



The TRAUMA

Audit & Research

NETWORK

DEVELOPING EFFECTIVE CARE
FOR INJURED PATIENTS THROUGH
PROCESS AND OUTCOME
ANALYSIS AND DISSEMINATION

The First Decade

1990 - 2000

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INTRODUCTION

- ❖ Already the commonest cause of loss of life under the age of 40 the burden of trauma is set to increase in the next 20 years.
- ❖ Taking a global view of 'life years lost' through premature death and disability, injury will be in 2nd place in 2020.

A lot of the tragedies represented in these staggering statistics are preventable but in the UK, as elsewhere, there is also unnecessary mortality directly due to inadequacies in the organisation and delivery of care. In the 1980s, research in North America identified the causes of these failures and in 1988 a working party chaired by Professor Sir Miles Irving at the Royal College of Surgeons of England drew remarkably similar conclusions. The College recommended changes in trauma management which included:

- ◆ Enhancing pre-hospital care, ensuring appropriate medical intervention
- ◆ Rapid transfer to the best local facility
- ◆ Assessing the use of helicopters
- ◆ Adopting ATLS principles
- ◆ Integrating trauma services within and between hospitals
- ◆ Investing in rehabilitation services
- and
- ◆ *Auditing and Researching injury and systems of care*

This report reviews the developments of
The Trauma *Audit & Research* Network
since the publication of the College report.

A DECADE OF ACHIEVEMENT

The work of Howard Champion at the Washington Hospital Centre demonstrated that statistics could be a powerful replacement for clinical anecdote in the drive to provide an evidence-base for the development of effective trauma care systems. A group of UK emergency physicians began to collect data using the Washington methodology and submitted it for analysis to North America.

The scoring systems initially developed by the Association for the Advancement of Automotive Medicine and the method of comparing expected and observed outcomes in relation to mortality, termed the 'TRISS Methodology', became central to the success of the UK initiative. By 1992 33 hospitals in the UK had used these techniques to analyse the effectiveness of their trauma care systems and published the results in the British Medical Journal. Their findings, in summary, were:

- ◆ UK mortality rate higher than in USA
- ◆ Large interhospital variations in performance
- ◆ Unacceptable delay before treatment
- ◆ Most initial care by junior doctors

Brit.Med.J. 1992;305:737-40

This paper brought trauma care to the attention of a wider audience.

Orthopaedic and general surgeons, anaesthetists and neurosurgeons joined directors of public health in a widening debate about how to integrate and improve the immediate care, initial reception and definitive management of the trauma victim.

The Department of Health gave strong support and until 1996 provided comprehensive funding for what had become known as the UK Major Trauma Outcome Study. The number of data collection forms received by the coordinating centre in the University of Manchester tripled in five years. The sheer complexity of handling 1 400 new forms each month, each with over 250 data items, demanded a major restructuring of the office and the computation links with the University mainframe. A data form scanner was purchased in order to speed up the turn round time in response to valid criticisms of the increasing delays between data submission and the provision of reports.

By the middle of the decade it was becoming clear that this was no mere 'Study'. The Department of Health was keen to emphasise that continuous trauma audit was an integral part of a hospital's activity. It proposed that our funding be increasingly derived from participating hospitals rather than from Central Government. The Central Health Outcomes Unit was pivotal to the successful changes in organisation which are outlined in later sections of this report.

In the late 90s one half of all trauma receiving hospitals in England and Wales returned data to the now re-named '[The Trauma Audit & Research Network](#)'.

The advent of clinical governance, the increasing interest of chief executives and directors of public health in the quality and effectiveness of trauma services and, importantly, a second report from the Royal College of Surgeons of England are expected to lead to a further upward trend in data returns.

The report to be published in July 2000 by a working party on better care for the severely injured from the Royal College of Surgeons of England will highlight the centrality of audit in the drive to improve further the effectiveness of trauma care. It will set out detailed performance standards and call for a monitoring of the attainment of these standards. The following summary has been specially released by the College for inclusion in this report.

BETTER CARE FOR THE SEVERELY INJURED

A REPORT FROM THE ROYAL COLLEGE OF SURGEONS OF ENGLAND AND THE BRITISH ORTHOPAEDIC ASSOCIATION

July 2000

Key Statements :

The Royal College of Surgeons of England and the British Orthopaedic Association recommend that standards of care for the severely injured should be nationally co-ordinated and systematically audited.

