical Care

Within each of these specialities proposals includes bespoke trauma-oriented models of care to be expanded and scaled whilst meeting or exceeding standards set by Royal Collages or similar groups.

REHABILITATION SERVICES

Investment in early rehabilitation is well evidenced to have significant benefits on patient outcome and health-economies. Despite being overlooked, this aspect is arguably the most critical part of the trauma pathway.

The proposed investments in acute trauma rehabilitation maintain a holistic and collaborative approach of care, to be delivered partners such as NCHC:

- Hyper Acute Rehabilitation
- Rehabilitation Consultants
- Trauma Psychology

While this section/case specifically address acute requirements for MTC, NNUH will also play an active role in the regional programme seeking to enhance community and specialist trauma rehabilitation capacity, ensuring equitable access to services.

REHABILITATION FOR THE MAJOR TRAUMA PATIENT

- Recent GAP analysis conducted by Major Trauma Network and University of Essex highlights the challenges that exist within EOE Rehabilitation service provision
- Service provision is “variable, inequitable and under-resourced”
- **Level 1 capacity: only 19.96%** of what is recommended for EOE by UKROC
- **Level 2 capacity:** currently sufficient but strained by the additional level 1 patients parked as “interim” provision whilst awaiting a level 1 bed availability.
- **Inequity:** Notable variation in the number of beds available across ICB’s as well as the type of services available
    - EoE rehab bed/population: 1: 4640
    - **Norfolk 1:6591**
    - Cambridgeshire 1: 2300
- Rehab pathway is complex and does not always match with patients’ needs – resulting in additional delays.
- Rehabilitation is one of the most Cost- Efficient Interventions in Healthcare
    - Lifetime Savings in cost of care (2019 Study)
        - Mean cost of Rehab episode: £43000
        - 6000+ TBI patients –care needs over 8 years - **£4.1 billion Savings**
- Early and targeted specialist rehabilitation interventions by experienced rehab clinicians can positively alter clinical outcomes.
- There are both short-term and long-term financial benefits in securing a reliable, effective rehabilitation service for major trauma patients.

THE ROLE OF THE TRAUMA NETWORK IN REHABILITATION SERVICES

- *A central repository for rehab needs in the region for Major Trauma patients.*
- *Coordination of rehab pathways.*
- *Provide quality assurance of rehab services to ICBs.*
- *Support efficient transfer of care between acute TUs and rehabilitation providers.*
- *Source of rehabilitation datasets and metrics.*
- *Gather feedback from rehab co-ordinators and patients to support future investments in regional rehabilitation.*

THE ROLE OF PSYCHOLOGICAL SUPPORT

PSYCHOLOGICAL SERVICE FOR THE MAJOR TRAUMA PATIENT

- Psychologically-informed approaches to care and rehabilitation make a significant difference to people's physical and functional recovery, as well as their mental health.
- Early psychological intervention in hospital can improve patient self- management, which in turn positively impacts rehabilitation and length of stay, resulting in cost saving implications.
- Psychological follow up in the community can reduce psychological morbidity, support recovery, Quality of Life and economic savings.

INPATIENT PSYCHOLOGY SERVICE

- Psychological Assessment.
- Psychological formulation.
- Psychoeducation and normalising.
- Brief and longer-term, evidence based, psychological interventions.
- Liaison and triaging to community mental health service if appropriate.

OUTPATIENT PSYCHOLOGY SERVICE

- Timely review, local treatment where needed.
- Therapy caseload.

THE NEUROSURGERY QUESTION

CURRENT ADDENBROOKE'S SERVICE

- 4.8 million patients in the catchment area.
- 15-17 referring hospitals.
- 4.5 operating theatres.
- 21 Neuro-ICU / Trauma beds.
- 3 wards.
- Rapid Access Rehabilitation.
- Day of Surgery Admission unit.
- All neurosurgical subspecialties.
- Imaging Centre.
- Multi-modality monitoring.

NEUROTRAUMA CASELOAD

- 9-13% of referrals made result in a transfer to the unit.
- NNUH referred **approx. 1300 patients during 2023/4.**
- Regionally, the most common reason for referral is **head injury.**
- Most common outcome for head injury referrals is advice only (approx. 80%).
- In 2023/4 approx. 50 patients with head injuries presenting to NNUH were transferred to Addenbrooke's Neurosurgery.

PHASED NEUROSURGICAL COLLABORATION WITH NNUH

- Fortnightly outpatient clinic (May 2023)
  - Consultant Neurosurgeon
  - Neurotrauma Clinical Nurse Specialists
  - Neurosurgery Fellow
- Participation in global neurotrauma registry (geotbi.org) with PROMs during clinic appointment.
- Plans to roll out neurotrauma RCTs (NIHR/HTA-funded) @NNUH.

