Institution: The University of Manchester

Unit of Assessment: 2 (Public Health, Health Services and Primary Care)

Title of case study: Radical reorganisation of trauma services reduces risk and saves many lives among severely injured patients.

Period when the underpinning research was undertaken: January 2000 – December 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Antoinette Edwards	Executive Director Operation Director Projects and Research Manager	2016 – present 2014 – 2016 2002 – 2014
Omar Bouamra	Medical Statistician	2000 – present
Hiren Patel	Honorary Senior Lecturer	2010 – present
Fiona Lecky	Honorary Professor Clinical Senior Lecturer	2012 – present 2000 – 2012
David Yates	Emeritus Professor Professor of Emergency Medicine	2012 – present 2000 – 2012

Period when the claimed impact occurred: August 2013 – December 2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact

Trauma is the UK's biggest cause of loss of life below age 40. University of Manchester (UoM) researchers developed a methodology that showed significant variation in trauma mortality depending on the type of treating hospital and created an economic case for change. This directly led to a radical policy shift and a fundamental reorganisation of NHS services, which has resulted in greatly enhanced care and a 19% reduction in mortality for severely injured patients - NHS England estimates that since 2013 the reorganisation has saved an estimated 400 patient lives each year. We have subsequently undertaken the same process in the Republic of Ireland, with similar impact on mortality risk observed.

2. Underpinning research

For persons aged below 40 years in England, trauma remains the commonest cause of death, with survivors often experiencing long-term disability. The National Audit Office estimated that there are 20,000 major trauma cases per year, resulting in 5,400 deaths.

Our key research outputs leading to the impact that occurred between 2013 and 2020 started with the 2000 publication [1], which showed significant variations in the process of care and outcomes between NHS hospitals. These data underpinned an influential report from the Royal College of Surgeons in 2000. In 2002 we reported significant variability in the proportion of survivors (adjusted for severity of injury and age) between the highest and lowest deciles of all UK hospitals [2], with no significant improvement in overall outcomes observed between 1994 and 2000. These papers highlighted the need for a radical change to the NHS trauma care system.

As head injury is the commonest cause of both death and disability following major trauma in the UK, we focussed our detailed analyses on neurosciences care, demonstrating in 2005 the variation in risk-adjusted head injury mortality depending on the type of treating hospital

[3]. This work also demonstrated that many patients with severe head injuries did not receive specialist care, and that patients taken to smaller hospitals often experienced long delays before being transferred to a specialist unit. With head injuries, delay in receiving intervention heightens risk of adverse outcomes.

In 2006 our group refined the underlying statistical risk adjustment models [4]. The previous modelling had been based on US systems and was therefore incongruent with UK practice. This new methodology rapidly became the UK standard and was used in all future research in this field.

The economic impact of major trauma on the NHS was evaluated in 2008 [5]. This analysis showed that the cost of major trauma treatment was both high overall and greatly variable between centres. Most of the variation in cost was related to efficiency (length of stay) suggesting that reorganisation to create a more efficient system might be cost-effective.

International collaborations were established, with alignment of methodologies. This enabled comparisons; for example in 2011, showing that head injury patients managed in England and Wales had an elevated risk-adjusted mortality when compared to those managed in the inclusive trauma system of Victoria State, Australia [6]. This provided further evidence of the need for change to improve NHS care.

In summary, our research developed and then refined a methodology [4], demonstrated variation in risk-adjusted outcomes [1,2], demonstrated variation in head injury outcome depending on hospital type [3], showed the excess cost of inefficient trauma care [5], and revealed comparatively poor post-trauma outcomes for the UK versus other countries [6].

3. References to the research

1. **Lecky FE**, Woodford M, **Yates DW**. Trends in trauma care in England and Wales 1989-1997. *The Lancet* 2000;355:1771-75. doi: 10.1016/S0140-6736(00)02264-9 (116 citations, Web of Science (WoS), 3 November 2020).
2. **Lecky FE,** Woodford M, **Bouamra O, Yates DW**. Lack of change in trauma care in England and Wales since 1994. *Emergency Medical Journal* 2002;19:0-3. doi: 10.1136/emj.19.6.520 (58 citations, WoS, 3 November 2020).
3. Patel HC, **Bouamra O**, Woodford M, King AT, **Yates DW**, **Lecky FE**; Trauma Audit and Research Network. Trends in head injury outcome from 1989 to 2003 and the effect of neurosurgical care: an observational study. *The Lancet*. 2005 Oct 29-Nov 4;366(9496):1538-44. doi: 10.1016/S0140-6736(05)67626-X (225 citations, WoS, 3 November 2020).
4. **Bouamra O**, Wrotchford A, Hollis S, Vail A, Woodford M, **Lecky F**. A new approach to outcome prediction in trauma: A comparison with the TRISS model. *Journal of Trauma*. 2006 Sep;61(3):701-10. doi: 10.1097/01.ta.0000197175.91116.10 (100 citations, WoS, 3 November 2020).
5. Christensen MC, Ridley S, **Lecky FE**, Munro V, Morris S. Outcomes and costs of blunt trauma in England and Wales. *Critical Care* 2008;12: R23. doi: 10.1186/cc6797 (31 citations, WoS, 3 November 2020).
6. Gabbe BJ, Biostat GD, **Lecky FE**, **Bouamra O**, Woodford M, Jenks T, Coats TJ, Cameron PA. The effect of an organised trauma system on mortality in major trauma involving serious head injury: A comparison of the United Kingdom and Victoria, Australia. *Annals of Surgery* 2011 253;1:138-143. doi: 10.1097/SLA.0b013e3181f6685b (65 citations, WoS, 3 November 2020).