A National Trauma Audit Committee (NTAC) should set standards and develop realistic outcome indicators against which Trusts can audit severe injury.

A National Trauma Audit Research Network (NTARN) should collect data from all hospital Trusts that receive severely injured patients. The development, improvement and monitoring of the standards of care for severely injured patients would thus be assured.

There should be a National Trauma Service based upon geographical trauma systems for England, Wales and Northern Ireland.

The achievement of audited standards of trauma care with satisfactory outcomes should determine a hospital's future reception of severe injuries rather than its size or apparent catchment population.

Improved care for the severely injured will create an opportunity for reducing the cost of avoidable death and unnecessary morbidity.

Much has been achieved in the 12 years between the two College reports – and the Trauma Network database, now extending to over 120 000 cases, is an increasingly important source of epidemiological data which can help to demonstrate the effectiveness of the changes which have been introduced. The research work of the Network will become increasingly important in the next decade. Achievements, challenges and opportunities in the research field are discussed in detail in a later section. The abstract from our paper published in the Lancet earlier this year provides a useful summary of the present status of the Network.

Abstract

The Royal College of Surgeons reported in 1988 major deficiencies in trauma care in UK hospitals. This paper seeks to determine if and how that care has changed in the last decade.

Injury severity, process and outcome variables were analysed from 91 602 patient records on the UK Trauma Audit and Research Network database at the end of 1997 collected from 99 (49% of trauma receiving) hospitals in England Wales and Northern Ireland. Longitudinal analyses of (casemix adjusted) odds of death, process variables and inter-hospital performance have been performed, taking account of potential selection bias from missing data and recruitment of new hospitals.

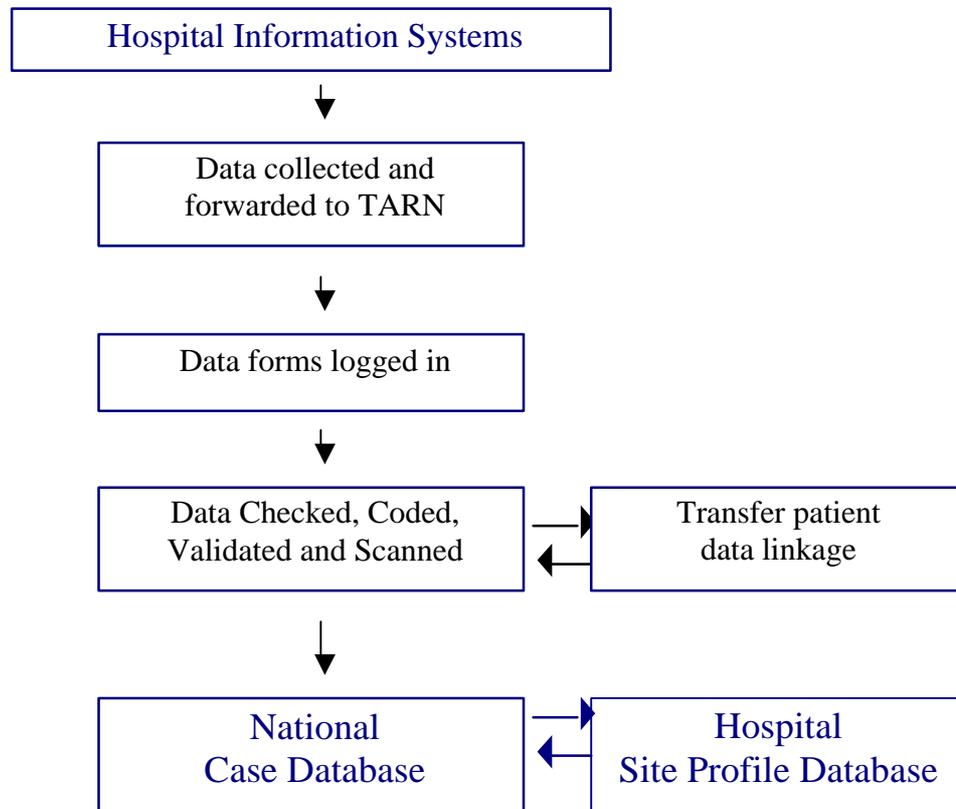
There has been a gradual decline in the severity adjusted odds of death after trauma since 1989 (Odds Ratio 1997:1989 = 0.63 (0.49-0.82)). In 1997 the reduction in odds of death is still significant when adjustments for missing data (OR '97:'89 = 0.72), and recruitment of new hospitals (OR '97:'89 =0.64) are made. There is however a significant variation in the casemix (severity of injury and age) adjusted number of survivors between the top and bottom 10% of UK hospitals. There has been a 41% increase in the time it takes injured patients to reach hospital since 1989 regardless of injury severity. The proportion of severely injured patients seen first by junior house staff has fallen by 41%.