CHALLENGES

- Management of severe TBI locally requires **significant investment in staffing and equipment:**
  - Access to neuro-theatres
  - Neuro-intensive care (specialised monitoring, advanced neuroimaging)
  - Interventional angiography
- Current Neurotrauma numbers are relatively small
  - 2 patients/week from NNUH, QEH KL and JPUH to CUH

THE ADDENBROOKE'S EXPERIENCE

- **The MTC received 11,000+ major trauma patients in the last 10 years.**
- Major trauma has actively increased by approx. 97% in the last 10 years.
- Now receive approx. 1,300 -1,400 patients each year.
- The 3 highest admitting specialties in the last 5 years were:
    - Neurosurgery
    - Trauma & Orthopaedics
    - General Medicine

EAST OF ENGLAND (EOE) POPULATION GROWTH

- In 2012, the Cambridge Major Trauma Centre was commissioned to serve **population of approx 5.8m** in the East of England (EoE).
- In 2021, the EoE population was estimated at **6.3m – population growth of approx. 8.3% since 2011 (15.4% since 2002).**
- **East of England had the highest population growth in England & Wales** (Census 2021).
- All regions are projected to have a greater proportion of people aged 65 years and over by mid-2028.

ADDITIONAL WORKLOAD GENERATED BY MAJOR TRAUMA

- Significant growth in associated complex caseload that don't account for the primary Major Trauma presentation. Complex skill sets bring complex work.
- 10-20% reoperation rate.

LESSONS LEARNED

- Commissioning should anticipate growth and match the resources and investment.
- Cater for the increased demands of the older patients.
- Important to secure allied frailty services early.
- Ensure you secure rehabilitation beds.
- Consider counting patient care episodes not patient numbers to accurately reflect workload.
- Mean number of surgical procedures: 6-7 per patient.
- Practice in silos is not conducive to successful trauma planning.
- Major Trauma needs to be more than a coordination service - decides ownership, power to address patient safety, ownership and involvement of teams.
- Transfer of care between teams – or better shared care models.
- Coordination of pathway strategy at the start saves days.