4. Details of the impact

Context and Pathways to Impact

In the UK, prior to 2012, major trauma patients were invariably taken to the nearest hospital, regardless of whether it had appropriate specialists. UoM research showed that patients

treated in local hospitals were more likely to have adverse outcomes than those treated in specialist centres and that specialist treatment was potentially more cost-effective. Our evidence was presented to the National Audit Office (NAO) in 2010 leading to reorganisation of NHS trauma care. In 2012, major trauma networks (MTNs) were introduced to address the variability in service and patient outcomes, with a GBP30,000,000 investment. The reorganisation enabled paramedics to take severely injured patients directly to specialist Major Trauma Centres (MTCs). All MTCs provided on-site neurosurgical services, as indicated by our research, and 24/7 access to senior clinicians and early investigation.

Policy Impacts

Policy changes, underpinned by UoM research, are now embedded in the NHS commissioning system. The 2013 NHS Standard Contract for Major Trauma included the aim of treatment through trauma networks with MTCs at the heart. It confirmed an MTC "*has all the facilities and specialties required to be able to treat patients with any type of injury in any combination*." The contract also mandated that submission of data for measurement through the Trauma Audit and Research Network (TARN) should underpin the Best Practice Tariff (distributing GBP60,000,000 to GBP80,000,000 per annum) [A]. TARN was founded by UoM and Salford Royal NHS Foundation Trust to enable hospitals to collect and evaluate their data on trauma care using the measurement tools that we developed. Treatment at an MTC and use of TARN remain as criteria for major trauma best practice payments in 2020/21 tariffs [B]. TARN also enables our researchers to create a direct link between their research and the national quality standards through the NHS England Major Trauma Clinical Advisor Group and the National Clinical Director for Major Trauma.

In January 2014, the National Institute for Health and Care Excellence (NICE) published updated guidance on head injury, which recommended, as a key priority, transporting *"patients who have sustained a head injury directly to a hospital that has the resources to further resuscitate them and to investigate and initially manage multiple injuries"*. It further recommended local guidelines on the transfer of patients with head injuries from hospital to a neuroscience centre should be drawn up and should recognise that "*transfer would benefit all patients with serious head injuries…irrespective of the need for neurosurgery*" [Ci]. UoM reference 3 (Patel et al.) was cited as evidence supporting the NICE guidance [Cii] and Lecky was a chair of the 2014 NICE guideline development group [Ciii].

Patient Impacts

The reorganisation of NHS England's trauma system and introduction of MTNs and MTCs has improved both the quality of care provided and has lowered mortality risk for trauma victims:

A study of care within England's MTNs during 2013-2016 showed time-critical interventions were delivered more rapidly when patients were transported directly to MTCs (compared to trauma units or secondary transfers). CT scans and urgent surgery were delivered on average an hour sooner in MTCs than in trauma units (CT median time 2 hours versus 3.15 hours, urgent surgery 4.37 hours versus 5.37 hours).The crude and adjusted odds of death for patients directly admitted to MTCs were also lower than those treated in trauma units and those admitted to MTC via secondary transfer [D].

A study of outcomes from April 2008 to March 2017 included >110,000 patients and 35 hospitals. It found that in five years after launch, MTNs had led to improved treatment systems e.g. 36.5% increase in consultant-led care and the proportion of patients having CT imaging increased from 50% to 72%. It also confirmed that MTNs were associated with beneficial changes in clinical practice. For instance, massive transfusion protocols and use of tranexamic acid, which reduces risk of death in bleeding trauma cases, have become routine practice during resuscitation for major trauma [E]. The number of patients needing critical care reduced from 31% to 24% and average length of stay on critical care wards reduced from four to three days [E]. From 2012/13 to 2016/17 there was an increase from 66% to 72% in the percentage of patients taken directly to MTCs across the 35 reporting

hospitals [E]. Importantly the study demonstrated a 19% improvement in adjusted mortality [E], equating to approximately 3,600 additional survivors between 2013 and 2020.