Hospital care appears to have made a valuable but variable contribution to reductions in case fatality after injury in the UK in the last ten years.

Lancet 2000;355:1771-75

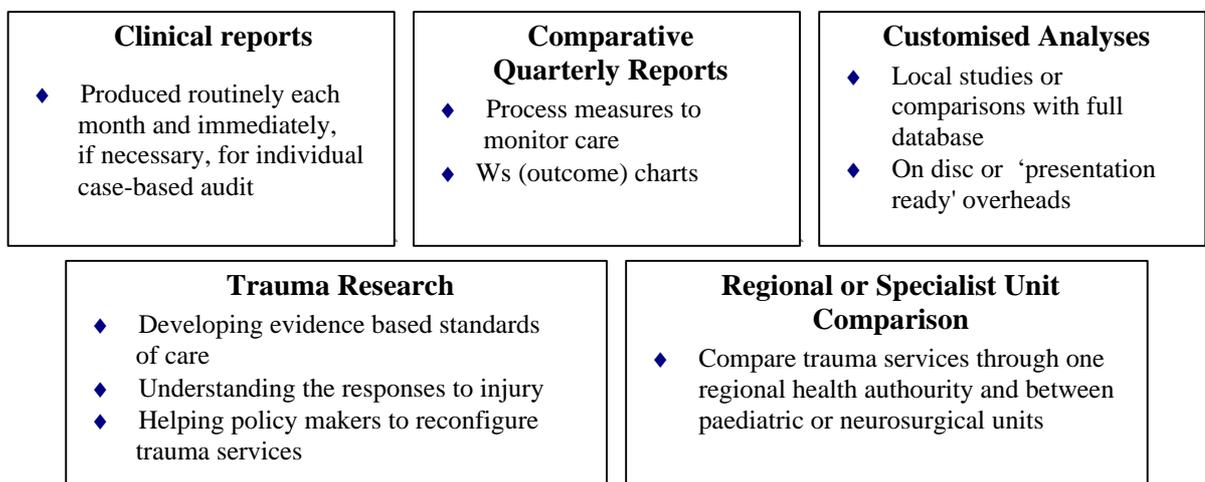
TARN 2000

Data Input

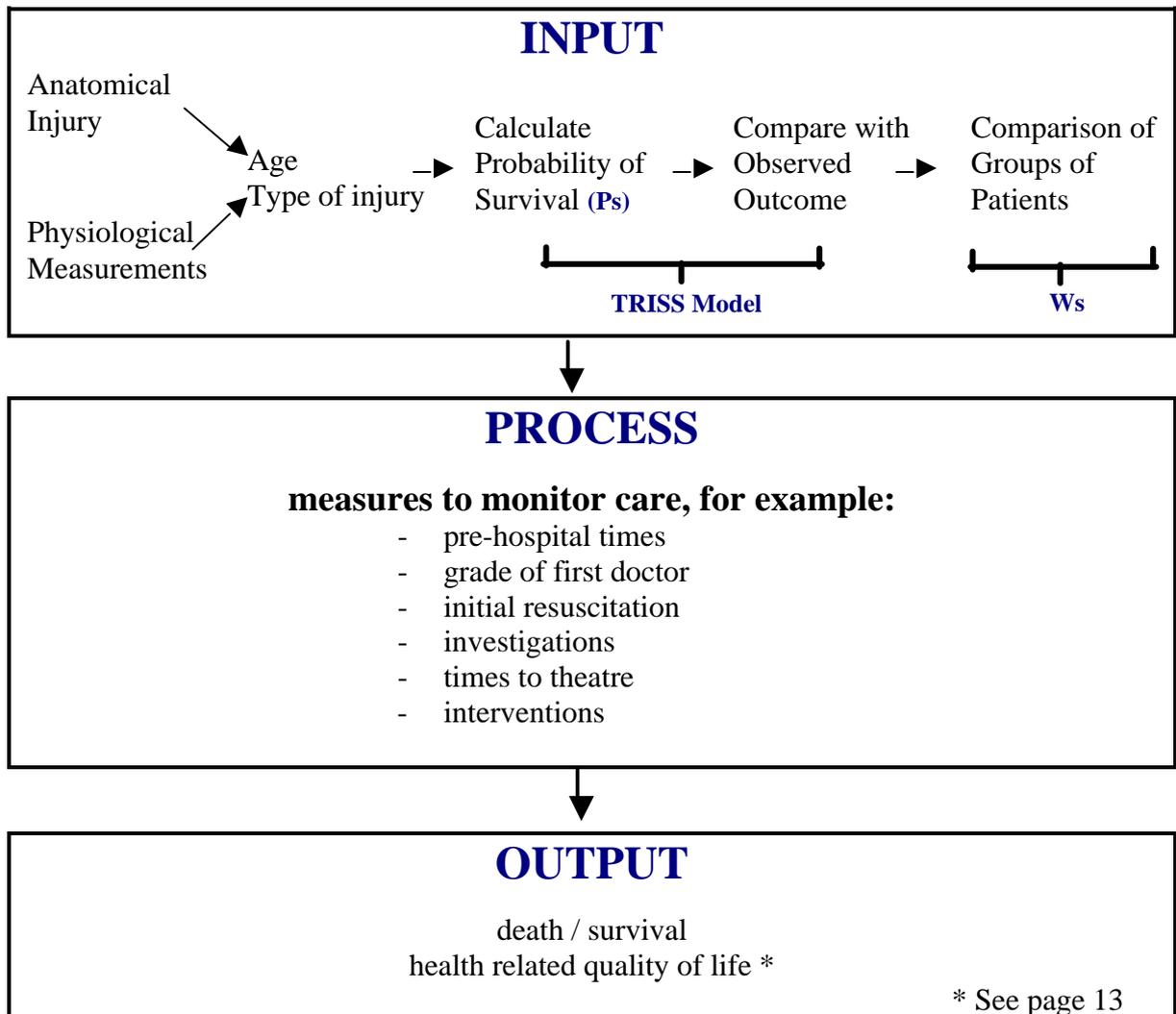


- ❖ Data collection is supported by STARTUP courses for audit and clinical staff
- ❖ Telephone advice is always available from the coordinating centre
- ❖ The annual Injury Scaling and Trauma Audit course provides in-depth instruction

Data Output



Data Analysis



- ❖ The national TRISS model used by *The Trauma Audit & Research Network* is internationally recognised.
- ❖ The model has been refined to reflect the influence of age on outcome.
- ❖ The new TRISS model takes account of the latest published changes in the Abbreviated Injury Scale (AIS 85 and AIS 90) and will be further updated when the AIS 98 is introduced.
- ❖ The specific inclusion criteria have been refined over the years, always ensuring our ability to undertake longitudinal analysis.

Quality Assurance

This includes:

- ❖ Validation during all stages of data input
- ❖ Injury coding verification
- ❖ Parallel data processing

TARNLET - Paediatric Group

“Children are different” but, remarkably, very little work has been published which permits an analysis of paediatric trauma care. The main *TARN* database contains information on 14 800 children under the age of 16 and has been a valuable asset. For example it has been used to demonstrate improvements in outcome during the 1990s. However many aspects of paediatric trauma assessment and management differ significantly from adult trauma care and it has been recognised that the data collection form, designed for adults, is unsuitable for children. Additionally the general analyses of the Network have been of very limited value to the paediatric trauma surgeon and emergency physician.

In the UK there are very few trauma systems designed exclusively for children but the variation in provision could, perhaps, be described as a natural experiment waiting to be analysed. Are paediatric trauma services better when they are integrated within a children’s hospital or is the system more effective when adult and children’s trauma services are mixed?

‘*TARNLET*’ has been established this year to address these and other questions relating to paediatric trauma care. A discrete paediatric group has been formed and a separate data collection form designed. A focused paediatric element to the database with more detailed information, particularly about the characteristics of the trauma service, will undoubtedly provide a valuable statistical platform on which to debate the future provision of paediatric services.