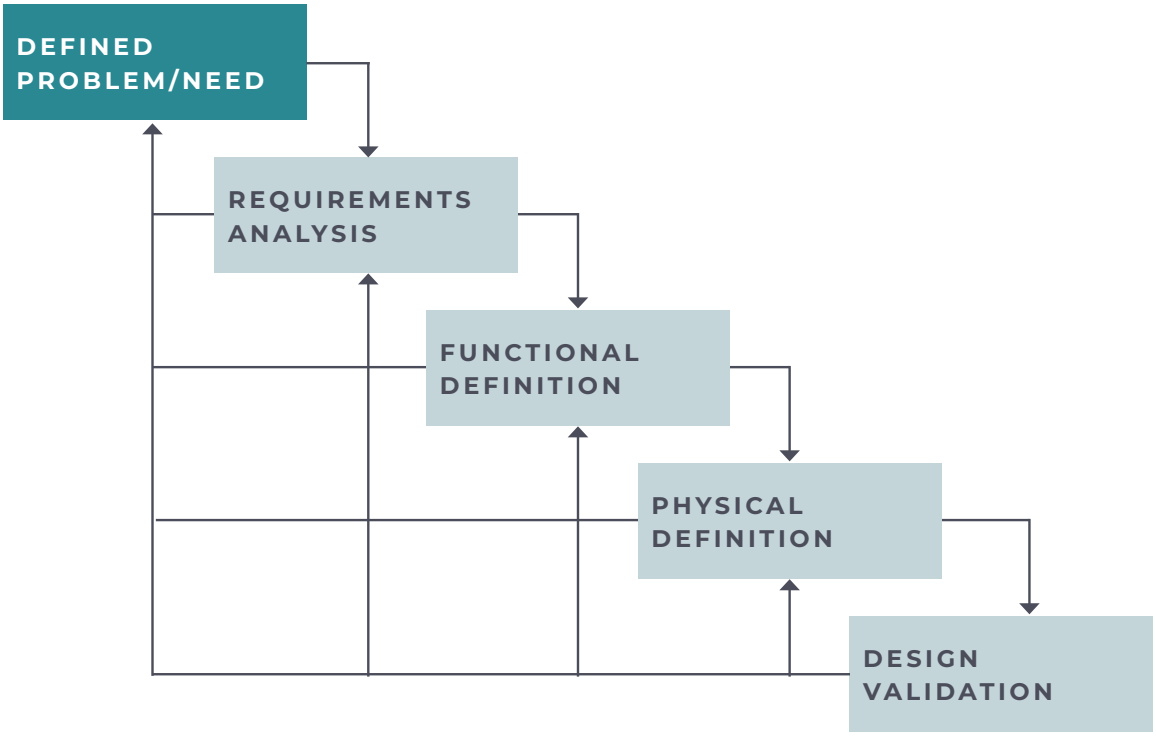
PLANNING AHEAD FOR A NEW MTC

- Ensure adequately sized resus.
- Include bereavement room/s.
- Ensure ED staffing capacity.
- Design for proximity of radiology services.
- Instil education, governance, compassion and care into the patient experience.
- Secure a Major Trauma Ward and a Frailty Trauma Ward.
- Set a Major Trauma MDT.
- Build in staffing redundancy to provide combined operating.
- Make provisions for combined operating e.g. orthoplastics.
- Recruit allied support services.
- Integrate an education and feedback mechanism into the service.

WHAT SYSTEMS ENGINEERING CAN OFFER

- Designing the Major Trauma Centre according to NHSE requirement to ensure compliance with national standards and delivery of reliable patient care.
- Tracing requirements to system functions and components to ensure the system is adequately and effectively budgeted for and delivered.
- Creating a platform where stakeholders can review the system requirements to ensure a shared vision on what the new Major Trauma Centre should be delivering.
- Considering requirements specific to the NNUH and integrating that into the design process to create a more contextually sensitive, better tailored system. E.g. designing a system that does not negatively impact elective operating at NNUH.
- Breaking down of the Major Trauma system into subsystems within the hospital to better appreciate how these are interconnected and how these interfaces can be improved to maximise efficiency.
- Understanding the wider context of the Major Trauma Centre and all the interacting external components, the exchange that occurs and the impact they have.
- The opportunity to plan which aspects of the MTC design and implementation can run in parallel and which must run in series to minimise time lost during the implementation phase and to allow for reassessment of the project and recalibration.
- A methodology to Test and Evaluate the system in parts, subsystems and in whole to ensure the designed product delivers the required service adequately and reliably.

SYSTEMS ENGINEERING PROCESS



FEEDBACK THROUGHOUT THE DAY

WHAT WE SHOULD STOP IMMEDIATELY...

- *Stop saying "IF"*
- *Are we, are we not!*
- *Do not forget support for rehab facilities*

WHAT WE SHOULD CHANGE URGENTLY...

- *Deadlines to be created*
- *What is the neurosurgery model?*
- *Accountability + timeframe for objectives*
- *Daily Major Trauma MDT*
- *Lack of deadlines*

THINGS WE SHOULD CHANGE ...

- *Include organisations within the MTC catchments*
- *Centralise rehab referral process*
- *Spinal surgery team should be here*
- *Improve internal (NNUH) engagement*
- *Access to rehab medicine*

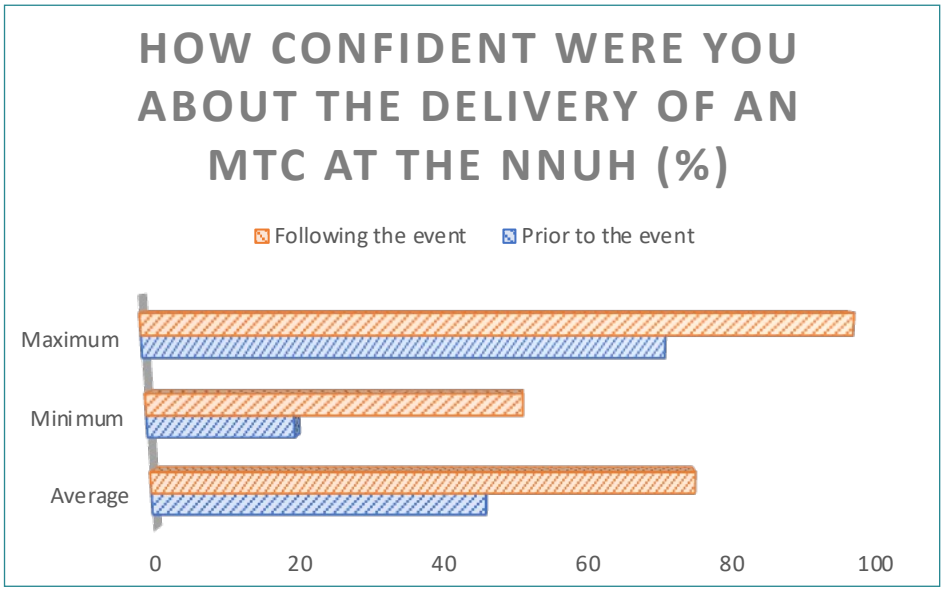
WHAT WE SHOULD CONTINUE TO DO...