A 2018 NHS England press release highlighted the study results, confirming "*The NHS in England has saved an additional 1,600 patients with severe injuries since major trauma centres were established in 2012*" [Fi]. The story was covered widely in nationwide press [Fii]. NHS England's National Clinical Director for Trauma Care said, "*This study shows that changes to trauma care…are saving hundreds of lives every year*" [Fi] and Clinical Director for a trauma network in England said in commentary "*The results…demonstrate the successful national introduction of clinically led networks to reduce trauma mortality*" and confirmed "*The implementation of the English trauma system has been an example of a successful clinically led process*" [G].

Impacts in the Republic of Ireland

A Trauma Care Policy Steering Group was developed in Ireland during 2015. This group reported in February 2018, recommending the establishment of two MTCs within two regional networks [H]. UoM research was reviewed as evidence by the group [6]. Complete implementation is expected to take between five and seven years. However, the Irish National Office of Clinical Audit's (NOCA) 2018 annual major trauma audit report indicated that implementation work has already produced positive results. NOCA reported a "*significant increase in access to CT within 1 hour for head injury patients from only 33% in 2016…to 48% (n=132) in 2018, with a median time of 1.1 hours*" [I] and a decrease in secondary transfers from "*28% in 2016…to 20% in 2018 indicating that more patients are getting to the right place at the right time than previously*" [I].

5. Sources to corroborate the impact

A. NHS Standard Contract for Major Trauma Services introduced by NHS England in 2013 - *confirmed the NHS England aim of treatment through MTCs within trauma networks.*

B. 2020/21 NHS National Tariff Payment System. Annex D: Guidance on best practice tariffs November 2020 – *best practice tariff criteria for major trauma includes treatment at MTC and completion/submission of data through TARN.*

C. NICE Clinical Guideline

   i. Clinical Guideline CG176. Head injury: assessment and early management, January 2014 – *transport of patients with head injury to MTCs listed as a key priority for implementation and local guidelines on transfer from hospital to neuroscience centre* should recognise that "*transfer would benefit all patients with serious head injuries".*

   ii. Head Injury - Triage, assessment, investigation and early management of head injury in children, young people and adults: Appendices, January 2014 - *UoM reference 3 was evidenced as an included clinical study.*

   iii. Head Injury - Triage, assessment, investigation and early management of head injury in children, young people and adults: Methods, evidence and recommendations, January 2014 – *confirms Lecky chaired 2014 Nice Guideline Development Group.*

D. Publication on care within England's trauma networks from 2013 to 2016. 'Time to definitive care in English major trauma networks'. NR Haslam, O Bouamra, T Lawrence, CG Moran, D.J. Lockey. *BJS Open* 2020 Jul 9. DOI:10.1002/bjs5.50316 - *demonstrated that CT scans and urgent surgery were delivered sooner for patients who were transported direct to MTCs. Showed secondary transfer of patients was associated in delays to specialist care and avoidable elevation in mortality risk.*

E. Changing the system-major trauma patients and their outcomes in the NHS (England) 2008–17. Moran CG, Lecky F, Bouamra O, Lawrence T, Edwards A,

Woodford M, Willett K, and Coats TJ. *EClinicalMedicine* 2 (2018): 13-21 DOI:10.1016/j.eclinm.2018.11.001*This paper was pivotal in demonstrating the significant impact of a regionalised trauma system through the increased odds of survival and improvements in the management of injured patients across England.*

F. News reports which followed the publication above [E], *highlighting the positive impact of the reconfiguration of the trauma care system.*

   i. NHS England press release 'More than 1,600 extra trauma victims alive today says major new study', 20 August 2018.

   ii. Examples of other media reports: Belfast Telegraph and ITV 19 August 2018, Herald Scotland and Sky News 20 August 2018, Nursing Standard 22 August 2018.

G. Commentary Paper: Improved trauma outcomes after the introduction of a trauma system in England. Lockey, DJ. *EClinicalMedicine*. 2018 Aug 20;2-3:3-4. DOI:10.1016/j.eclinm.2018.08.002 – *confirms the implementation of the English trauma system has been an example of a successful clinically-led process.*

H. A Trauma System for Ireland. Report of the Trauma Steering Group February 2018- *recommends the establishment of an inclusive trauma system with two trauma networks and MTCs – cites UoM reference 6, which was an included study.*

I. Republic of Ireland Major Trauma Audit Report 2018, National Office of Clinical Audit (published February 2020) - *demonstrates impact of initial implementation of Trauma Steering Group's recommendations and cites UoM reference 4*.