TARNLET Executive Committee

Dr R Boyd	Emergency Physician, Manchester Royal Infirmary
Dr F Davies	Emergency Physician, Royal London Hospital
Mr L Duane	Emergency Physician, Booth Hall Children’s Hospital
Ms E Dykes	Consultant Paediatric Surgeon, Lewisham Hospital
Mr S Kerr	Clinical Director of Intensive Care, Royal Manchester Children’s Hospital
Dr F Lecky	Specialist Registrar in A&E Medicine, Director of Research, TARN,
Professor D Lloyd	Professor of Paediatric Surgery, University of Liverpool
Mrs Y Murray	Senior Nurse, R&D and Audit, Royal Manchester Children’s Hospital
Dr I Roberts	Senior Lecturer in Epidemiology, Institute of Child Health, London
Mrs E Symonds	Emergency Physician, Birmingham Children’s Hospital
Mrs M Woodford	National Co-ordinator, TARN
Professor D Yates	Emergency Physician, Director, TARN

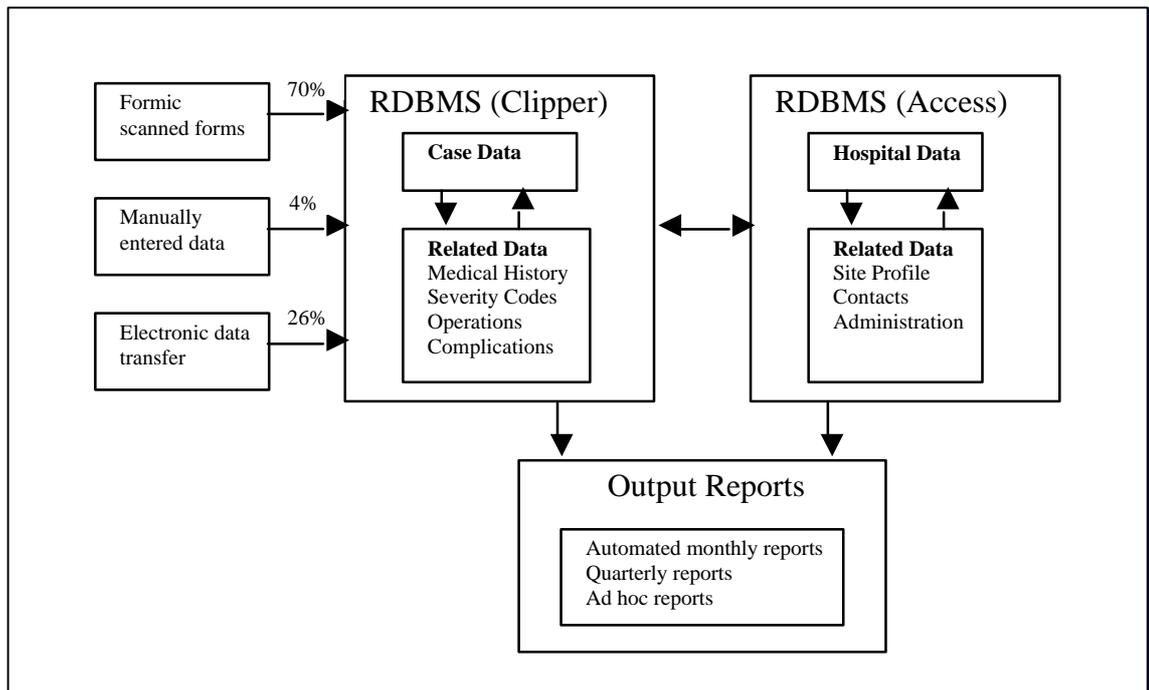
THE DATABASE

Early Developments

Initially case data were input and stored in a series of SPSS files by hospital; some hospitals had several files of data. The majority of data were entered manually with electronic data entry from floppy disks generated by the Yorkshire Trauma Network database system and from an in-house system, Palantir. The latter was used in a few hospitals in the mid nineties but was abandoned because of non-Y2K compliance. The entire system was backed up using numerous floppy disks.

SPSS was the main software package used for both input and analysis. Reports were generated quarterly, monthly and on an ad-hoc basis. The quarterly report was initially generated from a single SPSS file of all data using the University of Manchester central computing facilities. This required local data consolidation before transferring the files to a university Unix computer where hospital files were validated and processed into a single file for analysis; a process which took a few days to complete. A Unix version of SPSS was used for analysis and reports produced had to be transferred back to the local network for processing in Word or Excel to improve their presentation before printing and distribution. This system was effective but laborious. As more cases were added the workload for data management and analysis became excessive.

The Current System



Case data are now entered into a relational database on the local network. This facilitates data management and enables the monthly clinical report to be automated. Most of the data are now collected using forms that are scanned into the database using Formic software supported by an in-house transfer/validation program. The Yorkshire TARN information is transferred electronically from floppy disk into the database. However there is still the option of entering data manually. The database is backed up daily using central University facilities. These developments have improved data management, validation and integrity whilst reducing overall workload.