- *Communicate*
- *Look at how other hospitals (including internationally) solve these issues*

WHAT WE SHOULD AMPLIFY AND CELEBRATE...

- *Improvement to locally managed TBI patient pathway*
- *Link with external organisations e.g. Headway, SCIA, steel bones etc.*
- *Support of Voluntary Services & incentivise good quality rehab facilities*
- *Current progress and engagement*
- *Celebrate regional buy-in NHSE/ICB/PHE networks*

POST-EVENT FEEDBACK



WHAT THREE OUTCOMES DO YOU THINK WOULD BE KEY IN PROGRESSING THE PROJECT?

Themes of most consistent result:

- Business Case
- Neurosurgical Model

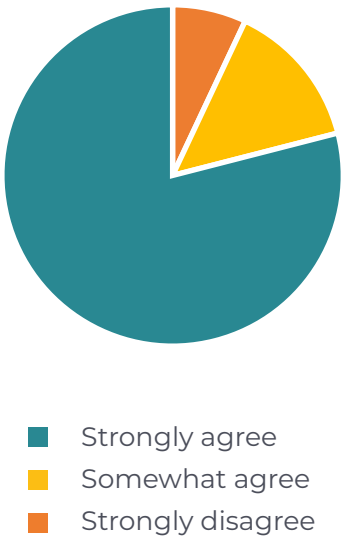
Other consistent themes:

- Financial/finding confirmation
- A single preferred model for the MTC
- Timeline/deadlines
- ICB engagement
- NNUH executives engagement
- Rehabilitation plan

Other themes:

- Clear communication
- Build trust
- Set accountability
- Start a Major Trauma Ward

A FOLLOW-UP EVENT IS NECESSARY TO BUILD MOMENTUM AND ASSIST PROGRESS OF THE PROJECT



TAKE HOME MESSAGES

1. All stakeholders are unequivocally committed to delivering a second EoE MTC at the NNUH. NHS England both hope and expect that the NNUH will take on this project with necessary stakeholder support.

2. There is established **inequity** in the delivery of trauma care across the East of England. This is particularly notable for:
   a. Elderly patients
   b. Trauma with a low fall mechanism
   c. Patients from more deprived backgrounds
   d. Access to rehabilitation services
   e. Patient further away from the EoE MTC in Cambridge

3. The East of England's sole Major Trauma Centre exceeded its bed capacity in 2018
   a. The volume of trauma cases has doubled in a decade and continues to grow, with no changes in Major Trauma bed capacity
   b. The population of the EoE is continuing to grow, particularly the >75 years
   c. The NNUH is admitting and managing increasing numbers of patients that warrant MTC care, despite its Trauma Unit status and provisions.

4. 22% of EoE major trauma patients reside in the Norfolk and Waveney ICB but none of these patients are within 45 minutes of the only MTC in the region
   a. Major trauma patients from N&W are the least likely to be admitted to the EoE MTC (only 7%)
   b. 52% of N&W major trauma patients present directly to the NNUH despite its TU status

5. There must be a trauma neurosurgical service at the NNUH for it to obtain MTC status. The neurosurgical team at Addenbrooke's have confirmed their commitment to engaging with and supporting the delivery of this service to maintain EoE standards.

6. Rehabilitation services are critical in delivering effective, efficient trauma care. Adequate delivery of service results in improved clinical outcomes and are very cost-effective. Rehab services must be fortified and expanded, and the geographic inequality addressed, to accommodate the rising trauma caseload and a new MTC at the NNUH.

7. Early access to psychology services for the major trauma has a significant impact on patients' physical, functional and mental recovery improving self-management, rehabilitation and length of stay.

8. Recruitment of Frailty Services and Care of the Elderly Medicine is important in catering to the NNUH trauma patient demographic.

9. A timeline with deadlines for the project is necessary to maintain momentum, track project progress and keep stakeholders aligned.

10. Stakeholder lines of communication and an accountability framework must be established to clarify responsibilities and to ease stakeholder engagement.

11. A business case is crucial to further engage the commissioners and to facilitate negotiations around scope, timeframe and collaborations across the ICB. There was participant consensus that a deadline for the SOC to be submitted by **31st January 2025.**

THANKS AND ACKNOWLEDGEMENTS

A sincere thanks to all those who contributed to the event from the Norfolk and Norwich University Hospital, East of England Major Trauma Network, NHS England, Norfolk and Waveney ICB, Cambridge University Hospital, East of England Neurosurgery Network, Cambridgeshire and Peterborough NHS Foundation Trust (CPFT), East of England Ambulance Service and the Judge Business School (University of Cambridge).

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