Analysis continues to be carried out using SPSS, but with improved local network facilities and PC resources validation of the quarterly report data files takes hours not days! Improvements in SPSS software have enhanced our ability to respond to general and specific requests for data interpretation. This, in turn, has led to improvements in our report presentation as well as reducing their preparation time.

Participating hospital site profile and contact data are held in an Access database where they can be easily used for both network administration and combined with the network case data for analysis.

Continuing Improvements

The basic design of the system ensures that it can respond to new developments. However continuous review of capabilities and performance is essential. Enhanced data capture techniques are a high priority. We are assessing the practicality of collecting most data electronically. This would be especially useful if a system could be introduced that allows local use of the data as it is collected and subsequent transfer of the data to the Network. Data presentation techniques, including the use of Geographical Information Systems (GIS), are also being reviewed. This will enable easier reading and assimilation of more data.

There is always a continuing agenda to improve our own audit procedures to ensure that the data collected are accurate and complete and that integrity is not jeopardised during any of the collection procedures. New database programs are under development assist with this quality assurance.

RESEARCH PROFILE

Research has always been integral to the *TARN* goal of improving care for the injured. Clearly the core "research business" is to maximise the validity and quality of the statistical methods used to audit hospital performance. This enables participating hospitals to confidently utilise *TARN* returns for clinical governance. However as the *Network* now represents the largest trauma database in Europe hence there is potential for other research projects which may assist policymakers, improve our understanding of the responses to injury and help develop standards in trauma care. Progress to date is summarised below, leading into in a discussion of future potential and areas of concern.

1989-1992 The Formative Years

The statistical method used to generate inter hospital comparative statistics relied on the 'W score' and the TRISS methodology. This had been directly imported from the US Major Trauma Outcome Study (MTOS) - which had stopped collecting data around this time. Hence UK hospitals were being compared to the US national norm for trauma care in the late 1970's. At the end of this period a database analysis demonstrated that UK hospitals generally appeared to perform less well for blunt trauma cases (negative W scores) than the US norm. The junior level of the first doctor to see the seriously injured in A&E was highlighted, echoing the findings of the Royal College of Surgeons 1988 report.

1993-1995 Improving the Model

During these interim years it became accepted that there was significant potential for improved trauma care in the UK. However many questioned the applicability of a US statistical model to UK patients. Increased hospital participation allowed development of a more robust model for UK data. UK coefficients for the TRISS methodology were established which employed a steeper age gradient than the US. It is likely that some of the previously reported apparent US-UK care deficit was in fact confounded by the generally greater age of our patients. At the same time the role of statistically based trauma audit, when compared to the earlier preference for individual case review, was clarified through comparative analysis of the original cases utilised in the RCS report. TRISS was further improved by standardising the W score (Ws) so that it reflects each hospital's performance against a standard national casemix rather than its own.

1996-2000 Demonstrating Improved Outcome and Changes in Process

Increasing hospital participation and the continuity of the database over many years has provided an opportunity to publish two important analyses. These demonstrate significant improvements in patient outcome since 1989. Alongside these analyses work on the model and on data quality has continued. More recent analyses have indicated that at present there is no indication for including pre morbid health (in addition to that reflected by an extended age profile) in the current TRISS model. However there is continuing concern about the coefficients for head injuries. All these developments relate to the continued use of mortality as the sole outcome measure. It is essential that we start measuring outcome in terms of survivor disability as well as mortality. Suitable scales have been identified after extensive literature review, but there are formidable problems with data collection and analyses.

The Future Extending the research remit?

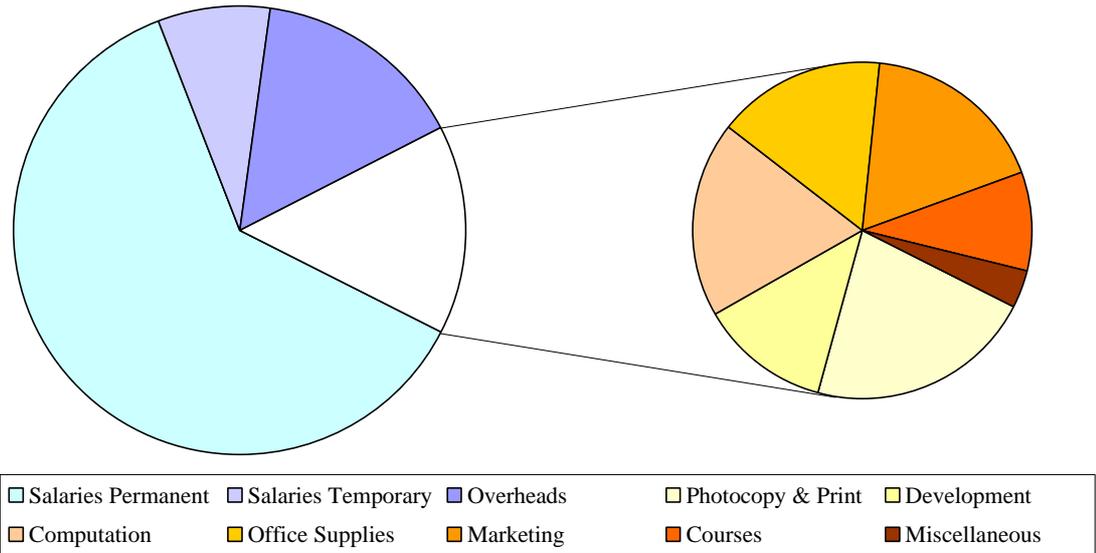
Future work on the model will address ways of handling missing data and of incorporating disability outcome scales into TRISS. However the database is now large and complete enough in some areas to allow epidemiological studies of major injury in relation to age/social class and to support case control studies comparing the clinical effectiveness of different treatment interventions. Extensive ongoing programmes of research with external funding are required. The *Trauma Audit & Research Network* staff are committed to pursuing this objective in collaboration with other research groups.

FINANCIAL SUMMARY

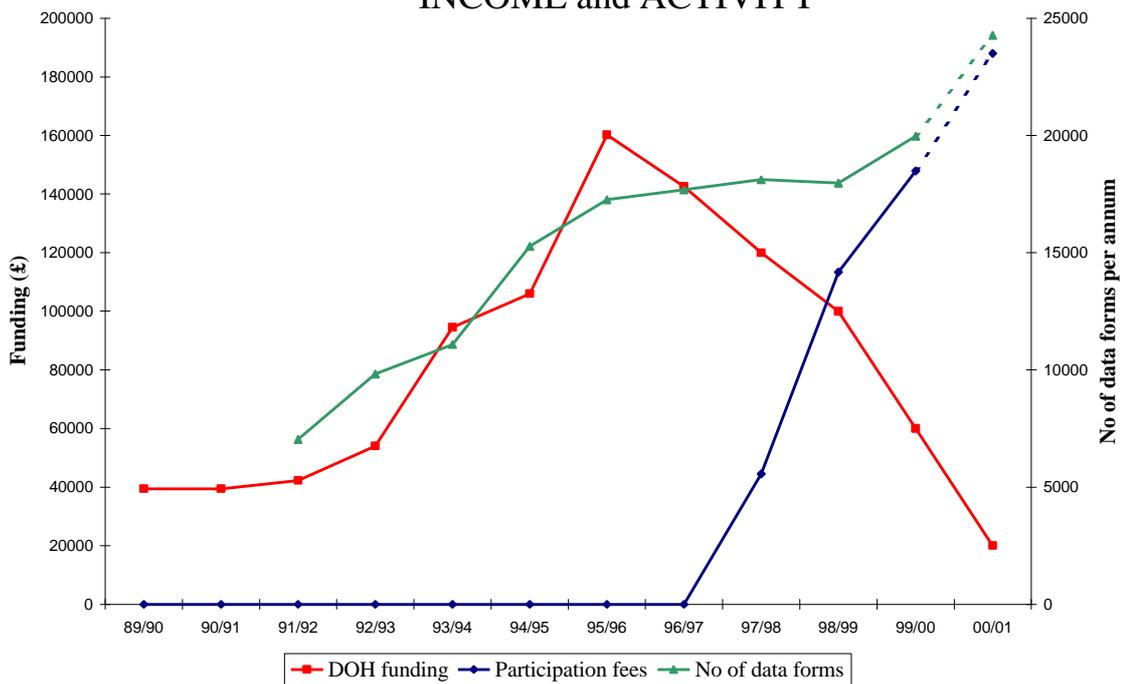
April 1999 – March 2000

OVERALL EXPENDITURE

NON-STAFF COSTS



INCOME and ACTIVITY



PUBLICATIONS AND PRESENTATIONS

Peer-Reviewed Papers

Preliminary analysis of the care of injured patients in 33 British hospitals: first report of the United Kingdom major trauma outcome study.

Yates, DW; Woodford, M; Hollis, S.

Brit.Med.J. 1992; 305:737-40.

Trauma audit: clinical judgement or statistical analysis?

Yates, DW; Woodford, M; Hollis, S.

Annals of the Royal College of Surgeons of England 1993; 75:321-24.

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Yates, DW; Bancewicz, J; Woodford, M; Driscoll, PA; Jones, RAC; Kishen, R; Marsh, DR; Hollis, S.

Injury 1994; 25:511-14.

Standardised comparison of performance indicators in trauma: a new approach to case-mix variation.

Hollis, S; Yates, DW; Woodford, M; Foster, P.

J. Trauma 1995; 38(5):763-66.

Reducing death rates in children and young adults: the contribution of hospital care.

Roberts, I; Campbell, F; Hollis, S; Yates, DW.

Brit.Med.J 1996; 313:1239-41.

Unexpected contribution of moderate traumatic brain injury to death after major trauma.

McMahon, CG; Yates, DW; Campbell, F; Hollis, S; Woodford, M.

J. Trauma 1999; 47(5):891-5.

Trends in trauma care in England and Wales 1989-97.

Lecky, F; Woodford, M; Yates, DW.

Lancet 2000; 355:1771-75.

Chapters

Scoring systems for trauma.

ABC of major trauma. BMJ 1990; 301:1090-94.

Yates, DW

Injury Scoring.

Trauma Resuscitation: The Team Approach. Macmillan 1992.

M Woodford

Trauma care systems in the United Kingdom, the United States and South Africa.

Trauma care update. 1995.

Lecky, F; Yates, DW; Little, RA.

Towards the practical application of recent advances.

Trauma, British Medical Bulletin 1999; 55(4):711-12.

Yates, DW

Co-morbid factors in trauma patients.

Trauma, British Medical Bulletin 1999; 55(4):711-12.

Wardle, T

Scoring systems for trauma.

BMJ Books pp. 98-102, 3rd edition, 2000.

Woodford, M

Abstracts

Pre-morbid medical conditions in trauma patients.
Wardle, T; Driscoll, P; Oxeby, C; Woodford, M; Munsal, F.
Journal of Accident and Emergency Medicine 1995; 12:243.

Medical problems in major trauma.
Wardle, T; Driscoll, P; Woodford, M.
Injury 1995; 26:137.

The effect of pre-existing medical conditions on the outcome of injured trauma patients.
Wardle, T; Driscoll, P; Oxeby, C; Dryer, C; Campbell, F; Woodford, M; Munsal, F.
Injury 1996; 27(5):370.

Presentations

Pre-morbid medical conditions in trauma patients.
Wardle, T; Driscoll, P; Oxeby, C; Woodford, M; Munsal, F.
Presented at BAEM conference April 1995.

Medical problems in major trauma.
Wardle, T; Driscoll, P; Woodford, M.
Presented at British Trauma Society 1995.

'Unexpected contribution of moderate traumatic brain injury to death after major trauma'
G McMahon, M Woodford, S Hollis, DW Yates
3rd International Conference on Recent Advances in Neurotraumatology, Riccione, Italy, 324, 1996

'The UK Trauma Network: Monitoring changes in the care of injured patients'
M Woodford
The Clinical Audit Association, 6th Annual Conference, Liverpool, 1997

'Trauma Care in England and Wales 1989-1997' (Poster)
M Woodford, DW Yates, F Lecky
'A First Class Service'
NHS Executive West Midlands, March 1999

'Trauma Care in England and Wales'
M Woodford, DW Yates, F Lecky
'Exploring contemporary issues in surgical practice'
Royal College of Surgeons of England, June 1999

'Trends in Trauma Care in England and Wales'
M Woodford, DW Yates, F Lecky
Faculty of Accident & Emergency Medicine. London, October 1999

TARN STAFF

Mo Adamopoulos	Data Validation Officer
Ruth Carroll	Office Manager
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Kathryn Marrin	Administration Officer
Laura White	Data Validation Officer
Maralyn Woodford	National Coordinator
Alan Wrotchford	Database Manager
David Yates	Director, Professor of Emergency Medicine, University of Manchester
To be appointed	Medical Statistician
12 month rotation	Clinical Research Fellow

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**Members of the Executive Committee*